DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Water-Supply Paper 508

SURFACE WATER SUPPLY OF THE UNITED STATES

1919-1920

PART VIII. WESTERN GULF OF MEXICO BASINS

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Prepared in cooperation with the
STATE OF TEXAS

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SURFACE WATER SUPPLY OF WESTERN GULF OF MEXICO BASINS, 1919–1920.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the biennium ending September 30, 1920.

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

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 1886 in connection with special studies relating to irrigation in the arid west. 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 ended June 30, 1895–1921.

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	180,000.00

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 5.

Measurements of stream flow have been made at about 5,000 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1920, 1,350 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 water-supply papers from time to time.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those 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.

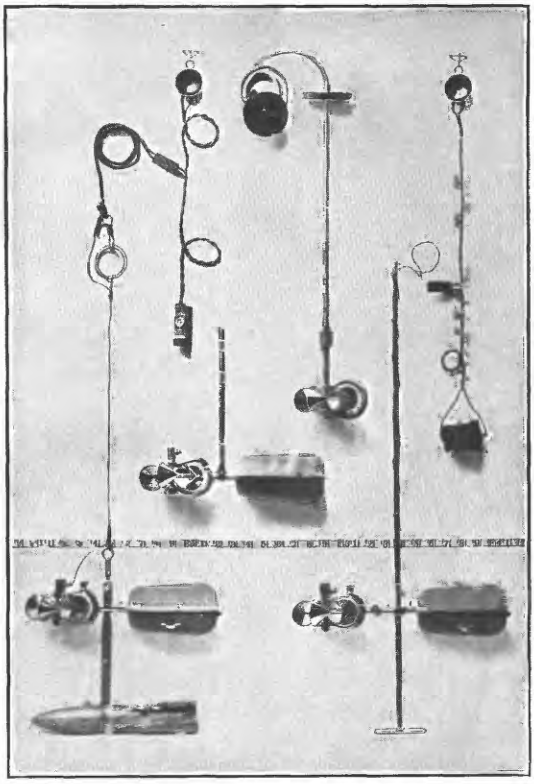
"Run-off in inches" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

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.

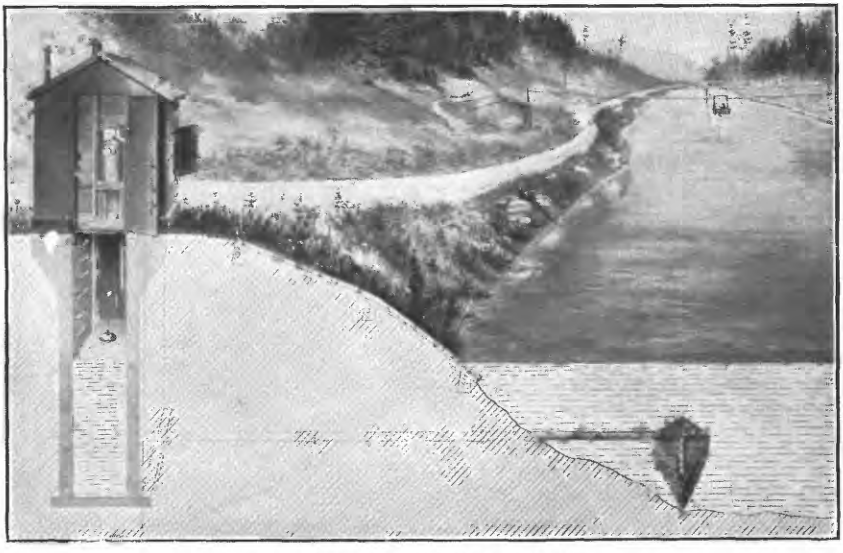
The following terms not in common use are here defined:

"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 determines the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.



A. PRICE CURRENT METERS.



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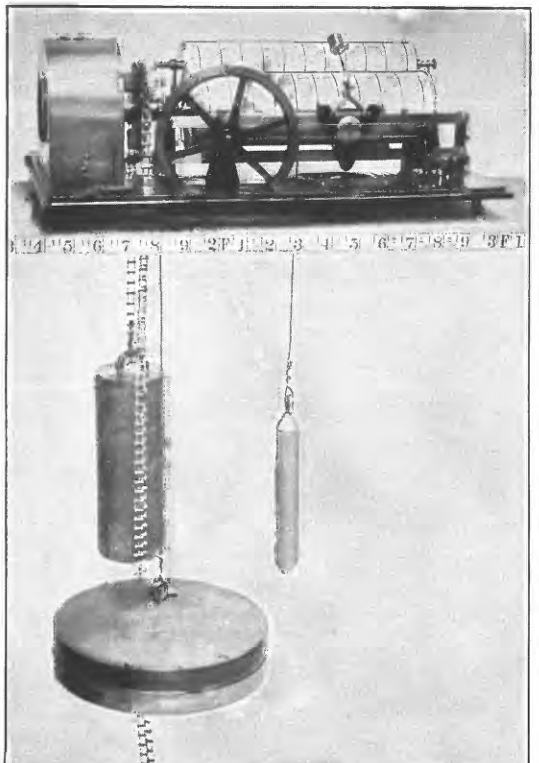

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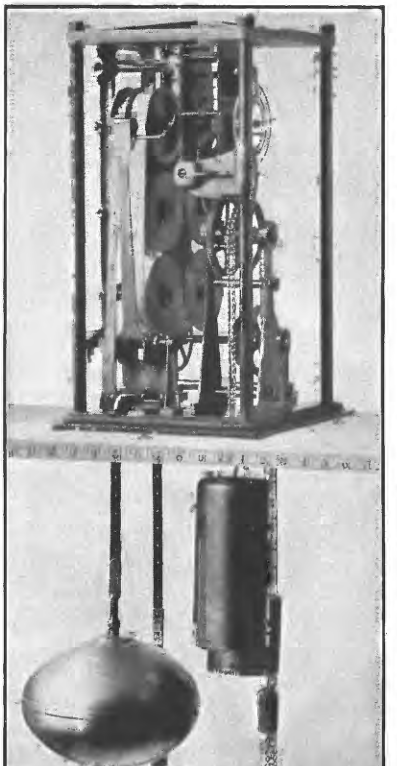
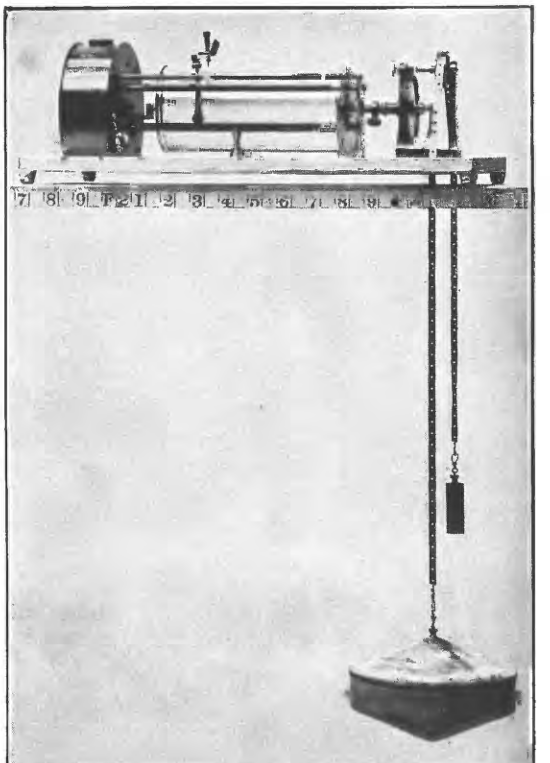


B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the water falls when the discharge of the stream is reduced to zero.

EXPLANATION OF DATA.

The data presented in this report cover the biennium beginning October 1, 1918, and ending September 30, 1920. At the beginning 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. (See Pls. I, II.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to gage heights, give the discharge from which the daily, monthly, and yearly mean discharge is determined.

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 of the stream, 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 constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, 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, in general, the discharge in second-feet corresponding to the mean of the gage heights read each

day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height 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 averaging discharge at regular intervals during the day, or by using 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 given in the maximum 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" is 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.

The deficiency table presented for some of the gaging stations shows the number of days in each year on which the mean daily discharge was less than the discharge given in the table. By subtraction the table gives the number of days each year that the mean daily discharge was between the discharges given in the table and, also by subtraction, the number of days that the mean daily discharge was equal to or greater than the discharge given.

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 observation 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.[1]

For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," 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

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

showing discharge per square mile and run-off in inches may be subject to gross errors caused by the inclusion of 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. The computations 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 areas 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 data previously published.

COOPERATION.

The work of measuring streams in Texas during the two years ending September 30, 1920, was carried on in cooperation with the State through the Board of Water Engineers, consisting of W. T. Potter, chairman; C. S. Clark; and John A. Norris, to whom special acknowledgments are due for the efficient and cordial manner in which they represented the State in the cooperative investigations.

Acknowledgments are due the United States Reclamation Service for records furnished and general assistance at the stations on Pecos River and Rio Grande in New Mexico, and to the United States Weather Bureau for climatologic data and equipment for the evaporation station near Austin.

The cities of Corpus Christi, Waco, and San Antonio; Wharton County; the Imperial Irrigation Co.; the Markham Irrigation Co.; the Garwood Irrigation Co.; the Lakeside Irrigation Co.; the Wharton County Association; the Pierce estate; the Texas & Pacific Railway; and the Pecos Valley Lines have aided in the collection of records by furnishing funds, or giving general assistance.

DIVISION OF WORK.

The data for stations in Texas and southeastern New Mexico, in the Rio Grande basin, were collected and prepared for publication under the direction of C. E. Ellsworth, district engineer, assisted by Clarence E. McCashin, Russell J. Hank, Donald A. Dudley, Harvey B. Kinnison, Edward P. Congdon, Andrew K. Gowans, Trigg Twichell, L. D. Snow, Robert G. West, H. C. Pritchett, John E. Powers, and Kate Casparis.

The manuscript was assembled and reviewed by B. J. Peterson and V. B. Lamoureux.

GAGING-STATION RECORDS.

TRINITY RIVER BASIN.

WEST FORK OF TRINITY RIVER AT BRIDGEPORT, TEX.[2]

LOCATION.—At suspension bridge on Balsora-Bridgeport road, half a mile southwest of center of Bridgeport, Wise County, a quarter of a mile above Chicago, Rock Island & Gulf Railway Co.'s pumping plant, and 1 mile below mouth of Gentry Creek.

DRAINAGE AREA.—1,060 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—October 1, 1914, to September 30, 1920. Records of stage have been obtained by United States Weather Bureau from August 16, 1908, to October 16, 1915.

GAGE.—Weight and tape gage of the Mott type, fastened to downstream side of bridge 56 feet from north end of guard rail; read by Mrs. U. E. Byers.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of clay, gravel, and sand. Banks are high, slightly wooded, and are overflowed at a stage of 25 feet. Channel straight above and below station for 100 feet. Control is rock outcrop three-quarters of a mile below station.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 20.00 feet at 6 p. m. December 23 (discharge, 7,550 second-feet); no flow, October 4–18, June 17–21, August 5–16, and September 15–18.

Maximum stage recorded during year ending September 30, 1920, 23.77 feet at 7 a. m. May 16 (discharge, 12,200 second-feet); minimum stage 0.77 foot at 7 a. m. June 17 (discharge, 0.6 second-foot).

1908–1920: Maximum stage recorded 28.9 feet June 8, 1915 (discharge not determined); no flow during several periods.

ICE.—None reported.

DIVERSIONS.—Practically the only diversion above station is by city of Bridgeport which diverts a small amount for municipal uses.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except for slight changes during floods. Rating curve well defined below 11,000 second-feet. Gage read to hundredths once daily and oftener during floods. Daily discharge ascertained by applying mean daily gage height to rating table, except October 6, 1918, to February 4, 1919, when indirect method for shifting control was used. Records good.

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[2] Published in earlier reports as Trinity River at Bridgeport, Tex.

Discharge measurements of West Fork of Trinity River at Bridgeport, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.				1919.			
Oct. 4	McCashin and Congdon	Ft.	Sec.-ft. 0	Dec. 3	C. E. Ellsworth	Ft. 1.76	Sec.-ft. 31.6
1919.				1920.			
Jan. 8	A. K. Gowans	1.77	31.2	Feb. 17	D. A. Dudley	1.73	20.4
Mar. 21	C. E. Ellsworth	1.41	7.5	Aug. 20	C. E. Ellsworth	1.80	25.5
June 14	R. J. Hank	.75	*a*.5				

a Estimated.

Daily discharge, in second-feet, of West Fork of Trinity River at Bridgeport, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	1.0	376	18	127	1,070	19	413	7.0	140	213	0.7	310
2	.5	36	18	262	2,490	16	179	3.5	955	248	.4	179
3	.1	27	17	273	1,580	14	530	2.3	144	319	.2	25
4	0	18	16	257	768	12	277	1.7	73	47	.1	71
5	0	12	15	146	378	10	1,360	1.3	48	24	0	68
6	0	14	14	99	196	8.5	907	1.1	25	22	0	33
7	0	2,180	13	64	177	7.0	1,540	390	1.9	2.1	0	30
8	0	2,320	12	36	114	9.1	475	1,020	1.4	1.3	0	16
9	0	765	10	26	79	15	1,360	330	1.1	1.6	0	2.4
10	0	518	10	16	56	14	1,140	38	.8	1.5	0	1.3
11	0	45	9.4	14	45	7.0	288	150	.6	1.4	0	1.2
12	0	17	8.5	12	30	4.1	160	487	.5	1.2	0	1.7
13	0	38	7.3	17	24	1.9	140	782	.8	1.0	0	1.1
14	0	20	6.5	16	19	1.1	120	1,320	.5	1.0	0	1.3
15	0	15	5.8	16	16	.7	91	866	.4	5.8	0	0
16	0	12	4.5	20	13	34	84	465	.2	2.0	0	0
17	0	8.8	3.9	39	10	10	46	4,830	0	2.1	1.7	0
18	0	5.8	8.2	45	8.8	7.6	10	3,530	0	19	2.5	0
19	109	3.3	12	42	8.8	7.0	7.9	2,210	0	775	1.4	.2
20	9.4	7.0	561	34	25	5.8	6.0	1,680	0	624	1.6	2.2
21	2.7	13	1,320	28	19	4.8	5.5	859	0	308	1,400	18
22	595	12	746	1,120	33	3.7	4.1	465	321	46	310	321
23	85	11	2,720	1,420	30	2.5	2.9	156	489	30	26	818
24	681	10	2,990	787	28	160	2.3	102	192	12	30	87
25	667	8.8	2,430	292	34	1,190	2.0	549	301	7.6	43	323
26	1,710	17	1,860	164	30	595	1.5	3,510	392	6.0	17	140
27	1,660	90	1,260	1,170	26	417	366	2,460	47	4.8	6.0	15
28	2,030	136	295	907	24	355	16	1,020	7.0	3.3	2.3	13
29	2,830	42	60	1,140	.....	160	14	447	1.4	1.9	28	10
30	1,580	19	34	1,080	.....	1,170	10	306	8.5	1.3	32	8.8
31	928	.....	492	885	.....	969	.....	177	.....	1.1	43	.....

Daily discharge, in second-feet, of West Fork of Trinity River at Bridgeport, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	26	782	30	8.8	28	7.0	4.5	67	25	6.0	4.1	470
2	11	332	28	8.2	24	6.5	4.1	26	23	3.5	1.7	344
3	30	181	24	8.8	22	5.8	3.5	12	14	2.3	120	194
4	3.1	185	19	8.2	21	4.5	2.7	9.4	7.3	1.8	22	638
5	2.0	108	16	8.5	20	4.1	2.5	5,410	22	1.4	16	179
6	1.8	79	12	15	19	3.5	2.4	9,200	73	91	12	447
7	566	175	9.4	30	18	2.9	2.4	8,720	31	321	7.3	4,460
8	5,490	518	6.8	288	17	2.5	2.3	2,900	23	111	4.3	4,040
9	3,700	662	4.5	266	16	2.5	4.5	854	16	30	5.8	7,640
10	2,280	390	2.7	61	24	2.4	6.0	2,520	12	494	213	4,730
11	2,030	266	2.1	244	16	2.3	35	3,950	7.9	424	344	2,140
12	1,650	332	1.9	223	12	2.1	25	9,080	5.8	378	1,240	1,170
13	1,020	710	1.7	200	10	1.9	23	5,660	3.1	310	2,520	518
14	321	196	1.5	111	8.2	1.8	12	2,060	1.8	185	1,470	158
15	181	133	1.4	53	7.0	1.8	7.6	3,340	1.3	133	662	72
16	112	106	1.3	55	6.0	1.7	7.0	11,600	.9	120	332	96
17	198	93	1.0	43	8.8	1.5	6.0	4,610	.6	100	102	60
18	401	67	.8	35	2.0	1.8	4.5	1,650	299	6.5	35	43
19	401	55	1.7	29	1.5	1.9	3.7	854	4,510	638	32	34
20	367	41	1.5	27	1.3	2.0	2.9	470	2,450	470	26	25
21	2,620	29	1.2	25	1.1	1.9	2.4	192	494	390	19	23
22	3,340	22	1.4	30	1.0	1.9	2.3	158	1,070	183	16	22
23	3,260	16	1.6	65	.9	1.8	2.1	135	5,270	213	14	19
24	2,310	10	1.7	91	.9	2.0	5.0	114	424	80	11	16
25	1,020	7.0	1.9	806	.8	2.4	277	96	33	41	14	15
26	191	74	2.0	614	2.5	11	181	86	23	34	1,590	14
27	183	74	2.1	288	4.8	25	174	79	19	28	3,380	12
28	266	24	2.0	144	7.0	16	244	62	16	25	2,340	11
29	518	22	1.9	66	7.9	9.4	321	54	13	21	1,650	8.8
30	244	31	7.3	38	.....	7.0	61	41	8.5	14	1,050	8.5
31	185	.....	11	35	.....	5.5	.....	29	.....	10	590	.....

NOTE.—Oct. 1–4, 1918, gage removed for repairs; records partly estimated. Gage reading Sept. 19, 1919, n error; discharge interpolated.

1 *Monthly discharge of West Fork of Trinity River at Bridgeport, Tex., for the years ending Sept. 30, 1919 and 1920.*

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	2,830	0	416	25,600
November	2,320	3.3	227	13,500
December	2,990	3.9	483	29,700
January	1,420	12	340	20,900
February	2,490	8.8	262	14,600
March	1,190	.7	169	10,400
April	1,540	1.5	319	19,000
May	4,830	1.1	909	55,900
June	955	0	105	6,250
July	775	1.0	88.2	5,420
August	1,400	0	62.8	3,860
September	818	0	83.2	4,950
The year	4,830	0	290	210,000
1919–20.				
October	5,490	1.8	1,060	65,200
November	782	7.0	190	11,300
December	30	.8	6.50	400
January	806	8.2	127	7,810
February	28	.8	10.6	610
March	25	1.5	4.66	287
April	321	2.1	47.7	2,840
May	11,600	9.4	2,390	147,000
June	5,270	.6	497	29,600
July	494	1.4	157	9,650
August	3,380	1.7	576	35,400
September	7,640	8.5	920	54,700
The year	11,600	.6	502	365,000

BRAZOS RIVER BASIN.

BRAZOS RIVER NEAR GRAHAM, TEX.

LOCATION.—At two-span steel highway bridge on Murray road, 6 miles above mouth of Clear Fork and 10 miles west of Graham, Young County.

DRAINAGE AREA.—12,900 square miles (measured on post-route map, and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—November 13, 1915. to March 25, 1920, when station was discontinued.

GAGE.—Vertical staff on left downstream corner of middle pier; read by Mrs. John Timmons.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Channel straight above and below station. Bed composed of sand and clay and is free from vegetation; shifting. Left bank high and not subject to overflow; right bank is of medium height and is overflowed during high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 15.55 feet at 4 p. m. November 2 (discharge not determined); no flow October 8.

Maximum stage recorded during year ending September 30, 1920, 9.98 feet at 10 a. m. October 12 (discharge not determined); minimum stage, 2.97 feet at 5 p. m. March 25 (discharge, 0.9 second-foot).

1916–1920: Maximum stage recorded, 15.55 feet at 4 p. m. November 2, 1919 (discharge not determined); no flow for several periods in 1916, 1917, and 1918, and for one day, October 8, 1919.

ICE.—None reported during year.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that numerous diversions are made above station for mining, irrigation, and municipal uses, but total probably does not appreciably affect the flow except during low stages.

REGULATION.—None of consequence.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve poorly defined below 1,600 second-feet, and extended above. Gage read to hundredths once daily. Records poor. Daily discharge, which was determined by indirect method for shifting control is not considered sufficiently accurate to warrant publication.

Discharge measurements of Brazos River near Graham, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 5	McCashin and Congdon	4.03	[a] 0.5	Aug. 16	T. Twichell	3.99	46.1
				Dec. 4	C. E. Ellsworth	4.27	95.9
1919.							
Jan. 9	A. K. Gowans	4.30	99.3	1920.			
Mar. 20	C. E. Ellsworth	3.43	5.4	Feb. 18	D. A. Dudley	3.82	38.9
June 15	R. J. Hank	5.10	91.0				

[a] Estimated.

Monthly discharge of Brazos River near Graham, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	8,740	0	1,040	64,000
November	166	11	42.9	2,550
December	2,840	4.8	470	28,900
January	1,720	42	348	21,400
February	1,360	9.4	162	9,000
March	2,830	6.2	392	24,100
April	6,750	136	1,310	78,000
May	6,860	572	2,130	131,000
June	5,020	12	825	49,100
July	5,830	7.6	858	52,800
August	336	40	[a] 168	10,300
September 1–17	.....	9.1	[a] 23.5	792
The period	.....	.....	.....	472,000
1919–20.				
October 5–31	4,690	414	2,550	137,000
November	2,490	106	755	44,900
December	112	31	65	4,000
January	157	28	74	4,550
February	432	13	67	3,850
March 1–25	13	.9	5.4	267
The period	.....	.....	.....	195,000

[a] Partly estimated.

NOTE.—See "Accuracy" in station description. No record Sept. 18–30, 1919; mean discharge probably considerably greater than from Sept. 1–17, 1919.

BRAZOS RIVER AT BRAZOS, TEX.

LOCATION.—At Texas & Pacific Railway bridge half a mile northeast of Brazos, Palo Pinto County, and 1½ miles above mouth of Palo Pinto Creek.

DRAINAGE AREA.—20,200 square miles (measured on standard topographic map; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—October 1, 1914, to April 30, 1920, when station was discontinued. Records of stage have been obtained by the United States Weather Bureau since August 16, 1908.

GAGE.—Vertical staff on northwest side of and 1 foot from upstream edge of pier nearest the middle of the railway bridge; graduations above 6 feet painted on pier; read by R. C. Lindsay.

DISCHARGE MEASUREMENTS.—Made from three-span highway bridge, about 600 feet below railway bridge, or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; shifts considerably. Right bank high, rocky, wooded, and not subject to overflow; left bank composed of sand, gravel, and clay, wooded, and medium in height, and subject to overflow at high water. Channel straight above and below for several thousand feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 10.0 feet at 5 p. m. July 22 (discharge, determined from extension of rating curve, 31,100 second-feet); minimum flow for year estimated at somewhat less than 30 second-feet in March.

Maximum stage recorded during period October 1, 1919, to April 30, 1920, 6.5 feet at 8 a. m. October 22 (discharge, 11,100 second-feet); minimum stage, 0.4 foot, April 18–30 (discharge, 107 second-feet). Gage record unreliable, and these discharges subject to error.

1908–1920: Maximum stage recorded, 22.0 feet, May 24, 1908 (discharge not determined); no flow for several periods within period of record.

ICE.—None reported during year.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that numerous small diversions are made above station for mining, irrigation, and municipal uses, but total probably does not appreciably affect the flow except during low stages.

REGULATION.—None of consequence.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve fairly well defined below 19,000 second-feet. Gage read to half-tenths once daily to November 30, 1919, and to tenths thereafter; reliability doubtful. Records poor. Data inadequate to determine discharge after September 30, 1919.

Discharge measurements of Brazos River at Brazos, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 2	McCashin and Congdon	1.60	68.7	Aug. 14	T. Twichell	2.48	656
1919.				Dec. 6	C. E. Ellsworth	1.21	212
Jan. 7	A. K. Gowans	1.82	321	1920.			
Mar. 19	C. E. Ellsworth	.68	30.1	Feb. 20	D. A. Dudley	.47	124
June 10	R. J. Hank	1.89	383				

Daily gage height, in feet, of Brazos River at Brazos, Tex., for the period Oct. 1, 1919, to Apr. 30, 1920.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.
1919-20.							1919-20.						
1	2.2	4.8	1.70	.....	0.9	0.6	16	4.1	2.4	.....	.....	.6	.5
2	2.1	4.6	1.70	.....	.8	.6	17	3.35	2.4	.....	.....	.6	.5
3	2.1	4.4	1.70	.....	.8	.6	18	2.55	2.3	.....	.....	.6	.4
4	2.1	4.2	1.70	.....	.8	.6	19	3.55	2.2	.....	.....	.6	.4
5	2.1	4.0	1.70	.....	.8	.6	20	3.5	2.15	.....	0.47	.6	.4
6	2.0	3.3	1.20	.....	.8	.6	21	3.5	2.1	.....	.....	.6	.4
7	2.0	2.9	.....	.....	.8	.6	22	6.5	2.1	.....	.....	.6	.4
8	2.0	2.4	.....	.....	.7	.6	23	6.2	1.70	.....	.....	.6	.4
9	1.9	2.4	.....	.....	.7	.6	24	5.2	1.50	.....	.....	.6	.4
10	1.9	2.4	.....	.....	.7	.6	25	5.0	1.50	.....	.....	.8	.4
11	5.4	2.3	.....	.....	.7	.6	26	3.15	1.65	.....	.....	.6	.4
12	5.7	2.25	.....	.....	.65	.5	27	3.1	1.80	.....	.....	.6	.4
13	5.4	2.15	.....	.....	.6	.5	28	2.9	1.80	.....	.....	.6	.4
14	5.2	2.4	.....	.....	.6	.5	29	2.8	1.90	.....	.....	.6	.4
15	4.8	2.55	.....	.....	.6	.5	30	5.4	1.70	.....	.....	.6	.4
							31	5.6	.....	.....	.....	.6	.....

NOTE.—No record Dec. 7, 1919, to Feb. 19, 1920, and Feb. 21-29, 1920.

Monthly discharge of Brazos River at Brazos, Tex., for the year ending Sept. 30, 1919

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	15,100	34	2,600	160,000
November	13,000	375	1,740	104,000
December	15,200	252	1,680	103,000
January	5,630	238	976	60,000
February	4,730	88	1,020	56,600
March	10,900	.....	1,060	65,200
April	14,000	151	2,990	178,000
May	22,500	1,080	7,520	462,000
June	9,520	390	2,470	147,000
July	24,500	137	3,390	208,000
August	9,700	174	1,350	83,000
September	2,540	34	548	32,600
The year	24,500	.....	2,300	1,660,000

NOTE.—Determination of daily discharge not sufficiently accurate to warrant publication.

BRAZOS RIVER AT WACO, TEX.

LOCATION.—At Southern Traction Co.'s bridge just above suspension bridge on Bridge Street, Waco, McLennan County, 2½ miles below mouth of Bosque River, 4½ miles above mouth of Cottonwood Creek, and 9 miles above lock No. 8.

DRAINAGE AREA.—25,500[3] square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—September 14, 1898, to December 31, 1911; October 1, 1914, to September 30, 1920. Records of stage have been obtained by United States Weather Bureau since August 9, 1900.

GAGE.—Gurley graph water-stage recorder installed March 29, 1918, on downstream side of pier of Southern Traction Co.'s bridge, 100 feet upstream from suspension bridge, inspected by Manton Hannah. Gage used from September 14, 1898, to February 29, 1908, was an inclined staff under left end of suspension bridge. From March 1, 1908, to December 31, 1911, and October 1, 1914, to December 5, 1917, record was obtained from a chain gage on downstream side of suspension bridge. From December 6, 1917, to March 28, 1918, gage was a vertical staff, painted on downstream side of pier of Southern Traction Co.'s bridge, the present location of the Gurley recorder. In 1902, a gage was marked off on the north pier of a new single-span highway bridge 300 feet above suspension bridge, and was used for high-water readings. From August 9, 1900, to May 21, 1903, the United States Weather Bureau used a vertical gage painted on pier nearest the center of the Saint Louis, Southwestern Railway bridge. From September 25, 1914, to March 23, 1915, during reconstruction of suspension bridge, the chain gage was on one-span highway bridge 300 feet upstream. All gages were installed at same datum, but readings probably differ slightly because of differences in location.

DISCHARGE MEASUREMENTS.—Made from upstream side of first one-span highway bridge above gage.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; shifts. Banks are clay, medium in height, have been improved by the city, and are overflowed at extremely high stages. Channel straight above and below for several thousand feet. Position of control not known.

EXTREMES OF DISCHARGE.—Maximum stage during year ending September 30, 1919, from water-stage recorder, 36.4 feet at 4 a. m. November 9 (discharge, 125,000 second-feet); minimum stage from water-stage recorder, 4.68 feet at 6 p. m. October 16, and 1 p. m. October 17 (discharge, 73 second-feet).

Maximum stage during year ending September 30, 1920, from water-stage recorder, 27.9 feet at 5 a. m. October 23 (discharge, 78,100 second-feet); minimum stage from water-stage recorder, 4.96 feet from 7 a. m. May 4 to 4 a. m. May 5 (discharge, 470 second-feet).

1898–1920: Maximum stage recorded, 39.7 feet December 3, 1913 (discharge not determined); no flow August 20–21, 1918.

ICE.—None reported during year.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that numerous small diversions are made above station for mining, irrigation, and municipal uses, but total probably does not appreciably affect the flow except during low stages.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve fairly well defined below 30,000 second-feet; above 30,000 second-feet curve based on one discharge measurement at discharge of 109,000 second-feet. Operation of water-stage recorder satisfactory except as indicated in footnote to daily-discharge table. Daily discharge determined by shifting-control method. Records good after July 29, 1919, because of more frequent measurements, and poor prior to that date.

[3] Revised since publication of Water-Supply Paper 308.

Discharge measurements of Brazos River at Waco, Tex., during the years ending Sept. 30 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec-ft.*	1919.		*Feet.*	*Sec-ft.*
Oct. 7	McCashin and Congdon	5.21	177	Dec. 1	Wagner and Green	11.18	6,940
Dec. 10	Ellsworth and McCashin	6.98	624	11	do	8.36	2,820
1919.				23	Wagner and Rubel	7.50	1,990
Mar. 17	Ellsworth and Hank	6.04	1,010	1920.			
24	C. E. Ellsworth	5.46	616	Jan. 1	do	6.90	1,390
27	R. J. Hank	7.55	2,330	13	Rubel and Wood	11.98	9,860
Apr. 1	C. E. McCashin	11.97	10,200	26	Wood and Rubel	9.32	4,960
June 9	R. J. Hank	7.66	1,640	Feb. 2	Rubel and Green	8.20	3,400
July 29	Ellsworth and Norris	10.53	5,600	12	Wood and Rubel	7.02	2,130
Aug. 7	Ellsworth and Stephens	7.02	993	25	do	6.60	1,820
18	Stephens and Stiles	7.08	1,120	Mar. 3	Rubel and Green	6.30	1,390
28	U. Stephens	10.42	4,810	13	Rubel and Wagner	5.87	1,280
Sept. 6	Stephens and Green	7.20	1,170	24	Rubel and Green	5.50	904
16	do	6.24	447	Apr. 2	Wagner and Rubel	7.98	3,510
26	Wood and Green	9.34	3,040	13	Wood and Rubel	5.58	983
Oct. 7	Waco City engineering department.	7.58	1,350	24	Rubel and Turner	5.15	596
				May 13	Ellsworth and McCashin	17.38	29,700
16	do	12.76	12,300	14	do	13.40	14,400
27	do	12.44	8,340	June 17	T. Twichell	6.45	1,070
Nov. 5	do	10.57	5,570	July 23	do	6.66	1,010
20	Wagner and Green	9.14	3,830				

NOTE.—Measurements from Aug. 18, 1919, to Apr. 24, 1920, made by engineers from city engineer's office at Waco.

Daily discharge, in second-feet, of Brazos River at Waco, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	501	8,210	1,490	2,990	5,610	1,200	10,600	14,700	11,100	10,200	2,560	1,830
2	390	6,420	1,500	2,320	10,900	1,150	6,990	7,700	8,130	7,580	2,090	1,730
3	314	4,860	1,340	1,790	19,600	1,110	10,400	6,760	5,660	4,800	1,760	1,850
4	265	3,660	1,070	1,460	9,890	1,080	9,420	4,940	4,010	4,140	1,560	1,500
5	230	2,990	928	1,280	6,700	1,090	6,700	3,680	3,080	3,420	1,380	1,320
6	200	2,450	838	1,170	5,480	1,090	4,820	5,160	2,630	3,220	1,180	1,220
7	174	7,120	786	1,090	4,680	1,010	4,380	4,560	2,220	3,060	974	1,250
8	159	89,700	737	1,020	4,760	1,060	7,800	7,450	1,830	2,900	943	1,280
9	140	99,800	681	898	4,140	1,130	10,800	3,460	1,610	2,330	912	1,050
10	123	24,500	612	765	3,540	1,050	8,210	15,200	2,050	1,990	1,840	890
11	113	15,700	566	667	3,260	942	4,740	10,800	2,620	1,680	1,760	772
12	106	10,900	572	600	2,980	890	3,500	8,000	1,770	1,420	1,680	660
13	108	7,250	16,200	543	2,690	838	3,040	7,550	1,240	1,200	1,600	577
14	95	5,220	6,830	501	2,520	830	2,450	8,820	1,050	1,010	1,520	522
15	81	13,800	2,120	606	2,100	830	2,010	9,090	950	882	1,440	485
16	75	12,700	1,410	1,740	1,890	1,250	4,000	8,870	1,190	786	1,370	465
17	554	3,780	1,160	4,070	1,790	1,070	3,420	12,000	3,020	1,090	1,290	435
18	3,720	2,840	1,010	9,320	1,820	920	2,450	10,300	2,380	1,380	1,210	412
19	3,440	2,220	1,020	8,540	1,840	765	1,980	9,320	3,800	860	1,130	381
20	2,690	1,780	4,740	7,350	2,240	695	1,610	8,900	9,590	716	1,460	36,900
21	2,060	1,470	8,430	7,220	2,320	648	1,300	13,300	.....	6,700	28,300	10,600
22	3,640	1,290	3,800	12,100	1,990	636	1,070	8,430	.....	10,700	21,500	39,100
23	6,720	1,170	24,600	25,300	1,770	630	890	5,370	.....	23,600	11,700	26,400
24	4,840	1,080	42,400	17,600	1,610	667	751	4,700	.....	19,800	13,700	8,080
25	9,380	1,010	23,500	11,200	1,510	8,830	636	5,180	.....	10,200	7,650	4,800
26	11,800	1,080	16,800	10,100	1,430	4,740	554	4,380	.....	8,840	7,220	3,280
27	16,400	1,080	9,890	8,820	1,350	2,550	490	9,530	.....	8,620	4,460	2,820
28	10,100	1,170	5,930	13,700	1,290	4,880	490	13,900	.....	7,650	4,440	3,820
29	23,900	1,690	4,560	9,380	.....	7,580	8,260	22,300	12,300	5,410	3,660	3,500
30	27,100	1,900	4,100	9,090	.....	23,100	7,980	21,600	9,860	4,010	2,810	2,840
31	12,600	.....	3,560	7,720	.....	33,800	.....	16,900	.....	3,170	2,200	.....

Daily discharge, in second-feet, of Brazos River at Waco, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	2,520	13,500	7,100	1,380	3,580	1,440	1,390	527	3,880	2,500	566	7,350
2	2,300	16,400	5,860	1,220	3,500	1,380	2,680	511	3,500	2,020	554	7,850
3	2,020	10,100	4,900	1,080	3,220	1,370	2,340	490	8,650	1,720	594	6,760
4	1,740	7,600	4,500	1,070	3,000	1,460	1,600	475	6,310	1,480	554	6,990
5	1,570	5,410	4,400	1,760	2,780	1,290	1,330	606	3,500	2,050	636	5,520
6	1,450	4,800	4,500	15,800	2,690	1,320	1,160	3,760	3,420	1,850	6,310	4,100
7	1,370	8,100	4,100	9,200	2,620	1,290	1,150	19,500	2,690	1,760	7,980	40,400
8	6,090	33,800	3,800	13,100	2,600	1,370	1,120	28,100	1,980	1,750	4,900	45,500
9	7,850	31,100	3,420	7,850	2,520	1,380	1,120	21,000	1,630	2,450	2,680	43,400
10	6,540	48,600	3,280	4,020	2,420	1,450	1,090	24,100	1,420	3,200	1,840	36,100
11	35,600	23,300	2,900	6,990	2,660	1,460	1,090	41,400	1,350	2,360	1,850	21,800
12	16,400	10,100	2,900	23,300	4,300	1,380	1,010	37,500	1,210	1,450	1,460	16,400
13	11,300	8,380	2,820	11,300	4,700	1,310	974	28,600	1,250	1,270	6,760	12,500
14	8,920	10,400	2,640	6,990	3,680	1,240	982	15,100	1,430	1,110	6,990	8,920
15	12,500	8,100	2,300	5,980	2,990	1,180	966	16,800	1,250	1,460	8,100	6,760
16	17,800	6,540	2,220	5,980	2,600	1,130	882	26,100	1,170	1,090	5,410	5,410
17	34,300	5,750	2,330	5,300	2,480	1,100	845	34,300	1,060	890	11,000	4,700
18	14,100	5,100	2,240	4,200	2,540	1,080	815	37,100	990	772	6,310	3,880
19	8,100	4,400	2,520	3,720	2,440	1,050	751	30,700	1,110	667	6,650	3,200
20	6,090	3,880	2,700	3,420	2,320	1,030	716	17,800	3,600	793	9,200	2,750
21	5,000	3,500	2,390	3,200	2,220	974	654	15,100	22,900	1,090	12,800	2,300
22	39,900	3,050	2,130	3,120	2,100	928	624	14,800	20,000	1,280	21,400	2,160
23	64,400	2,750	2,010	9,200	2,010	905	600	12,500	13,500	1,010	13,500	2,020
24	27,300	2,450	1,920	10,100	1,970	928	600	7,600	14,400	1,250	13,100	1,750
25	14,100	2,380	1,830	6,650	1,870	5,640	618	5,000	17,500	1,570	26,500	1,560
26	9,500	8,920	1,730	5,100	1,790	14,800	612	4,020	8,650	1,120	15,100	1,430
27	8,100	4,700	1,670	4,700	1,720	4,700	600	3,420	6,420	1,050	11,000	1,310
28	5,980	13,800	1,640	4,400	1,620	2,980	583	3,200	4,900	765	13,100	1,220
29	4,900	34,700	1,580	4,130	1,570	2,160	549	2,600	3,800	681	8,650	1,120
30	4,020	11,300	1,480	3,850	.....	1,700	538	2,200	3,050	744	9,800	1,060
31	4,200	.....	1,440	3,580	.....	1,510	.....	2,980	.....	667	6,880	.....

NOTE.—Discharge, June 21–28, 1919, estimated 24,000 second-feet. Discharge interpolated, Aug. 11–18, 1919; Jan. 29, 30, 1920. Gage heights from U. S. Weather Bureau gage used for determining discharge June 19, 20, 22–25, 1920. Gage heights partly estimated Oct. 24–25, Nov. 9–10, Dec. 6–7, 1919; Jan. 31, Apr. 4–6, May 5–10, and Sept. 4, 1920.

Monthly discharge of Brazos River at Waco, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	27,100	75	4,580	282,000
November	99,800	1,010	11,300	672,000
December	42,400	566	6,230	383,000
January	25,300	501	5,840	359,000
February	19,600	1,290	3,990	222,000
March	33,800	630	3,490	215,000
April	10,800	490	4,390	261,000
May	22,300	3,460	9,450	581,000
June	.....	950	9,470	564,000
July	23,600	716	5,270	324,000
August	28,300	912	4,430	272,000
September	39,100	381	5,360	319,000
The year	99,800	75	6,150	4,450,000
1919–20.				
October	64,400	1,370	12,400	762,000
November	48,600	2,380	11,800	702,000
December	7,100	1,440	2,940	181,000
January	23,300	1,070	6,180	380,000
February	4,700	1,570	2,640	152,000
March	14,800	905	2,030	125,000
April	2,680	538	1,000	59,500
May	41,400	475	14,800	910,000
June	22,900	990	5,550	330,000
July	3,200	667	1,420	87,300
August	26,500	554	7,810	480,000
September	45,500	1,060	10,200	607,000
The year	64,400	475	6,580	4,780,000

NOTE.—See footnote to table of daily discharge.

Days of deficiency in discharge of Brazos River at Waco, Tex., for the years ending Sept. 30, 1901–1910 and 1915–1920.

Discharge in second-feet.	Days of deficient discharge.															
	1900–1	1901–2	1902–3	1903–4	1904–5	1905–6	1906–7	1907–8	1908–9	1909–10	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20
100	34	76	1	14	.....	.....	.....	.....	203	144	.....	.....	91	208	3	.....
200	73	124	17	98	15	.....	1	2	260	220	.....	32	202	234	10	.....
300	115	141	33	125	63	16	17	20	287	246	4	76	234	247	13	.....
400	164	152	42	148	98	79	61	31	300	260	28	132	250	258	16	.....
500	199	163	71	181	126	106	102	43	307	282	38	164	260	263	22	2
600	220	177	98	202	136	130	131	56	310	293	42	177	270	267	31	11
700	242	192	130	215	141	145	153	65	314	294	49	189	277	273	43	23
800	256	206	168	239	153	160	179	73	315	305	53	198	288	278	51	29
900	266	222	184	254	161	168	220	97	317	310	67	211	294	284	61	33
1,000	274	235	192	260	164	172	233	109	317	314	83	218	307	289	68	41
1,200	288	250	217	280	184	196	265	153	326	322	124	231	319	292	99	67
1,400	296	265	230	286	195	210	271	183	328	329	152	247	332	308	118	91
1,600	299	279	243	298	214	233	290	218	335	336	176	258	338	313	131	111
1,800	301	292	256	300	227	242	298	232	340	338	199	265	342	316	147	126
2,000	306	302	259	304	233	249	302	250	341	341	204	273	346	320	159	134
2,500	314	314	274	313	245	279	317	274	345	347	223	287	350	329	175	162
3,000	326	323	293	322	252	297	325	291	348	348	245	298	353	329	189	187
4,000	337	327	320	333	274	315	338	307	353	350	277	317	356	337	214	217
5,000	345	337	332	344	291	322	347	318	356	351	294	327	362	342	241	241
6,000	349	342	339	349	308	335	354	325	358	352	306	335	363	345	250	256
7,000	352	346	342	354	314	340	355	329	358	355	314	342	364	348	258	274
8,000	354	350	348	356	320	343	357	333	360	357	316	344	364	352	273	282
9,000	357	351	352	357	329	347	358	335	360	357	321	347	364	352	289	294
10,000	358	352	354	360	331	352	359	337	360	357	326	352	364	355	301	299
15,000	361	357	359	364	343	359	365	343	360	362	339	357	365	363	329	324
20,000	363	359	361	365	354	361	.....	348	362	362	344	359	.....	365	338	336
40,000	365	361	365	366	362	364	.....	356	365	365	354	361	.....	.....	362	360
60,000	.....	363	.....	.....	364	365	.....	359	.....	.....	357	365	.....	.....	363	365
80,000	.....	365	.....	.....	364	.....	.....	360	.....	.....	361	365	.....	.....	363	366
100,000	.....	.....	.....	.....	365	.....	.....	363	.....	.....	365	366	.....	.....	365	.....
150,000	.....	.....	.....	.....	.....	.....	.....	366	.....	.....	.....	.....	.....	.....	.....	.....

BRAZOS RIVER NEAR COLLEGE STATION, TEX.

LOCATION.—At Jones' Bridge, 4 miles below Munson Shoals, 6 miles southwest of College Station, Brazos County, 19 miles above mouth of Yegua River, and 30 miles above mouth of Navasota River.

DRAINAGE AREA.—35,400 square miles (measured on standard topographic maps; post-route map, and topographic map of Texas compiled in 1899 by Robert T. Hill, of United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—February 23, 1918, to September 30, 1920.

GAGE.—Vertical staff in two sections on fourth pier from right bank. Section 0 to 14 feet is attached to sheet piling around footing of pier. Section 14 to 52 feet is painted on same pier. Read by Will Reaves or Ed Phillips.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and mud; shifting. Location of control not known. Banks high and free from vegetation. Right bank subject to overflow at extremely high stages (about 40 feet).

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 41.0 feet at 8.30 a. m. November 11 (discharge, 69,300 second-feet, determined from extension of rating curve); minimum stage, 4.3 feet at 6 a. m. October 16, and 6 p. m. October 16 and 17 (discharge, 272 second-feet).

Maximum stage recorded during year ending September 30, 1920, 41.5 feet at 6 a. m. October 25 (discharge, 70,500 second-feet, determined from extension of rating curve); minimum stage, 6.2 feet at 9 a. m. August 1 (discharge, 945 second-feet).

1918–1920: Maximum stage recorded in 1920 (see above); minimum stage 3.75 feet September 4, 1918 (discharge, 92 second-feet).

ICE.—None reported during years.

DIVERSIONS.—No important diversions above or below station.

REGULATION.—None. A lock and dam is being constructed by the War Department about 25 miles upstream, which may eventually regulate the flow during extremely low stages.

ACCURACY.—Stage-discharge relation not permanent. Rating curve well defined below 40,000 second-feet. Gage read to half-tenths twice daily. Discharge ascertained by shifting-control method. Records fair.

Discharge measurements of Brazos River near College Station, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Ft.*	*Sec.-ft.*	1919.		*Ft.*	*Sec.-ft.*
Oct. 9	McCashin and Congdon	4.87	486	Sept. 8	C. E. Ellsworth	7.40	2,140
Nov. 9	C. E. McCashin	26.79	[a] 38,200	Dec. 29	T. Twichell	10.4	6,750
9	do	28.95	[b] 41,700				
10	do	36.45	[c] 56,600	1920.			
Dec. 11	Ellsworth and McCashin	6.00	1,160	Apr. 3	do	9.57	4,190
				May 15	Ellsworth and McCashin	19.25	20,500
1919.				17	do	30.0	[d] 52,900
Jan. 3	C. E. McCashin	10.98	5,790	June 18	T. Twichell	8.10	2,400
July 30	Ellsworth and Norris	13.50	8,810				

[a] Surface velocities observed and coefficient of 0.72 used to reduce to mean velocity.
[b] Surface velocities observed and coefficient of 0.80 used to reduce to mean velocity.
[c] Surface velocities observed and coefficient of 0.90 used to reduce to mean velocity.
[d] Measurement made during rising stage.

Daily discharge, in second-feet, of Brazos River near College Station, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	1,550	18,400	2,970	9,400	13,900	3,000	42,000	13,800	19,700	32,500	5,650	5,340
2	1,480	11,500	2,660	7,720	11,600	2,980	24,300	22,800	16,100	30,100	4,730	4,010
3	1,310	8,430	2,440	5,530	24,800	2,560	16,300	17,800	12,600	24,200	3,980	3,490
4	1,090	6,450	2,280	4,880	32,700	2,560	16,800	12,900	9,610	17,300	3,480	2,880
5	903	4,570	2,100	3,810	22,500	2,560	18,800	11,100	7,840	12,900	3,030	3,400
6	759	3,090	1,800	3,290	15,100	2,550	13,000	6,670	5,860	10,700	2,780	2,830
7	726	3,110	1,570	3,410	12,000	2,550	10,700	9,970	4,630	8,420	2,250	2,430
8	605	4,720	1,460	3,110	10,200	2,550	8,500	14,200	4,090	7,610	2,210	2,260
9	500	39,400	1,370	2,870	8,440	2,550	10,300	15,800	3,890	9,330	2,210	2,070
10	436	61,000	1,270	2,660	8,110	2,470	14,000	12,400	4,630	13,400	2,400	2,220
11	456	66,200	1,200	2,650	7,560	3,020	12,200	21,900	4,130	10,700	2,140	2,030
12	627	33,500	1,180	2,570	6,060	2,740	8,240	18,900	5,840	5,750	3,280	1,840
13	536	19,800	2,990	2,400	5,700	2,500	6,200	15,700	7,310	4,490	3,750	1,270
14	368	17,000	19,600	2,100	5,310	2,160	5,470	16,200	4,670	3,960	2,560	1,270
15	302	17,100	19,300	2,200	4,500	2,150	4,680	15,600	4,130	3,760	2,210	1,270
16	272	22,100	10,700	5,420	4,380	2,140	4,290	14,700	12,200	3,050	2,210	1,730
17	278	22,100	6,920	8,110	5,300	2,140	4,510	12,800	12,600	3,050	1,910	2,180
18	376	15,500	4,460	12,300	5,690	2,690	5,450	15,600	13,700	4,000	1,480	2,610
19	546	8,110	3,310	12,900	7,600	3,400	4,560	15,500	18,500	4,480	1,480	2,410
20	2,030	5,970	2,860	12,400	10,200	2,910	3,830	14,600	18,200	7,610	1,480	1,840
21	2,570	5,840	3,760	10,800	14,100	2,280	3,340	14,200	17,400	8,410	1,870	26,800
22	2,200	3,930	11,900	14,500	11,300	1,940	3,290	19,800	16,900	11,400	24,700	13,900
23	2,220	2,710	13,100	23,500	6,720	1,720	3,040	16,600	13,100	21,500	42,500	34,700
24	6,350	2,520	31,500	37,800	5,040	1,430	2,680	15,500	11,600	31,200	33,700	43,800
25	5,970	2,190	46,100	36,300	4,350	1,430	2,440	18,700	10,500	32,300	22,300	30,500
26	10,100	2,140	39,600	26,400	3,480	12,500	2,430	18,100	18,500	21,400	17,700	21,800
27	13,200	2,010	35,500	20,000	3,440	19,600	2,350	15,500	37,000	17,300	17,300	13,600
28	19,900	2,360	23,000	16,300	3,180	14,400	2,350	20,800	48,300	13,200	12,900	8,440
29	15,800	3,030	14,300	20,200	.....	10,400	2,040	23,900	46,200	11,500	11,900	6,880
30	19,000	3,150	11,300	17,300	.....	14,000	4,930	27,300	42,000	9,430	9,000	7,210
31	27,300	.....	10,200	15,900	.....	29,200	.....	27,200	.....	7,150	7,870	.....

Daily discharge, in second-feet, of Brazos River near College Station, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919-20.												
1	6,140	21,700	24,400	6,140	12,600	5,110	4,640	1,700	5,230	5,230	1,080	8,660
2	5,110	28,200	19,400	6,140	11,700	5,110	4,640	1,700	5,230	5,110	1,420	7,820
3	4,870	30,400	16,300	6,140	11,200	5,110	4,310	1,700	5,230	4,530	2,000	8,480
4	4,530	22,700	14,900	6,000	8,480	5,110	4,420	1,700	9,020	4,100	2,080	8,300
5	3,800	17,900	14,900	6,700	10,300	6,140	4,640	1,700	11,000	3,140	1,210	8,140
6	3,800	17,100	14,900	14,500	8,840	5,870	3,900	1,700	9,560	4,100	1,210	6,860
7	3,700	15,700	12,400	29,300	8,660	4,990	3,600	1,560	6,560	4,640	2,220	8,660
8	5,350	16,700	10,800	27,300	8,660	4,990	3,500	12,800	7,660	3,140	13,300	29,900
9	6,860	38,100	11,000	30,600	8,300	4,640	3,320	23,200	5,610	2,870	16,500	46,800
10	11,400	46,300	16,300	26,000	8,300	4,530	2,780	22,100	4,100	2,780	17,300	45,600
11	19,000	62,900	17,500	17,700	8,300	4,530	2,780	27,300	3,700	2,780	14,100	41,000
12	44,500	56,400	12,800	27,300	8,140	4,530	2,700	34,800	3,140	3,410	10,500	35,400
13	42,200	37,200	11,200	43,800	12,600	4,530	2,700	33,000	2,870	3,900	5,480	22,100
14	38,700	31,700	10,300	41,700	13,300	3,900	2,700	31,900	2,780	3,600	6,420	17,100
15	37,600	29,100	9,560	34,600	12,300	3,900	2,620	21,700	2,620	2,540	8,840	12,800
16	39,900	25,300	8,800	29,900	11,400	3,900	2,540	30,600	2,700	2,300	8,480	10,300
17	46,800	20,000	8,140	24,900	8,660	3,900	2,540	41,700	2,460	3,050	8,480	9,560
18	59,400	16,900	7,820	21,500	8,140	3,900	2,540	51,400	2,300	2,300	13,300	8,140
19	48,100	14,900	9,560	18,100	7,980	3,900	2,540	52,300	4,100	2,080	9,920	7,340
20	35,200	13,700	11,200	16,100	7,500	3,700	2,220	44,500	5,480	1,700	8,840	5,870
21	27,500	11,700	11,000	14,300	7,340	3,700	1,920	28,000	6,280	1,560	9,740	4,990
22	34,600	10,600	10,800	13,700	6,420	3,700	1,920	19,400	21,100	1,560	14,500	4,100
23	60,800	10,500	9,200	17,900	6,420	2,960	2,000	19,600	19,600	1,560	21,500	3,900
24	70,000	10,300	7,980	42,400	6,420	2,960	1,850	17,500	17,100	2,300	16,300	3,800
25	69,300	9,560	7,500	47,000	6,420	2,960	1,850	12,600	17,900	2,000	14,300	3,230
26	48,100	9,560	7,660	45,200	6,000	2,870	1,780	9,380	17,100	1,700	24,200	3,230
27	36,300	12,600	7,500	35,000	5,480	16,700	1,780	8,480	10,800	2,000	19,400	2,960
28	29,300	17,100	7,020	22,300	5,110	9,200	2,150	8,300	8,140	2,220	14,300	2,960
29	24,900	17,100	6,420	17,700	5,110	6,700	2,460	7,820	6,560	1,490	15,300	2,960
30	21,700	36,500	6,560	15,100	.....	4,310	2,080	7,340	5,610	1,490	10,800	2,220
31	20,400	.....	6,420	13,500	.....	4,750	.....	5,350	.....	1,280	10,500	.....

NOTE.—Discharge June 5, 1920, interpolated.

Monthly discharge of Brazos River near College Station, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	27,300	272	4,510	277,000
November	66,200	2,010	13,900	827,000
December	46,100	1,180	10,700	658,000
January	37,800	2,100	11,200	689,000
February	32,700	3,180	9,760	542,000
March	29,200	1,430	5,200	320,000
April	42,000	2,040	8,770	522,000
May	27,300	6,670	16,700	1,030,000
June	48,300	3,890	15,100	898,000
July	32,500	3,050	13,000	799,000
August	42,500	1,480	8,290	510,000
September	43,800	1,270	8,570	510,000
The year	66,200	272	10,500	7,580,000
1919-20.				
October	70,000	3,700	29,400	1,810,000
November	62,900	9,560	23,600	1,400,000
December	24,400	6,420	11,300	695,000
January	47,000	6,000	23,200	1,430,000
February	13,300	5,110	8,620	496,000
March	16,700	2,870	4,940	304,000
April	4,640	1,780	2,850	170,000
May	52,300	1,350	18,800	1,160,000
June	21,100	2,300	7,720	459,000
July	5,230	1,280	2,790	172,000
August	24,200	1,080	10,400	640,000
September	46,800	2,220	12,800	762,000
The year	70,000	1,080	13,100	9,500,000

CLEAR FORK OF BRAZOS RIVER NEAR ELIASVILLE, TEX.

LOCATION.—At new suspension highway bridge 2½ miles northeast of Eliasville, Young County, 4½ miles southwest of South Bend, 6 miles above mouth of stream, and below all tributaries.

DRAINAGE AREA.—5,650 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—November 12, 1915, to April 30, 1920, when station was discontinued.

GAGE.—Staff gage on left bank below bridge used for stages below 6.7 feet; chain gage on downstream side of bridge used for stages above 6.7 feet. Read by Gilmer Vaughn.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Banks high, wooded, composed of clay and gravel, and not subject to overflow. Bed composed of sand and gravel; free from vegetation. Channel straight above and below station. A shoal about 600 feet below station serves as control for low and medium stages; control shifts during changing stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 27.2 feet at 5.40 p. m. May 27 (discharge, 12,500 second-feet, determined from extension of rating curve); minimum stage, 2.90 feet October 8 (discharge, 1.6 second-feet).

Maximum stage recorded during year ending September 30, 1920, 10.9 feet at 5 p. m. October 21 (discharge, 2,800 second-feet); minimum stage, 2.90 feet from 8 a. m. April 24 to 8 a. m. April 26 (discharge, 1.4 second-feet).

1916–1920: Maximum stage recorded, 27.2 feet at 5.40 p. m. May 27, 1919 (discharge, 12,500 second-feet, determined from extension of rating curve); no flow for extended periods.

ICE.—None reported during year.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that numerous small diversions are made above station for mining, irrigation, and municipal uses which probably reduce the flow considerably during low stages. Two diversions are made for irrigation between station and confluence of Clear Fork and Brazos River.

REGULATION.—None of consequence except possibly during extremely low stages.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve fairly well defined below 9,000 second-feet. Gage read to hundredths twice daily. Mean of two daily gage readings during low stages may not be true index of mean daily flow because of regulation for power above station. Daily discharge ascertained by indirect method for shifting control. Records fair.

Discharge measurements of Clear Fork of Brazos River near Eliasville, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 5	McCashin and Congdon	3.06	4.3	Aug. 16	T. Twichell	3.71	39.0
1919.				Dec. 4	C. E. Ellsworth	3.59	25.1
Jan. 9	A. K. Gowans	3.48	21.6	1920.			
Mar. 20	C. E. Ellsworth	3.26	5.4	Feb. 18	D. A. Dudley	3.60	32.1
June 15	R. J. Hank	4.52	229				

Daily discharge, in second-feet, of Clear Fork of Brazos River near Eliasville, Tex., for the period Oct. 1, 1918, to Apr. 30, 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	2.9	316	18	71	104	3.0	641	1,680	421	1,140	78	122
2	2.4	130	17	56	1,190	3.5	481	657	274	841	66	83
3	2.2	80	17	47	413	3.5	1,960	481	246	801	63	65
4	3.4	63	13	42	109	3.5	1,760	316	169	381	58	57
5	4.5	47	8.8	30	59	3.4	3,300	401	118	204	51	37
6	3.8	40	8.8	30	45	3.0	2,620	1,940	106	246	47	31
7	2.8	1,570	10	30	33	2.9	1,100	1,000	102	152	47	29
8	1.7	4,390	11	30	26	3.0	326	1,240	292	78	47	26
9	1.6	569	8.8	21	21	3.2	326	429	721	66	47	27
10	9.2	449	18	18	21	3.2	441	228	1,300	56	1,380	26
11	10	409	10	16	13	3.2	721	369	1,100	51	204	19
12	1,630	281	8.0	11	14	2.9	1,240	521	901	44	102	16
13	1,230	130	6.4	12	11	2.8	721	256	821	42	66	13
14	2,090	58	7.2	15	11	2.9	326	1,260	362	38	56	10
15	1,230	40	6.8	18	9.6	5.8	152	961	204	36	38	11
16	593	40	6.4	19	7.6	3.8	97	701	299	42	30	15
17	162	32	8.0	16	6.8	4.5	381	344	1,600	44	34	13
18	82	33	6.8	12	6.8	4.2	176	761	781	32	34	12
19	54	24	8.0	12	6.4	3.8	53	3,700	344	30	1,110	14
20	39	18	1,380	12	6.0	4.8	47	1,640	601	3,900	3,500	18
21	26	18	765	16	5.8	12	44	1,300	1,300	8,620	7,330	18
22	2,670	18	725	3,040	4.8	14	42	1,360	1,740	5,340	2,680	109
23	4,680	18	4,110	1,280	4.0	7.6	42	529	1,700	4,590	2,480	113
24	4,370	15	3,840	445	5.0	11	38	309	1,100	5,060	1,060	250
25	1,350	15	1,790	597	5.5	7,180	30	5,000	1,020	5,810	401	453
26	2,540	18	1,320	183	4.8	5,370	26	5,870	1,180	1,120	461	214
27	7,830	21	425	1,240	4.8	2,930	1,180	11,500	1,120	381	369	99
28	6,340	24	180	817	3.2	2,050	2,440	11,500	881	222	169	69
29	4,970	26	99	330	.....	1,200	2,860	9,650	621	152	256	54
30	3,620	28	147	190	.....	441	2,530	4,850	901	113	721	49
31	3,220	.....	99	149	.....	1,360	.....	741	.....	93	274	.....
1919-20.												
1	33	573	20	11	50	15	6.0	.....	.....	.....	.....	.....
2	25	385	19	9.0	47	15	5.5	.....	.....	.....	.....	.....
3	23	405	19	9.0	53	12	5.0	.....	.....	.....	.....	.....
4	23	190	24	8.0	50	13	5.3	.....	.....	.....	.....	.....
5	75	104	22	9.0	44	12	4.5	.....	.....	.....	.....	.....
6	75	149	19	11	40	12	4.5	.....	.....	.....	.....	.....
7	69	52	20	11	32	12	4.0	.....	.....	.....	.....	.....
8	553	67	19	10	32	13	4.0	.....	.....	.....	.....	.....
9	1,710	312	16	5.5	32	11	4.0	.....	.....	.....	.....	.....
10	2,270	985	13	9.2	32	10	4.0	.....	.....	.....	.....	.....
11	453	425	13	9.2	36	11	4.0	.....	.....	.....	.....	.....
12	197	267	13	13	33	12	4.0	.....	.....	.....	.....	.....
13	133	116	13	13	32	12	3.8	.....	.....	.....	.....	.....
14	90	72	13	18	32	12	3.5	.....	.....	.....	.....	.....
15	66	62	13	22	32	11	3.5	.....	.....	.....	.....	.....
16	80	59	14	40	32	8.8	3.4	.....	.....	.....	.....	.....
17	401	44	12	43	36	12	3.0	.....	.....	.....	.....	.....
18	281	34	11	37	28	10	2.9	.....	.....	.....	.....	.....
19	106	34	9.0	41	24	11	2.8	.....	.....	.....	.....	.....
20	97	38	7.0	37	24	12	2.6	.....	.....	.....	.....	.....
21	1,410	33	7.0	37	19	12	2.4	.....	.....	.....	.....	.....
22	1,190	16	8.0	48	23	12	2.0	.....	.....	.....	.....	.....
23	292	14	11	65	24	12	1.8	.....	.....	.....	.....	.....
24	246	12	12	340	23	11	1.4	.....	.....	.....	.....	.....
25	222	6.0	11	295	44	12	1.4	.....	.....	.....	.....	.....
26	176	16	9.0	149	21	8.4	1.8	.....	.....	.....	.....	.....
27	125	19	9.0	80	13	8.8	253	.....	.....	.....	.....	.....
28	63	23	9.0	65	12	6.0	581	.....	.....	.....	.....	.....
29	144	26	9.0	65	16	6.0	228	.....	.....	.....	.....	.....
30	194	19	13	60	.....	6.0	88	.....	.....	.....	.....	.....
31	73	.....	18	60	.....	6.0	.....	.....	.....	.....	.....	.....

NOTE.—Discharge, May 27 and 28, 1919, determined from extension of rating curve.

Monthly discharge of Clear Fork of Brazos River near Eliasville, Tex., for the period Oct. 1, 1918, to Apr. 30, 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	7,830	1.6	1,570	96,500
November	4,390	15	297	17,700
December	4,110	6.4	486	29,900
January	3,040	11	284	17,500
February	1,190	3.2	76.8	4,270
March	7,180	2.8	666	41,000
April	3,300	26	870	51,800
May	11,500	228	2,310	142,000
June	1,740	102	744	44,300
July	8,620	30	1,280	78,700
August	7,330	30	750	46,100
September	453	10	69.1	4,110
The year	11,500	1.6	793	574,000
1919-20.				
October	2,270	23	351	21,600
November	985	6.0	152	9,040
December	24	7.0	13.7	842
January	340	5.5	52.6	3,230
February	50	12	31.6	1,820
March	15	6.0	10.9	670
April	581	1.4	41.4	2,460
The period				39,700

LITTLE RIVER AT CAMERON, TEX.

LOCATION.—200 feet below city pumping plant, half a mile south of Cameron, Milam County, 1 mile above Gulf, Colorado & Santa Fe Railway bridge, 6 miles below mouth of San Gabriel River, and 25 miles above confluence with Brazos River.

DRAINAGE AREA.—7,010 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—November 1, 1916, to September 30, 1920.

GAGE.—Vertical and inclined staff; three sections attached to trees on left bank a short distance below home of pumpman; read by T. H. Crawford or M. H. Hayes.

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

CHANNEL AND CONTROL.—Bed composed of rock, gravel, and sand; permanent during normal flow and free from vegetation. Banks composed of clay and gravel; medium height; wooded; subject to overflow only during extreme stages. At a stage of 18 feet (discharge, 6,950 second-feet) water begins to enter old channel a mile above gage and returns to main channel below the gage; consequently, all records of discharge greater than 6,950 second-feet do not represent the total flow of the stream, but only that in the main channel. Rock and gravel shoal 100 feet below gage serves as control for low and medium stages; subject to change during flood stages. During extremely high stages on Brazos River, backwater may reach gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 30.2 feet at 7 a. m. December 28 (discharge, 13,900 second-feet; see "Channel and control" in station description); minimum stage recorded, 1.06 feet at 7 a. m. October 14 (discharge, 23 second-feet).

Maximum stage recorded during year ending September 30, 1920, 31.6 feet at 5.50 p. m. January 24 (discharge, 14,700 second-feet; see "Channel and control" in station description); minimum stage recorded, 3.20 feet at 6.30 p. m. July 29 (discharge, 472 second-feet).

1917–1920: Maximum stage recorded in 1920 (see above). Minimum stage, 0.78 foot at 7 a. m. September 3, 5, and 7, 1918 (discharge, 2.6 second-feet).

ICE.—None reported.

DIVERSIONS.—Numerous small diversions are made for irrigation and municipal uses, but such diversions have little effect on flow at the station except during extremely low stages. Records of the Board of Water Engineers for the State of Texas show that about 2,500 acres have been declared irrigated above the station. No diversions of consequence below the station. During time of low flow, water pumped by Cameron Power & Light Co., will affect the flow at this station.

REGULATION.—Slight effect from pumping for city of Cameron.

ACCURACY.—Stage-discharge relation practically permanent for low stages but changes during medium and high stages. Extremely high stages of Brazos River may cause backwater at this station. Rating curve well defined below 13,000 second-feet. Gage read to half-tenths twice daily and oftener during floods. Daily discharge ascertained by applying mean daily gage heights to rating table, or by shifting-control method, as shown in footnote to daily-discharge table. Above a stage of 18 feet (discharge, 6,950 second-feet) water enters an old channel about a mile above gage and returns to river below gage. Records published are for main channel only. Records good for low and medium stages; fair for high stages.

Discharge measurements of Little River at Cameron, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 8	McCashin and Congdon	1.18	35.4	1920.			
Dec. 10	Ellsworth and McCashin	2.31	238	Apr. 2	T. Twichell	7.37	2,010
1919.				May 16	Ellsworth and McCashin	28.66	[a]13,000
Mar. 27	C. E. Ellsworth	22.8	10,300	18	do	29.55	[a]11,800
July 29	Ellsworth and Norris	8.14	2,530	19	do	21.28	8,210
Sept. 7	C. E. Ellsworth	3.51	547	June 18	T. Twichell	5.79	1,370
Dec. 27	T. Twichell	8.56	2,800				

[a] Surface velocity observed and coefficient of 1.07 used to reduce to mean velocity.

Daily discharge, in second-feet, of Little River at Cameron, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1.....	401	1,410	593	3,160	4,060	1,540	5,000	7,230	1,380	11,100	1,520	1,020
2.....	150	902	636	1,910	4,220	1,460	4,330	6,920	1,240	9,740	1,320	838
3.....	87	731	590	1,340	7,980	1,420	3,830	4,740	1,380	6,090	1,200	787
4.....	65	546	457	1,140	6,980	1,380	5,110	2,950	1,930	4,100	1,100	737
5.....	51	339	398	1,020	4,700	1,360	4,310	1,560	1,580	3,270	1,020	689
6.....	45	223	351	909	4,010	1,400	3,290	1,480	1,180	2,910	927	643
7.....	40	167	323	804	3,830	1,640	3,000	3,780	1,020	2,840	891	581
8.....	34	370	292	753	3,450	1,400	3,360	4,900	950	4,720	838	565
9.....	32	5,650	267	737	3,450	1,420	2,860	5,610	909	9,130	821	537
10.....	27	8,730	250	674	3,520	1,700	2,120	3,380	1,080	7,180	804	525
11.....	32	7,880	233	643	2,930	1,540	2,080	2,680	2,930	3,380	1,140	506
12.....	28	6,580	226	612	2,290	1,320	2,010	3,380	4,310	2,310	1,040	491
13.....	26	7,820	1,770	565	2,060	1,220	1,700	5,490	2,370	2,030	821	472
14.....	24	9,380	3,300	534	1,870	1,160	1,540	4,280	1,400	1,800	737	444
15.....	218	10,300	3,770	550	1,720	1,120	1,440	2,500	1,300	1,660	721	447
16.....	120	9,440	2,300	3,540	1,560	1,120	1,320	2,200	3,580	1,560	674	2,060
17.....	298	7,300	1,470	3,540	1,930	1,260	1,220	1,740	7,640	1,620	643	1,800
18.....	156	3,870	636	2,220	4,720	1,870	1,140	2,950	12,800	1,460	643	1,360
19.....	84	1,820	509	2,100	3,760	1,560	1,080	3,940	12,100	1,930	674	770
20.....	67	1,140	920	2,440	6,020	1,180	1,040	3,600	4,740	1,740	927	633
21.....	56	747	2,280	2,640	6,210	1,040	984	5,950	7,410	2,060	1,780	731
22.....	117	605	3,190	6,500	2,860	984	927	6,140	7,080	3,700	2,910	3,060
23.....	78	528	3,630	13,100	2,350	927	891	4,970	5,370	8,030	3,270	7,750
24.....	2,110	466	10,300	13,300	2,060	891	855	6,140	4,610	8,860	5,440	12,200
25.....	3,720	419	12,700	10,400	1,910	1,740	821	7,820	5,470	5,350	3,810	12,100
26.....	2,720	432	13,600	7,030	1,820	9,240	769	5,590	10,000	4,120	3,040	7,510
27.....	2,760	463	9,100	5,680	1,700	9,240	721	6,210	12,000	3,130	4,150	3,060
28.....	3,210	556	5,040	5,870	1,620	5,990	721	5,470	13,500	2,480	3,060	2,030
29.....	2,830	484	4,290	5,920	.....	4,470	737	2,700	13,600	2,420	2,460	2,080
30.....	1,840	534	4,220	5,090	.....	4,240	3,180	1,840	11,600	2,180	1,780	1,700
31.....	1,860	.....	3,930	4,260	.....	4,540	.....	1,560	.....	1,780	1,340	.....
1919–20.												
1.....	1,400	6,070	6,800	2,220	4,740	2,350	2,140	965	1,480	1,970	627	1,720
2.....	1,200	5,110	6,600	2,180	4,560	2,310	2,060	927	1,400	2,010	596	1,560
3.....	1,160	4,970	5,630	2,100	4,380	2,220	1,760	891	1,240	1,640	565	2,010
4.....	1,120	3,920	5,870	2,060	4,240	2,660	1,640	891	4,060	1,240	658	2,180
5.....	1,080	3,600	5,540	2,400	4,010	2,750	1,520	855	4,380	1,440	658	1,600
6.....	1,080	3,060	4,790	6,400	3,920	2,220	1,440	855	2,440	3,380	721	1,240
7.....	2,620	2,880	4,280	7,260	3,880	2,060	1,400	821	3,780	1,600	2,480	1,280
8.....	3,470	2,880	4,150	8,140	3,740	1,970	1,400	1,520	2,480	1,000	10,800	5,830
9.....	1,400	5,020	3,880	8,090	3,650	1,930	1,400	3,290	1,760	927	13,900	8,890
10.....	1,440	10,000	4,840	5,830	3,560	1,930	1,360	3,020	1,560	787	13,000	10,000
11.....	4,280	12,300	4,240	4,650	3,470	1,970	1,360	3,060	1,240	787	7,200	8,780
12.....	12,700	12,300	3,830	9,160	3,600	1,970	1,280	1,800	1,160	1,760	2,570	6,310
13.....	14,500	13,000	3,470	13,400	4,280	1,890	1,240	1,440	1,080	2,010	2,260	4,150
14.....	13,800	12,500	3,240	14,000	4,790	1,840	1,200	2,180	1,000	1,480	2,800	2,980
15.....	10,700	10,700	3,110	13,100	4,330	1,720	1,160	5,210	965	1,520	2,010	3,160
16.....	10,600	7,720	2,880	10,800	3,740	1,720	1,160	11,700	927	1,440	1,970	3,600
17.....	11,800	4,930	2,800	8,350	3,600	1,720	1,120	14,300	927	965	2,750	3,700
18.....	12,100	4,330	2,800	7,620	3,470	1,720	1,120	13,500	1,200	787	3,110	3,020
19.....	10,600	4,010	3,600	6,700	3,380	1,680	1,120	7,770	2,100	753	3,110	1,840
20.....	6,650	3,740	5,400	5,680	3,290	1,640	1,120	4,650	3,020	721	2,660	1,520
21.....	5,540	3,560	3,560	5,350	3,060	1,600	1,080	4,560	4,560	658	2,480	1,280
22.....	7,620	3,380	3,290	5,110	2,980	1,600	1,000	4,010	2,570	658	2,480	1,120
23.....	7,880	3,240	3,020	9,770	2,880	1,560	1,000	2,700	1,890	658	1,840	1,080
24.....	10,300	3,160	2,840	14,400	2,800	1,520	965	2,660	2,140	658	1,680	927
25.....	10,400	3,020	2,750	14,400	2,700	1,600	965	3,060	2,140	658	1,360	891
26.....	9,990	3,060	2,660	11,400	2,570	2,220	1,000	2,800	1,890	565	2,060	855
27.....	7,460	3,340	2,570	6,450	2,480	2,880	1,000	2,140	1,640	534	2,570	787
28.....	6,160	3,520	2,480	5,870	2,400	2,480	1,000	1,890	1,600	503	1,840	753
29.....	6,210	3,470	2,400	5,680	2,400	2,010	965	1,680	1,800	472	1,680	753
30.....	5,540	5,730	2,350	5,160	.....	1,890	965	1,560	1,760	658	1,600	787
31.....	5,780	.....	2,260	4,970	.....	2,060	.....	1,400	.....	596	1,520	.....

NOTE.—Indirect method for shifting control used Oct. 1 to Nov. 8 and Nov. 19 to Dec. 23, 1918; Feb. 1 to May 22 and Aug. 12 to Sept. 30, 1920. See "Accuracy."

Monthly discharge of Little River at Cameron, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	3,720	24	751	46,200
November	10,300	167	2,990	178,000
December	13,600	226	2,950	181,000
January	13,300	534	3,520	216,000
February	7,980	1,560	3,410	189,000
March	9,240	891	2,300	141,000
April	5,110	721	2,080	124,000
May	7,820	1,560	4,180	257,000
June	13,600	909	5,220	311,000
July	11,100	1,460	4,020	247,000
August	5,440	643	1,660	102,000
September	12,200	444	2,270	135,000
The year	13,600	24	2,940	2,130,000
1919–20.				
October	14,500	1,080	6,660	410,000
November	13,000	2,880	5,620	334,000
December	6,800	2,260	3,800	234,000
January	14,400	2,060	7,380	454,000
February	4,790	2,400	3,550	204,000
March	2,880	1,520	1,990	122,000
April	2,140	965	1,260	75,000
May	14,300	821	3,490	215,000
June	4,560	927	2,010	120,000
July	3,380	472	1,120	68,900
August	13,900	565	3,080	189,000
September	10,000	753	2,820	168,000
The year	14,500	472	3,570	2,590,000

NOTE.—The above table shows the discharge in main channel only. See "Accuracy" in station description.

COLORADO RIVER BASIN.

COLORADO RIVER NEAR BRONTE, TEX.

LOCATION.—At wagon bridge 400 feet below Kansas City, Mexico & Orient Railroad bridge, 1½ miles above mouth of Kickapoo Creek and below mouth of Live Oak Creek, and 2½ miles south of Bronte, Coke County.

DRAINAGE AREA.—5,550 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—September 19, 1915, to September 30, 1920.

GAGE.—Chain gage attached to downstream side of bridge near left bank. Read by J. E. Gay, Mrs. D. S. McAuley, Dick Walden, Mrs. W. O. Kissee, and Miss Irene Walden. Vertical staff attached to left bent of railroad bridge 400 feet above present site and referred to same datum was used from September 19 to October 29, 1915.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of a clay hardpan with gravel; shifts. Channel straight about 500 feet above and below station. Right bank wooded, sloping, and subject to overflow at extreme stages; left bank high, clean, and not likely to overflow. Control probably at shoal 300 feet below gage; shifts.

EXTREMES OF STAGE.—Maximum stage recorded during year ending September 30, 1919, 16.6 feet at 5.30 p. m. July 20; no flow during several periods in October and November.

Maximum stage recorded during year ending September 30, 1920, 17.1 feet at 8.30 a. m. October 6; minimum stage, 2.94 feet May 4 and 5.

1915–1920: Maximum stage recorded in 1920 (see above); no flow during periods throughout the record.

ICE.—No ice reported during year.

DIVERSIONS.—Some water is diverted for irrigating small areas in Coke and Mitchell counties and for municipal use by the city of Robert Lee. No large irrigation projects developed in drainage basin above station. Records of the Board of Water Engineers for the State of Texas show that about 1,700 acres have been declared irrigated above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve not developed. Gage read to hundredths twice daily prior to January 6, 1919, and once daily after that date. Discharge not determined.

Discharge measurements of Colorado River near Bronte, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Ft.*	*Sec.-ft.*	1920.		*Ft.*	*Sec.-ft.*
Oct. 8	Kinnison and Gowans..	.....	0	Jan. 15	D. A. Dudley.....	3.78	29.9
1919.				Mar. 10	.....do.....	3.42	8.0
Jan. 10	Ellsworth and Congdon.	1.52	5.7	Apr. 6	.....do.....	3.21	2.0
May 15	J. E. Powers.....	1.92	60.6	22	.....do.....	3.09	*a* .5
Aug. 5	Dudley and Twichell...	2.70	51.0	May 26	.....do.....	3.98	82.7
Nov. 14	D. A. Dudley.....	4.10	93.8	June 28	.....do.....	4.21	107
Dec. 12	.....do.....	3.72	27.4	Aug. 2	.....do.....	3.43	*a* 2.0

a Estimated.

Daily gage height, in feet, of Colorado River near Bronte, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	.....	2.55	1.40	1.27	1.52	1.23	.....	2.94	7.09	.....	2.84	3.10
2	.....	2.25	1.42	1.25	1.54	1.23	6.10	2.48	5.39	.....	2.86	3.09
3	.....	2.08	1.42	1.25	1.53	1.22	8.50	2.30	2.89	.....	.....	3.41
4	.....	1.95	1.38	1.24	1.52	1.22	.....	.....	2.79	.....	2.72	3.45
5	.....	.....	1.30	1.23	1.51	1.21	4.40	.....	2.39	.....	2.68	3.01
6	.....	.....	1.23	.....	1.52	1.21	.....	2.40	2.12	2.57	.....	2.91
7	.....	3.10	1.21	.....	1.52	1.20	2.96	2.90	3.48	2.41	2.66	.....
8	.....	3.55	1.20	.....	1.53	1.97	.....	.....	.....	2.41	2.56	3.15
9	1.80	3.15	1.00	.....	1.52	1.94	3.10	2.38	7.68	.....	2.46	.....
10	7.70	1.80	.98	1.50	1.51	2.52	8.20	2.48	11.28	5.67	2.50	2.93
11	6.10	.....	.96	1.52	1.52	2.23	5.00	.....	15.38	.....	2.50	.....
12	3.70	.....	.96	1.53	1.52	2.04	4.30	2.72	4.78	3.57	2.52	.....
13	2.90	.....	.95	1.49	1.49	1.98	.....	2.18	2.62	3.17	.....	2.83
14	2.47	3.55	.94	1.54	1.48	1.74	.....	2.00	3.30	2.77	2.50	.....
15	2.20	2.00	.94	1.57	1.47	1.72	2.38	1.96	9.98	2.65	2.48	.....
16	1.95	1.50	.93	.....	1.42	.....	.....	2.63	11.18	.....	2.34	.....
17	1.75	.....	.94	1.58	1.34	1.54	.....	2.03	7.68	.....	2.24	.....
18	.....	.....	.92	.....	1.35	1.65	.....	2.63	5.08	.....	2.38	3.35
19	.....	.....	2.75	1.55	1.34	1.64	.....	.....	6.58	.....	2.38	3.45
20	.....	.....	3.00	1.52	1.34	1.50	.....	2.01	8.18	16.06	2.28	4.75
21	7.75	.....	2.25	1.52	1.30	1.48	.....	1.73	6.18	15.98	2.38	4.55
22	12.70	.....	2.31	1.92	1.28	1.50	.....	1.71	10.08	6.66	2.38	6.45
23	8.10	.....	2.46	1.64	1.27	1.52	.....	1.73	6.78	4.56	3.56	4.15
24	6.05	.....	2.35	1.60	1.27	11.40	.....	3.49	4.18	4.16	.....	3.85
25	4.20	.....	2.00	1.58	1.28	14.14	.....	1.97	.....	3.76	12.86	3.35
26	7.30	.....	1.70	1.59	1.28	5.10	.....	1.83	3.67	3.46	13.66	3.15
27	10.55	1.80	1.64	1.70	1.26	.....	.....	1.79	.....	.....	6.26	2.97
28	10.48	1.34	1.60	1.69	1.23	3.70	.....	1.79	4.27	3.20	4.36	2.81
29	4.50	1.50	1.50	.....	.....	3.32	.....	1.73	3.27	3.14	3.76	2.67
30	3.35	1.45	1.29	.....	.....	3.60	3.50	1.71	3.09	.....	3.56	2.61
31	2.85	.....	1.28	1.52	.....	5.00	.....	.....	.....	2.94	.....	.....

Daily gage height, in feet, of Colorado River near Bronte, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	2.96	5.24	4.00	3.65	3.60	3.40	3.22	3.02	3.80	3.82	.....	.....
2	2.92	4.84	3.90	3.65	3.68	3.42	3.16	3.02	4.10	3.72	3.40	4.80
3	2.78	4.34	3.90	3.65	3.60	3.40	3.14	3.02	4.10	3.72	3.32	4.70
4	2.82	3.84	3.90	3.60	3.60	3.40	3.22	2.94	.....	3.62	3.40	4.70
5	2.96	3.54	3.80	3.85	3.55	3.40	3.18	2.94	4.70	3.62	3.80	4.90
6	17.04	3.94	3.80	3.64	.....	3.40	3.14	3.04	4.40	3.52	6.90	11.10
7	8.24	4.84	.....	3.66	3.55	3.40	3.14	3.02	4.40	3.62	4.30	11.40
8	4.84	4.14	.....	3.74	3.55	3.40	3.14	4.90	4.40	.....	3.90	.....
9	4.14	4.84	.....	3.72	3.55	3.40	3.12	4.20	4.00	3.62	3.80	5.50
10	4.74	4.54	3.70	3.68	3.60	3.40	3.16	4.90	4.00	3.62	3.80	5.20
11	4.94	4.00	.....	.....	3.60	3.40	3.14	8.20	4.00	3.62	3.80	4.90
12	4.84	.....	.....	3.82	3.60	3.40	3.14	6.20	3.90	3.42	4.30	4.90
13	4.54	.....	3.70	3.84	3.60	3.20	3.14	5.20	3.91	3.42	5.60	4.80
14	4.24	4.10	3.70	3.82	.....	3.24	3.12	4.20	3.91	3.34	4.60	4.70
15	4.24	4.10	3.75	3.82	3.55	3.32	3.06	3.70	3.91	.....	5.00	5.00
16	3.74	4.00	3.70	3.95	3.55	3.32	3.06	13.40	4.51	3.34	.....	4.90
17	3.44	3.90	3.70	3.80	3.55	3.32	3.06	11.90	4.61	3.34	10.40	4.70
18	4.54	3.90	.....	3.80	.....	3.32	3.06	5.10	4.61	3.35	13.30	4.60
19	4.34	3.80	3.70	3.80	.....	3.30	3.06	4.40	3.91	3.35	13.40	4.50
20	4.14	.....	3.60	.....	3.50	3.32	3.04	4.10	5.41	3.35	16.35	4.50
21	4.14	3.90	3.70	3.90	.....	3.30	3.04	4.00	5.21	3.93	5.90	4.40
22	4.74	3.90	.....	3.84	3.45	3.28	3.02	3.90	4.91	3.73	5.50	4.40
23	3.14	3.90	3.75	3.82	3.45	3.28	3.06	4.10	.....	3.53	14.50	4.40
24	.....	3.90	3.60	3.80	3.45	3.26	3.08	4.00	4.81	3.43	13.70	4.40
25	2.94	3.80	3.60	3.75	3.48	3.18	3.08	4.00	4.91	.....	.....	4.30
26	2.94	4.00	3.60	3.70	3.48	3.18	3.06	4.00	4.71	3.33	5.50	4.30
27	2.94	4.10	3.60	3.70	3.48	3.18	3.06	4.00	4.41	3.43	5.30	4.30
28	2.24	.....	3.65	3.70	3.48	3.16	3.08	3.90	4.16	3.33	9.30	4.30
29	12.54	4.10	3.65	3.65	3.40	3.16	3.08	3.90	4.11	3.33	7.20	4.30
30	14.74	4.10	3.60	3.68	.....	3.14	3.02	3.90	3.81	3.63	5.60	4.30
31	5.54	.....	3.62	3.60	.....	3.16	.....	3.90	.....	3.53	5.30	.....

NOTE.—Oct. 1 to Nov. 16, 1918, point of zero flow was at gage height 1.7 feet; after Nov. 16, point of zero flow not known except that it was below 0.92 foot. Change probably occurred during period, Nov. 17–26, 1918. No flow, Oct. 1–6, 18–20, Nov. 5–6, 11–13, and 17–26, 1918. No record for days of missing gage heights except for days of no flow during year ending September 30, 1919.

COLORADO RIVER AT BALLINGER, TEX.

LOCATION.—At Hutchins Avenue highway bridge, 800 feet below Gulf, Colorado & Santa Fe Railway bridge in Ballinger, Runnels County, 1 mile above mouth of Elm Creek.

DRAINAGE AREA.—6,460 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—December 11, 1915, to September 30, 1920. Records of stage have been obtained by the United States Weather Bureau since July 1, 1903; current-meter measurements were begun May 29, 1915.

GAGE.—Chain gage attached to downstream handrail of bridge; read by A. J. Voelkel.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Banks consist of clay and gravel; medium height and wooded; subject to overflow at extremely high stages. Bed composed of hard clay, sand, and gravel; shifting. Control is shoal 1,000 feet below gage; shifts.

ICE.—None reported during year.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 18.50 feet, at 7.30 a. m., July 21 (discharge not determined); no flow October 2–8.

Maximum stage recorded during year ending September 30, 1920, 16.50 feet at 7.30 a. m. October 7 (discharge, 20,700 second-feet, determined from extension of rating curve); no flow April 29 to May 6; July 16–22 and 28–29.

1916–1920: Maximum stage recorded, 18.50 feet at 7.30 a. m. July 21, 1919 (discharge not determined); no flow during several periods.

DIVERSIONS.—During low stages a large part of the flow is diverted a few miles above the station for irrigation. Records of the Board of Water Engineers for State of Texas show that about 6,900 acres have been declared irrigated above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve fairly well defined below 12,000 second-feet. Gage read to hundredths twice daily. Daily discharge determined by applying mean daily gage height to rating table or by indirect method for shifting control as noted in footnote to daily-discharge table. Records above 12,000 second-feet determined from extension of rating curve and subject to error. Records below 12,000 second-feet good.

Discharge measurements of Colorado River at Ballinger, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 5	Kinnison and Gowans..	0.31	0	Dec. 15	D. A. Dudley.....	0.68	44.6
1919.				1920.			
Jan. 10	Ellsworth and Congdon	.70	9.0	Jan. 17	.....do.....	.76	57.1
May 14	J. E. Powers.....	1.15	136	Mar. 11	.....do.....	.54	23.8
June 17	C. E. Ellsworth.....	7.96	6,940	Apr. 6	.....do.....	.42	6.94
17	.....do.....	7.10	6,060	May 26	.....do.....	.90	118
18	.....do.....	4.67	2,740	June 30	.....do.....	.78	77.1
18	.....do.....	3.89	1,910	Aug. 24	.....do.....	14.78	[a] 16,000
19	.....do.....	3.09	1,300	Sept. 7	.....do.....	10.76	[b] 11,500
Aug. 6	Dudley and Twichell...	.84	83.0	7	.....do.....	9.72	[b] 10,400
Nov. 13	D. A. Dudley.....	.93	105				

[a] Probably in error. Not used to define rating curve.
[b] Surface velocities observed and coefficient of 1.05 used to reduce to mean velocity.

Daily discharge, in second-feet, of Colorado River at Ballinger, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1...	0.5	225	13	12	13	2.3	1,680	367	1,160	518	131	250
2...	0	176	10	12	12	2.3	925	257	2,030	197	123	206
3...	0	130	9.2	15	10	2.3	3,700	163	903	133	114	160
4...	0	104	10	15	9.8	2.3	1,930	141	410	136	100	138
5...	0	86	9.2	15	8.0	2.3	985	10,600	215	143	89	125
6...	0	68	9.2	11	7.4	1.9	544	339	136	102	78	116
7...	0	4,980	8.6	10	6.2	1.9	410	479	219	102	71	106
8...	0	1,660	9.2	10	5.6	1.9	239	432	212	84	69	97
9...	15	713	8.6	10	5.6	10	188	296	5,760	75	66	89
10...	5,910	168	8.0	9.2	5.6	53	2,100	200	15,200	1,070	64	89
11...	4,600	92	8.0	9.2	5.6	114	2,780	473	14,900	1,080	63	76
12...	888	61	8.0	9.2	5.6	71	1,060	537	6,540	531	59	71
13...	212	46	10	9.2	4.4	46	648	229	1,180	300	53	68
14...	164	37	9.8	9.2	4.1	26	344	131	544	182	47	63
15...	117	39	8.6	10	4.1	18	209	194	280	112	40	93
16...	68	37	8.0	12	4.1	13	166	399	11,400	87	40	4,420
17...	33	27	8.0	15	4.1	12	129	160	9,070	76	46	1,770
18...	19	21	8.0	15	4.1	9.8	123	125	2,550	66	43	3,250
19...	17	16	9.8	16	4.4	8.0	112	200	2,070	197	41	746
20...	12	13	98	11	4.7	8.0	104	143	2,950	13,400	41	697
21...	1,830	12	101	10	4.7	6.8	91	106	2,980	23,400	41	5,770
22...	12,700	13	41	17	4.7	7.4	87	82	4,550	20,000	54	7,380
23...	8,170	10	1,130	71	4.7	8.6	82	70	6,080	2,110	798	2,540
24...	3,150	10	229	31	4.7	9,680	80	5,530	1,540	1,120	305	843
25...	1,620	11	63	17	4.1	12,100	75	456	1,020	683	158	410
26...	2,400	18	31	11	3.5	8,700	76	148	479	432	13,900	273
27...	14,100	22	19	10	2.9	1,640	131	106	1,160	296	9,580	219
28...	14,900	22	18	10	2.3	662	138	80	1,140	229	2,470	158
29...	1,750	19	12	12	.....	399	108	63	620	206	970	136
30...	734	17	11	12	.....	334	100	57	1,040	177	505	121
31...	430	.....	12	12	.....	265	.....	53	.....	150	313	.....

Daily discharge, in second-feet, of Colorado River at Ballinger, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1...	107	1,260	85	33	44	24	12	0	63	49	1.9	1,060
2...	243	910	77	32	47	24	12	0	85	42	3.2	550
3...	158	518	71	30	45	24	13	0	107	30	79	394
4...	132	321	69	33	42	24	11	0	98	29	45	261
5...	100	236	67	42	40	24	7.6	0	177	26	19	473
6...	5,840	197	67	47	40	24	7.6	0	348	26	49	5,280
7...	18,300	179	61	47	42	24	9.7	1,720	226	13	254	12,200
8...	4,200	197	54	47	44	24	12	485	152	9.7	51	3,580
9...	1,560	148	54	44	42	24	14	334	121	7.6	20	2,000
10...	1,220	142	51	44	54	22	13	3,460	85	11	9.7	872
11...	985	140	47	63	51	22	14	3,460	73	11	4.2	518
12...	1,100	138	45	67	49	22	9.7	4,200	60	7.6	948	321
13...	1,100	107	49	65	47	20	7.6	2,090	58	5.0	948	239
14...	910	103	49	54	44	19	5.5	725	52	6.6	426	177
15...	518	98	45	54	40	19	6.6	426	47	3.2	485	185
16...	300	98	45	52	40	19	8.6	6,260	52	0	456	250
17...	276	98	47	51	40	19	6.6	13,200	317	0	7,770	182
18...	485	92	49	51	40	19	5.5	2,090	166	0	12,100	130
19...	1,140	92	49	52	37	17	5.0	910	125	0	12,500	135
20...	485	87	49	49	35	19	4.5	485	138	0	14,500	121
21...	321	83	45	52	33	16	4.1	292	985	0	9,180	112
22...	2,590	79	49	58	33	16	3.7	212	485	0	1,640	103
23...	377	79	47	61	33	16	3.2	168	236	37	8,860	94
24...	209	75	45	61	33	16	1.0	160	301	7.6	16,900	87
25...	152	75	49	60	32	16	.4	140	226	5.5	5,140	77
26...	125	75	45	56	30	16	.9	114	239	3.7	1,820	73
27...	116	75	42	52	27	16	.3	100	194	.6	1,560	71
28...	109	78	38	51	27	15	.2	89	135	0	2,390	71
29...	112	82	38	49	27	12	0	85	94	0	3,460	69
30...	12,200	85	37	47	.....	12	0	77	71	1.9	2,000	61
31...	5,420	.....	35	47	.....	13	.....	71	.....	11	1,100	.....

NOTE.—Indirect method for shifting control used Oct. 1, 1918, to Mar. 24, 1919, May 6–23, July 23 to Aug. 25, Aug. 28 to Dec. 31, 1919; May 17 to July 14 and Aug. 18 to Sept. 30, 1920. Discharge on following days determined from extension of rating curve and subject to considerable error: Oct. 22, 23, 27, 28, 1918; Mar. 24–26, May 5, June 10, 11, 16, 17, July 20–22, Aug. 25 and 26, 1919.

Monthly discharge of Colorado River at Ballinger, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	14,900	0	2,380	146,000
November	4,980	10	295	17,600
December	1,130	8.0	62.5	3,840
January	71	9.2	14.5	892
February	13	2.3	5.71	317
March	12,100	1.9	1,100	67,600
April	3,700	75	645	38,400
May	10,600	53	730	44,900
June	15,200	136	3,280	195,000
July	23,400	66	2,170	133,000
August	13,900	40	983	60,400
September	7,380	63	1,020	60,700
The year	23,400	0	1,060	769,000
1919–20.				
October	18,300	100	1,970	121,000
November	1,260	75	198	11,800
December	85	35	51.6	3,170
January	67	30	50.1	3,080
February	54	27	39.2	2,250
March	24	12	19.3	1,190
April	14	0	6.64	395
May	13,200	0	1,330	81,800
June	985	47	184	10,900
July	49	0	11.1	682
August	16,900	1.9	3,380	208,000
September	12,200	61	992	59,000
The year	18,300	0	693	503,000

COLORADO RIVER NEAR CHADWICK, TEX.

LOCATION.—At Gulf, Colorado & Santa Fe Railway bridge half a mile below Chadwick dam, 1 mile above mouth of Elliott Creek, 2 miles west of Chadwick, on line between San Saba and Lampasas counties, 2½ miles below mouth of San Saba River.

DRAINAGE AREA.—26,400 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch =25 miles).

RECORDS AVAILABLE.—October 21, 1915, to September 30, 1920.

GAGE.—Vertical and inclined staff, in 4 sections, on right bank 75 feet upstream from railway bridge. A high-water section is painted on second concrete pier from left abutment of railway bridge; read by A. G. Walker. Prior to April 1, 1920, inclined staff in 3 sections, attached to rock ledge on left bank 75 feet upstream from railway bridge; a high-water section painted on left face of left bridge pier; a vertical staff on right bank directly opposite inclined gage used during low water. From April 1 to June 4, 1920, gage was temporarily located 50 feet below the bridge. All gages referred to same datum.

DISCHARGE MEASUREMENTS.—Made either by wading or from railroad bridge at gage, or from Red Bluff highway bridge, 2½ miles below gage.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; shifts slightly, owing to movement of gravel. Channel straight above and below station for 1,000 feet. Left bank high, rocky, wooded, and not subject to overflow; right bank medium in height, wooded, composed of clay and gravel, and subject to overflow during extreme stages. Position of control not known, but current-meter measurements indicate that it shifts, affecting stage-discharge relation at low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 41.35 feet at 9.20 a. m. November 10 (discharge, 77,100 second-feet); minimum stage, 0.56 foot on October 4, 8, and 9 (discharge, 29 second-feet).

Maximum stage recorded during year ending September 30, 1920, 21.4 feet at 9.45 a. m. September 8 (discharge, 25,000 second-feet); minimum stage 1.38 feet at 5.10 p. m. August 3, and 6.15 p. m. August 5 (discharge, 258 second-feet).

1916–1920: Maximum stage recorded, 41.35 feet at 9.20 a. m. November 10, 1919 (discharge, 77,100 second-feet); minimum stage, 0.16 foot August 22 and 23, 1918 (discharge, 1.5 second-feet).

ICE.—None reported during year.

DIVERSIONS.—No large irrigation works have been completed in the drainage basin above station, but tracts ranging in size from 5 to 1,500 acres adjacent to the main river and tributaries are irrigated by diversion. A large part of the irrigated area is in Runnels, Brown, and Mills counties and along Concho and San Saba rivers. Several small dams have been constructed in the drainage basin above station. Chadwick dam, half a mile above, creates a small pond and serves only to divert to a water wheel that has not been operated for some time. Records of the Board of Water Engineers for the State of Texas show that about 30,000 acres have been declared irrigated above the station.

REGULATION.—None of consequence except possibly during extremely low stages.

ACCURACY.—Stage-discharge relation not permanent for low stages, owing to deposit of sand and gravel on control, but not seriously affected during medium and high stages. Rating curve well defined below 80,000 second-feet. Gage ordinarily read daily to hundredths during low and medium stages and to tenths during high stages. One reading a day may not be true index to discharge, owing to rapid fluctuations. Daily discharge determined by applying mean daily gage height to rating table, by indirect method for shifting control, or on days of no record, by interpolation or estimation, as noted in footnote to daily-discharge table. Records fair.

Discharge measurements of Colorado River near Chadwixk, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Dis. charge.	Date.	Made by—	Gage height.	Dis-charge.
1918.		*Ft.*	*Sec.-ft.*	1919.		*Ft.*	*Sec.-ft.*
Oct. 13	Kinnison and Gowans	17.20	[a] 17,900	May 22	J. E. Powers	4.00	1,320
Nov. 9	E. P. Congdon	35.6	[b] 58,000	Aug. 9	Dudley and Twichell	2.40	375
10	do	41.3	[b] 76,900	Nov. 3	D. A. Dudley	6.00	2,880
11	do	31.5	[b] 45,200				
11	do	27.1	[b] 34,400	1920.			
				Mar. 3	do	2.82	615
1919.				Apr. 26	do	1.78	296
Jan. 13	Ellsworth and Congdon	1.58	219	June 3	do	2.82	708
22	E. P. Congdon	12.20	[a] 10,600	July 13	do	1.66	351
23	do	17.79	[a] 19,600				

[a] Surface velocity observed and coefficient of 0.90 used to reduce to mean velocity.
[b] Surface velocity observed and coefficient of 1.00 used to reduce to mean velocity.

Daily discharge, in second-feet, of Colorado River near Chadwick, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	45	1,250	277	225	633	123	3,230	1,660	500	4,650	633	1,000
2	45	900	277	175	705	123	2,000	900	395	3,810	395	615
3	31	615	225	155	9,570	123	1,680	615	2,440	2,330	.....	465
4	29	458	225	135	2,000	121	1,250	430	1,460	1,530	.....	335
5	33	395	200	135	1,150	121	7,220	1,120	1,000	1,250	.....	615
6	31	335	175	95	928	123	3,610	3,140	800	820	.....	705
7	31	1,740	175	79	705	125	2,330	8,260	705	870	.....	535
8	29	23,000	175	75	615	125	1,840	3,230	551	615	.....	335
9	29	56,100	175	75	543	200	950	1,620	1,840	500	430	311
10	335	74,100	175	66	465	200	1,000	1,000	10,100	6,580	335	277
11	14,200	37,500	155	60	423	195	4,650	1,120	20,500	3,250	320	230
12	18,900	2,440	155	95	305	190	4,010	3,610	27,900	1,840	283	188
13	17,300	1,250	200	95	288	190	2,960	2,580	29,300	820	225	175
14	9,690	900	200	175	129	185	2,690	1,540	5,090	705	200	175
15	2,080	1,840	155	155	127	185	2,000	1,460	2,160	660	200	705
16	900	1,250	115	250	127	225	705	1,390	1,620	615	200	950
17	669	335	75	395	131	230	615	9,850	2,000	705	200	8,000
18	430	277	75	750	133	225	465	2,240	13,200	615	195	3,320
19	283	277	1,000	705	133	220	395	5,450	12,700	535	335	3,810
20	185	225	3,230	638	129	225	365	3,160	4,650	4,870	395	4,210
21	220	225	1,180	750	127	220	335	2,460	12,600	36,600	9,170	10,300
22	2,760	200	900	9,850	127	220	311	1,250	7,480	27,800	12,700	16,400
23	15,700	200	18,000	19,100	131	220	291	1,120	10,600	22,100	8,460	33,200
24	23,000	225	9,990	16,100	131	4,320	277	900	13,400	20,900	4,210	20,200
25	15,700	200	1,840	3,050	129	12,000	277	.....	10,100	9,170	3,810	15,700
26	3,810	305	1,250	1,530	127	19,900	230	.....	16,100	6,960	6,530	13,500
27	2,330	705	1,120	2,580	127	22,800	205	.....	13,500	4,210	9,850	9,170
28	2,000	615	850	6,340	125	12,400	175	5,540	10,400	3,250	13,300	7,350
29	14,200	365	705	2,000	.....	2,870	500	1,700	9,170	1,870	9,300	6,000
30	9,850	335	585	1,120	.....	3,050	2,420	840	8,260	810	3,050	5,310
31	3,050	.....	465	705	.....	3,140	.....	633	.....	705	2,190	.....

Daily discharge, in second-feet, of Colorado River near Chadwick, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919-20.												
1	.....	.....	.....	482	800	522	430	291	412	396	274	2,960
2	.....	.....	.....	448	1,180	568	412	277	412	291	264	2,870
3	.....	2,870	.....	448	1,680	615	412	277	638	285	258	2,780
4	.....	.....	.....	380	1,250	.....	365	274	535	285	258	2,420
5	.....	.....	.....	412	800	.....	365	272	575	283	258	
6	.....	.....	.....	350	800	.....	350	277	465	285	261	3,000
7	.....	.....	900	518	705	.....	350	2,960	335	285	728	
8	.....	.....	705	589	682	.....	350	14,200	335	283	728	24,700
9	.....	.....	705	660	660	.....	335	6,000	320	280	682	23,600
10	.....	.....	2,510	950	660	.....	320	12,700	305	448	595	8,520
11	.....	.....	2,000	4,650	638	.....	320	12,100	311	392	448	7,610
12	.....	.....	1,180	7,220	638	.....	320	14,400	305	365	359	3,710
13	.....	.....	705	3,710	638	.....	320	16,700	305	332	326	2,160
14	.....	.....	705	2,510	615	.....	320	6,700	299	326	470	1,680
15	.....	.....	682	1,390	412	.....	320	7,740	294	314	615	1,320
16	.....	.....	682	1,250	350	.....	320	8,780	294	299	1,390	1,060
17	.....	.....	682	1,120	350	.....	305	6,340	294	272	4,010	800
18	.....	.....	901	705	350	.....	305	5,660	294	273	8,130	775
19	.....	.....	1,120	800	335	.....	305	4,870	412	274	9,370	638
20	.....	.....	800	850	350	.....	305	3,050	606	272	10,600	615
21	.....	.....	705	1,000	335	.....	305	1,460	800	269	8,520	595
22	.....	.....	705	1,000	520	.....	305	1,360	500	269	8,390	595
23	.....	.....	638	900	705	.....	305	1,250	775	266	6,120	555
24	.....	.....	638	900	682	.....	305	1,120	2,960	266	5,660	445
25	.....	.....	638	850	682	.....	291	1,120	2,280	274	5,200	335
26	.....	.....	638	800	575	.....	291	1,000	1,600	272	4,870	335
27	.....	.....	638	705	482	800	291	1,000	1,460	266	4,210	335
28	.....	.....	595	705	430	638	291	900	1,180	266	4,110	320
29	.....	.....	595	682	476	575	291	535	850	264	3,910	320
30	.....	.....	595	682	.....	395	291	500	500	311	3,140	302
31	.....	.....	595	660	.....	335	.....	465	.....	283	3,140	.....

NOTE.—Discharge interpolated Oct. 14, Dec. 30, 1918, Feb. 6, Mar. 31, May 1, 13, 15, July 15, Aug. 23, Sept. 21, Dec. 18, and 26, 1919; Jan. 8, Feb. 22, 29, Mar. 1, 2, Apr. 11, 23, May 15, 22, 30, June 20, 25, July 1, 18, Aug. 4, 14, 19, 24, Sept. 2, 16, and 24, 1920.

Discharge estimated: Dec. 18, 1918; Mar. 23, Apr. 10, May 25–27 (10,000 second-feet), Aug. 3–8 (350 second-feet), Sept. 17, 1919; and Sept. 5–7, 1920. No record for periods not recorded. Discharge Apr. 1 to June 3, 1920, possibly slightly in error, owing to change in location of gage. See "Accuracy" in station description.

Monthly discharge of Colorado River near Chadwick, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	23,000	29	5,090	313,000
November	74,100	200	6,960	414,000
December	18,000	75	1,430	87,900
January	19,100	60	2,180	134,000
February	9,570	125	724	40,200
March	22,800	121	2,730	168,000
April	7,220	175	1,630	97,000
May	.....	430	3,190	196,000
June	29,300	395	8,350	497,000
July	36,600	500	5,5 0	341,000
August	13,300	195	2,870	176,000
September	33,200	175	5,4 0	325,000
The year	74,100	29	3,850	2,790,000
1919–20.				
December 7–31	2,510	595	850	42,100
January	7,220	350	1,240	76,200
February	1,680	335	648	37,300
April	430	291	326	19,400
May	16,700	272	4,340	267,000
June	2,960	294	685	40,800
July	448	264	298	18,300
August	10,600	258	3,140	193,000
September	24,700	302	3,380	201,000

NOTE.—See footnote to table of daily discharge.

COLORADO RIVER AT MARBLE FALLS, TEX.

LOCATION.—At steel highway bridge one-fourth mile south of Marble Falls, Burnet County, 10 miles below mouth of Sandy Creek, 16 miles below mouth of Llano River, and 23 miles above mouth of Pedernales River.

DRAINAGE AREA.—32,200 square miles (measured on topographic and post-route maps).

RECORDS AVAILABLE.—October 1, 1916, to September 30, 1920. Miscellaneous discharge measurements were made in 1902. Records of stage have been obtained by the United States Weather Bureau since January 1, 1908.

GAGE.—United States Weather Bureau weight and tape gage on upstream side of bridge; read by M. M. Berry and M. M. Galloway.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of solid rock. Banks composed of rock, gravel, and clay; high, wooded, and not subject to overflow. Rapids just below gage serve as permanent control for low and medium stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 18.7 feet at 7.30 a. m. September 24 (discharge, 85,000 second-feet, determined from extension of rating curve); minimum stage, 0.70 foot, October 9 and 10 (discharge, 68 second-feet).

Maximum stage recorded during year ending September 30, 1920, 14.2 feet at 7.30 a. m., October 11 (discharge, 52,400 second-feet); minimum stage, 1.50 feet at 7.30 a. m., July 21 (discharge, 236 second-feet).

1900–1920: Maximum stage recorded, 23.9 feet, April 7, 1900 (discharge, not determined); no flow August 7, 8, 11–25, 1918, caused by storing water above gage.

ICE.—None reported during year.

DIVERSIONS.—Several large projects have been proposed in the drainage basin above station, but none have been developed. Numerous small diversions for irrigation and municipal uses are made above the station. Total amount diverted not known. Records of the Board of Water Engineers for the State of Texas show that approximately 36,000 acres have been declared irrigated by diversions above station. Little water is diverted between Marble Falls and Austin.

REGULATION.—None except possibly during extremely low stages.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Gage read to half-tenths twice daily. Mean of two readings daily during low stages may not be true mean owing to operation of water-power plant just above. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Colorado River at Marble Falls, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Ft.*	*Sec.-ft.*	1920.		*Ft.*	*Sec.-ft.*
Oct. 2	Kinnison and Gowans..	1.10	141	Feb. 14	T. Twichell.....	3.82	2,780
				Apr. 28	D. A. Dudley.....	2.28	580
1919.				28	.....do.....	2.28	589
Jan. 6	Ellsworth and Congdon	2.74	949	28	.....do.....	2.28	591
May 23	J. E. Powers.....	3.91	2,790				
Nov. 1	D. A. Dudley.....	4.29	[a]3,610				

[a] Surface velocities observed and coefficient of 0.85 used to reduce to mean velocity.

Daily discharge, in second-feet, of Colorado River at Marble Falls, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19												
1.....	187	3,450	1,080	1,750	2,600	1,020	7,230	2,600	1,530	12,200	1,500	3,160
2.....	137	2,640	805	2,140	2,410	779	7,750	2,640	1,600	10,700	1,260	2,410
3.....	114	2,190	688	2,000	2,740	779	3,050	1,880	1,390	6,400	1,140	1,880
4.....	100	1,300	632	1,460	7,920	868	2,640	1,460	1,080	4,240	1,000	1,570
5.....	97	1,000	618	1,140	5,020	1,080	3,450	1,120	3,010	3,450	946	1,390
6.....	83	1,000	618	1,000	3,570	868	9,700	1,910	2,360	2,700	917	1,260
7.....	83	3,640	618	917	2,500	779	5,020	4,460	1,800	15,600	822	1,140
8.....	80	40,200	618	848	1,910	917	2,900	15,600	1,360	5,620	822	1,000
9.....	68	46,700	618	822	1,530	1,260	2,320	6,080	1,830	3,010	762	968
10.....	68	48,500	565	762	1,300	1,200	2,090	3,570	7,060	2,360	1,680	917
11.....	14,900	71,500	481	740	1,360	897	1,880	6,400	21,400	10,800	897	848
12.....	21,900	24,500	438	688	1,360	822	1,680	26,100	29,800	4,600	848	779
13.....	22,400	5,080	3,330	688	1,300	762	1,200	11,400	31,000	2,700	725	725
14.....	18,600	3,220	3,810	703	1,300	1,260	3,680	9,340	31,000	3,120	688	779
15.....	7,920	2,840	1,030	917	1,260	703	2,600	9,880	10,800	2,410	618	3,730
16.....	4,240	4,680	688	1,460	1,200	848	1,800	15,600	4,320	2,090	565	6,140
17.....	3,120	2,640	688	1,750	1,800	822	1,430	11,600	3,930	1,910	504	8,630
18.....	2,020	2,140	805	3,810	3,450	725	1,180	9,060	9,880	1,910	449	6,460
19.....	1,300	1,690	1,400	2,950	2,450	667	1,060	6,240	16,700	1,500	1,360	7,580
20.....	1,120	1,300	1,910	2,600	2,000	618	822	6,560	18,700	1,240	1,570	5,170
21.....	868	1,180	2,270	6,960	1,830	667	740	10,200	8,520	14,100	10,900	20,700
22.....	1,570	1,280	7,640	17,800	1,680	632	703	5,470	16,000	41,800	16,000	26,600
23.....	7,750	926	34,800	22,100	1,530	598	667	1,260	14,900	29,100	11,800	42,600
24.....	20,400	747	22,900	22,000	1,300	1,140	618	1,910	18,400	27,400	10,100	84,200
25.....	23,400	725	14,400	17,100	1,260	26,400	565	1,830	18,300	22,500	6,460	51,400
26.....	15,400	946	8,200	12,000	762	18,600	585	18,000	29,800	8,450	9,230	17,400
27.....	8,000	1,240	5,470	7,400	1,020	26,200	476	14,700	26,200	3,930	5,170	13,100
28.....	5,620	2,190	3,330	5,620	848	24,800	438	6,620	22,600	2,800	8,000	6,720
29.....	11,600	2,500	2,640	10,700	.....	16,000	1,960	6,240	19,400	2,360	16,100	5,020
30.....	12,800	2,270	2,270	4,460	.....	4,880	3,610	3,500	14,500	1,910	10,100	4,190
31.....	9,880	.....	2,140	3,220	.....	5,380	.....	2,050	.....	1,750	5,780	.....
1919–20												
1.....	3,450	3,450	5,930	1,570	2,600	1,500	1,060	585	946	848	413	5,020
2.....	3,120	10,400	5,620	1,500	2,500	1,430	1,060	552	946	848	413	3,930
3.....	2,800	7,920	3,930	1,430	2,410	1,430	1,000	552	1,880	762	492	3,220
4.....	2,600	5,020	3,450	1,570	2,410	1,360	946	1,240	2,050	848	618	2,600
5.....	2,600	3,930	3,220	1,880	2,410	1,300	946	1,300	1,800	848	438	3,120
6.....	2,800	3,330	3,010	2,800	2,410	1,300	848	848	1,360	688	618	2,800
7.....	3,450	3,010	3,010	5,020	2,230	1,180	762	618	1,240	552	9,700	2,800
8.....	21,400	4,470	2,900	4,190	2,230	1,300	762	6,890	1,060	492	1,570	22,900
9.....	27,200	24,000	2,800	3,450	2,230	1,300	762	20,900	762	465	1,430	27,700
10.....	35,100	19,000	2,500	2,800	2,230	1,430	688	17,100	725	492	1,000	27,700
11.....	46,000	8,630	2,410	3,450	2,230	1,430	762	5,930	688	762	762	16,700
12.....	13,600	6,890	2,230	18,000	2,410	1,300	725	19,000	1,060	762	688	15,300
13.....	7,920	5,620	2,050	16,200	2,600	1,300	762	26,100	897	618	946	6,240
14.....	5,620	3,930	2,050	9,700	2,500	1,180	688	14,900	762	492	1,570	2,800
15.....	6,240	3,450	1,960	7,580	2,600	1,180	688	15,800	688	465	2,410	2,050
16.....	12,800	3,220	1,880	5,620	2,600	1,180	688	18,000	688	492	2,230	1,720
17.....	19,000	3,220	1,880	4,740	2,230	1,180	688	13,200	653	438	2,410	1,570
18.....	20,900	3,010	1,880	4,190	2,230	1,180	653	7,580	585	388	4,190	1,430
19.....	11,200	2,800	2,230	3,680	2,320	1,180	688	12,800	762	344	4,460	1,060
20.....	6,890	2,600	2,230	3,450	2,140	1,180	618	11,600	1,360	304	10,800	946
21.....	4,460	2,600	2,140	3,450	2,050	1,060	618	4,460	848	268	20,900	946
22.....	6,560	2,320	2,230	3,220	1,960	1,060	618	3,450	946	304	13,600	946
23.....	16,200	2,410	2,050	3,930	1,880	1,180	618	2,230	1,060	344	11,200	848
24.....	20,900	2,410	2,050	7,920	1,880	1,180	618	1,880	848	388	8,280	848
25.....	21,900	2,500	1,880	4,460	1,720	1,430	618	1,570	2,050	344	3,680	762
26.....	8,630	2,600	3,010	3,680	1,720	1,720	653	1,640	2,700	304	14,900	688
27.....	5,930	2,410	2,230	3,450	1,570	1,300	653	1,430	2,230	268	17,600	618
28.....	4,460	2,600	1,640	3,220	1,570	1,800	618	1,240	1,880	286	12,400	618
29.....	3,680	5,020	1,570	3,010	1,430	1,500	585	1,060	1,300	304	8,280	762
30.....	3,330	7,920	1,570	2,800	.....	1,300	552	1,060	946	438	3,680	653
31.....	3,220	.....	1,720	2,700	.....	1,180	.....	1,000	.....	388	4,190	.....

Monthly discharge of Colorado River at Marble Falls, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	23,400	68	6,960	428,000
November	71,500	725	9,470	564,000
December	34,800	438	4,110	253,000
January	22,100	688	5,110	314,000
February	7,920	762	2,110	117,000
March	26,400	598	4,610	283,000
April	9,700	438	2,460	146,000
May	26,100	1,120	7,270	447,000
June	31,000	1,080	13,000	774,000
July	41,800	1,240	8,210	505,000
August	16,100	449	4,150	255,000
September	84,200	725	10,900	649,000
The year	84,200	68	6,540	4,740,000
1919–20.				
October	46,000	2,600	11,400	701,000
November	24,000	2,320	5,360	319,000
December	5,930	1,570	2,560	157,000
January	18,000	1,430	4,670	287,000
February	2,600	1,430	2,180	125,000
March	1,800	1,060	1,310	80,600
April	1,060	552	732	43,600
May	26,100	552	6,980	429,000
June	2,700	585	1,190	70,800
July	848	268	501	30,800
August	20,900	413	5,350	329,000
September	27,700	618	5,310	316,000
The year	46,000	268	3,980	2,890,000

COLORADO RIVER AT AUSTIN, TEX.

LOCATION.—At Congress Avenue concrete viaduct in Austin, Travis County, half a mile below Shoal Creek and above mouth of Waller Creek, 1 mile below mouth of Barton Creek, and 3½ miles below Austin dam.

DRAINAGE AREA.—34,200[4] square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—February 15, 1898, to December 31, 1911; October 1, 1914, to September 30, 1920. September 1, 1895, to April 7, 1900, at Austin dam. Records of stage have been obtained by United States Weather Bureau since July 1, 1903.

GAGE.—Stevens water-stage recorder installed April 26, 1918, on downstream side of pier of viaduct, inspected by engineers from United States Geological Survey. Record of depth of water on crest of dam 3½ miles above Austin was kept Aug. 13, 1895, to April 7, 1900. Gage used February 15, 1898, to December 31, 1911, was a vertical staff, attached to bathhouse on left bank of river 150 feet above Congress Avenue bridge; during this period high-stage readings were made by means of a gage painted on first pier from left end of bridge, and a chain gage attached to bridge. From October 1, 1914, to June 18, 1915, the vertical gage of United States Weather Bureau was read. Record from June 18, 1915, to April 25, 1918, was obtained by means of Dexter water-stage recorder installed at end of viaduct. All gages at or near bridge have been referred to same datum.

DISCHARGE MEASUREMENTS.—Made by wading, or from upstream side of Montopolis highway bridge, 4 miles below gage.

[4] Revised since publication of Water-Supply Paper 308.

CHANNEL AND CONTROL.—Channel straight for 1,000 feet above and 500 feet below gage. Right bank of medium height, composed of clay and gravel, clean, improved by city, and subject to overflow; left bank resembles right bank except that it is high and nearly vertical in places. Bed composed of rock, gravel, and sand; clean; shifts. Control is a gravel and rock shoal, 500 feet below gage; changes during high water, and also during low water because of the removal of sand for municipal use.

EXTREMES OF DISCHARGE.—Maximum stage from water-stage recorder during year ending September 30, 1919, 19.5 feet at 9 a. m. November 9 (discharge, 74,800 second-feet); minimum stage, 0.40 foot at midnight October 11 (discharge, 95 second-feet).

Maximum stage from water-stage recorder during year ending September 30, 1920, 13.7 feet at 11 p. m. October 11 (discharge, 50,300 second-feet); minimum stage, 0.87 foot at 10 p. m. July 29 (discharge, 378 second-feet).

1898–1911; 1914–1920: Maximum stage recorded, 33.5 feet during flood of April 7, 1900, which destroyed the dam. The discharge at that time has been computed by means of the formula [5] $Q=clh^{3/2}$ to be 122,000 second-feet ($c=3.09$, $l=1,091$ feet; $h=11$ feet). Recent computations indicate that the discharge probably exceeded 122,000 second-feet, but there are insufficient data to enable a more exact determination to be made. Minimum stage, 0.18 foot at 6 p. m. August 18, 1918 (discharge, 2.2 second-feet).

ICE.—None.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that approximately 36,000 acres of land have been declared irrigated by diversions above station. Most of the area irrigated is in the upper basin of the main stream and adjacent to large tributaries. Little water is diverted between Austin and Columbus.

REGULATION.—Flow entirely regulated at times by operation at the Austin dam, about 3½ miles upstream. Neither sluice gates, crest gates, nor power plant at the dam were in operation during the years ending September 30, 1919 and 1920. Capacity of reservoir about 24,000 acre-feet.

ACCURACY.—Stage-discharge relation not permanent. Numerous measurements were made throughout the period. Standard rating curve well defined between 20,000 and 30,000 second-feet, and fairly well defined between 30,000 and 75,000 second-feet. Operation of water-stage recorder satisfactory except for breaks in record. Daily discharge ascertained by applying to rating table mean daily gage height obtained from recorder graph by inspection or by planimeter, by shifting-control method, or for days of considerable fluctuation, by applying gage heights for fractional parts of a day to rating table. See footnote to daily-discharge table. Records good.

From recent information it is believed that the discharge as published in Water-Supply Paper 408 for December 13–26, 1914, and February 9–17, 1915, is too low. Discharge on these days probably exceeded 20 second-feet.

[5] U. S. Geol. Survey Water-Supply Paper 50, p. 337.

Discharge measurements of Colorado River at Austin, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 14	McCashin and Congdon.	8.64	23,900	Oct. 9	D. A. Dudley	6.33	18,600
				11	Dudley and Snow	12.08	42,700
16	do	3.88	7,650	Nov. 15	L. D. Snow	3.04	5,830
18	Gowans and Kinnison.	2.32	3,090	Dec. 13	T. Twichell	2.39	3,270
Nov. 9	R. J. Hank	19.03	a 74,000				
12	Congdon and Kinnison.	16.85	a 61,100	1920.			
13	Congdon and Gowans.	5.64	a 13,000	Jan. 3	T. Twichell	2.02	2,190
18	E. P. Congdon	2.35	3,270	17	do	3.54	7,240
Dec. 2	H. B. Kinnison	1.74	1,710	31	Twichell and Pritchett.	2.72	4,440
14	Gowans and Kinnison.	2.26	3,750	Feb. 14	Kinnison and Dudley.	2.50	3,590
31	Congdon and Kinnison.	2.12	2,630	Mar. 2	T. Twichell	2.04	2,620
				20	do	1.76	1,730
1919.				Apr. 14	do	1.50	1,150
Jan. 23	R. J. Hank	7.31	21,500	24	do	1.34	1,040
25	Hank and Congdon	8.28	b 25,100	May 1	do	1.30	737
Feb. 11	A. K. Gowans	2.00	2,300	8	do	1.53	1,210
28	do	1.81	1,780	22	do	3.28	6,440
Mar. 14	R. J. Hank	1.56	1,320	June 9	McCashin and Twichell.	1.80	1,690
27	C. E. McCashin	6.23	c 16,600	22	T. Twichell	1.68	1,630
May 5	R. J. Hank	2.08	2,800	July 7	do	1.42	1,210
21	do	2.97	5,260	21	do	1.00	516
28	Hank and Powers	5.24	13,700	31	do	.95	447
June 14	Ellsworth and Quarles.	10.02	30,000	Aug. 24	do	4.86	12,700
Aug. 13	T. Twichell	1.74	1,760	Sept. 18	do	1.78	1,970
Sept. 10	Ellsworth and Twichell.	1.69	1,400				

a Surface velocities observed and coefficient of 0.87 used to reduce to mean velocity.
b Surface velocities observed and coefficient of 0.85 used to reduce to mean velocity.
c Surface velocities observed and coefficient of 0.90 used to reduce to mean velocity.

Daily discharge, in second-feet, of Colorado River at Austin, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19												
1	472	11,000	1,970	2,220	4,230	1,610	5,870	2,970	3,530	13,300	3,060	6,300
2	288	5,160	1,720	2,000	3,480	1,520	6,830	3,980	2,970	9,820	2,720	4,570
3	312	2,860	1,440	1,900	3,200	1,440	7,580	3,140	3,340	8,640	2,470	3,310
4	247	2,020	1,240	1,760	4,260	1,460	5,060	3,340	2,660	6,610	2,220	2,660
5	205	1,580	1,100	1,630	9,250	1,440	3,890	3,310	2,150	4,940	2,070	2,200
6	140	1,320	988	1,460	6,060	1,400	4,010	5,720	2,380	4,010	1,920	1,900
7	140	1,260	922	1,400	4,100	1,540	6,240	3,480	3,110	5,370	1,780	1,720
8	130	17,100	890	1,300	3,310	1,500	6,210	4,820	2,690	23,400	1,700	1,610
9	127	62,300	840	1,240	2,780	1,380	4,480	10,800	2,500	8,010	1,560	1,500
10	123	50,200	810	1,170	2,500	1,340	3,590	7,260	3,000	4,570	1,630	1,420
11	123	64,700	750	1,110	2,280	1,610	3,220	6,090	5,810	3,360	1,760	1,320
12	1,380	56,700	750	1,060	2,150	1,560	2,890	8,990	18,400	7,950	2,200	1,170
13	10,000	17,100	1,030	1,020	1,970	1,420	2,610	12,700	27,600	5,810	1,720	1,130
14	23,000	5,900	3,640	1,110	1,880	1,280	2,250	10,800	29,500	3,340	1,480	990
15	19,000	3,820	6,210	1,670	1,740	1,220	3,450	10,400	23,400	3,080	1,320	1,180
16	8,380	4,380	3,700	1,560	1,650	1,240	3,480	9,250	10,500	2,800	1,170	3,080
17	4,970	4,820	2,550	2,410	1,850	1,150	2,970	11,200	11,500	2,330	1,060	7,080
18	4,350	3,080	2,040	4,070	2,360	1,130	2,520	11,600	7,300	2,410	1,000	6,710
19	3,730	2,100	1,880	4,380	3,590	1,130	2,150	10,600	9,440	2,150	1,020	8,100
20	3,030	1,720	2,520	4,070	3,640	1,080	1,830	7,330	19,300	1,970	1,220	5,870
21	2,470	1,400	6,060	4,040	3,110	988	1,650	6,340	16,000	4,010	2,890	6,490
22	2,200	1,320	8,010	11,400	2,860	939	1,500	10,100	12,900	24,200	7,390	6,370
23	1,720	1,200	12,500	20,700	2,470	956	1,380	7,200	19,500	39,200	24,100	19,500
24	7,950	1,110	41,500	20,800	2,300	1,020	1,280	4,480	16,000	32,100	16,800	46,100
25	22,800	1,060	23,000	23,800	2,020	16,000	1,180	3,280	18,300	28,600	9,440	64,200
26	26,900	1,040	12,100	14,300	1,850	24,800	1,110	3,060	21,500	20,800	7,200	34,100
27	15,600	1,020	6,830	7,610	1,760	18,100	1,060	11,800	31,000	9,570	8,260	15,800
28	7,450	1,120	4,880	6,240	1,650	24,500	1,000	13,600	27,700	5,780	6,240	10,000
29	5,190	1,400	3,700	7,480	.....	21,500	1,080	7,330	22,000	4,570	7,580	8,260
30	8,990	1,780	2,970	8,350	.....	11,300	1,340	6,400	18,200	3,820	12,500	6,860
31	13,400	.....	2,800	5,620	.....	6,370	.....	5,130	.....	3,420	10,200	.....

Daily discharge, in second-feet, of Colorado River at Austin, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20												
1	6,020	6,800	6,990	2,330	4,230	2,500	1,880	720	1,480	1,700	599	4,160
2	5,400	6,960	6,060	2,200	4,100	2,580	1,650	720	1,400	1,440	651	5,440
3	4,940	13,000	5,900	2,170	4,010	2,550	1,580	720	1,380	1,280	638	5,130
4	4,600	10,600	5,130	2,120	3,920	2,220	1,460	677	1,850	1,170	638	4,350
5	4,350	8,040	4,410	2,330	3,790	2,220	1,380	664	3,060	1,540	651	3,390
6	5,720	7,260	4,100	2,410	3,640	2,220	1,380	1,020	2,720	1,380	720	3,890
7	6,490	6,640	4,010	2,970	3,590	2,220	1,320	1,340	2,250	1,180	10,400	3,590
8	6,340	6,180	3,950	4,380	3,530	2,220	1,320	1,150	1,970	1,060	28,100	5,220
9	18,200	8,140	3,820	4,350	3,480	1,970	1,320	4,830	1,650	922	9,150	20,000
10	29,100	27,400	3,700	4,010	3,450	1,970	1,280	15,900	1,400	856	4,570	24,400
11	44,600	16,800	3,560	3,730	3,360	1,970	1,300	9,990	1,200	810	3,140	23,100
12	40,000	9,790	3,390	4,230	3,390	2,300	1,280	6,800	1,100	735	2,660	14,100
13	18,100	7,730	3,220	13,400	3,420	2,040	1,150	13,100	1,040	856	2,580	10,600
14	11,600	6,640	3,310	15,100	3,560	2,040	1,150	18,500	1,110	988	4,040	6,460
15	10,600	5,720	3,030	10,900	3,640	1,800	1,200	16,100	1,100	906	4,070	3,670
16	10,300	5,160	2,750	8,350	3,560	1,830	1,220	20,600	1,060	735	3,860	2,830
17	20,300	4,910	2,470	7,110	3,480	1,780	1,150	18,200	988	651	5,400	2,330
18	22,300	4,750	2,470	6,490	3,340	1,800	1,180	11,300	1,000	638	5,590	1,950
19	22,300	4,570	2,170	5,990	3,200	1,760	1,150	8,350	1,020	599	5,620	1,720
20	14,400	4,410	3,000	5,500	3,140	1,720	1,130	10,600	939	549	5,840	1,560
21	10,800	4,100	3,000	5,190	3,060	1,700	1,060	10,300	1,150	505	6,810	1,380
22	9,310	4,010	3,000	4,910	3,000	1,650	1,060	6,340	1,580	472	11,100	1,300
23	9,790	3,920	3,000	5,400	2,970	1,650	1,020	4,230	1,480	432	11,800	1,180
24	17,700	3,790	3,000	5,720	2,920	1,650	1,040	3,340	1,400	432	12,500	1,130
25	22,300	3,760	2,720	7,080	2,830	1,850	988	2,860	1,380	441	9,600	1,060
26	21,600	3,760	2,720	6,460	2,750	2,070	972	2,520	1,480	483	6,400	956
27	12,300	3,890	2,440	5,500	2,660	2,970	856	2,220	2,750	461	10,400	873
28	8,830	4,070	2,170	5,190	2,440	2,800	795	1,970	2,470	472	15,100	750
29	7,880	3,920	2,170	4,850	2,470	3,140	765	1,800	2,380	423	11,500	677
30	7,420	4,690	2,170	4,600	.....	2,550	780	1,630	2,070	405	8,540	664
31	7,110	.....	1,920	4,380	.....	2,100	.....	1,500	.....	450	5,720	.....

NOTE.—No record Oct. 18–23, 1918, and Feb. 28 to Mar. 3, 1919; gage heights interpolated. Indirect method for shifting control used Oct. 12–23, Nov. 1–7, Dec. 1–22, 1918; Jan. 16 to Feb. 1, Feb. 19 to Mar. 12, Mar. 25 to June 11, June 14 to July 21, Aug. 30 to Sept. 22, Oct. 8, 1919, to Feb. 19, 1920, Feb. 22 to Mar. 15, Apr. 13 to May 30, and June 4 to Sept. 27, 1920. Daily discharge determined by applying to rating table hourly gage heights on the following dates: Oct. 9–13, 17, 26, Nov. 9–11, 1919; May 9–11, 13–17, Aug. 7–9, 21 and 27, Sept. 8–9 and 11–12, 1920. Discharge partly estimated, owing to incomplete record: Jan. 1–4; Mar. 2–3, 29–31, Apr. 5–6, 1920. Gage heights obtained from U. S. Weather Bureau staff-gage records: Dec. 14–31, 1919; Jan. 13–16, Feb. 28–29, Mar. 1 and 4–15, 1920.

Monthly discharge of Colorado River at Austin, Tex., for the years ending Sept. 30, 1919 and 1920

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	26,900	123	6,280	386,000
November	64,700	1,020	11,100	660,000
December	41,500	750	5,200	320,000
January	23,800	1,020	5,450	335,000
February	9,250	1,650	3,010	167,000
March	24,800	939	4,960	305,000
April	7,580	1,000	3,120	186,000
May	13,600	2,970	7,310	449,000
June	29,500	2,150	13,100	780,000
July	39,200	1,970	9,680	595,000
August	24,100	1,000	4,760	293,000
September	64,200	990	9,380	558,000
The year	64,700	123	6,950	5,030,000

Monthly discharge of Colorado River at Austin, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1919–20.				
October	44,600	4,350	14,200	873,000
November	27,400	3,760	7,050	420,000
December	6,990	1,920	3,410	210,000
January	15,100	2,120	5,460	336,000
February	4,230	2,440	3,340	192,000
March	3,140	1,650	2,120	130,000
April	1,880	765	1,190	70,800
May	20,600	664	6,450	397,000
June	3,060	939	1,600	95,200
July	1,700	405	806	49,600
August	28,100	599	6,720	413,000
September	24,400	664	5,260	313,000
The year	44,600	405	4,820	3,500,000

Days of deficiency in discharge of Colorado River at Austin, Tex., for the years ending Sept. 30, 1902–1910 and 1915–1920.

Discharge in second-feet.	Days of deficient discharge.														
	1901–2	1902–3	1903–4	1904–5	1905–6	1906–7	1907–8	1908–9	1909–10	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20
100	.....	.....	.....	.....	.....	45	.....	.....	36	26	3	45	39	.....	.....
200	1	.....	3	20	45	103	1	34	55	44	29	81	182	6	.....
300	20	10	22	75	135	204	11	94	102	68	52	203	233	9	.....
400	68	30	130	150	185	228	41	156	165	72	97	264	247	10	.....
500	167	59	189	177	198	253	78	195	228	83	145	281	260	11	10
600	216	77	223	196	207	261	92	203	241	95	177	290	273	11	14
700	236	90	243	218	221	292	142	226	266	112	222	298	286	11	24
800	251	108	259	234	224	300	166	234	279	120	239	303	301	13	34
900	263	122	266	242	231	305	179	244	281	135	257	313	308	16	39
1,000	271	148	273	247	234	310	190	250	294	142	272	315	315	22	47
1,200	284	197	286	263	241	315	225	273	307	205	289	321	326	51	73
1,400	292	218	292	273	247	323	256	293	319	240	300	333	327	70	91
1,600	301	232	300	282	255	327	261	299	321	255	310	341	332	91	104
1,800	313	247	305	291	263	331	271	310	321	262	315	343	335	112	116
2,000	317	260	309	296	267	334	276	317	322	262	318	343	336	123	130
3,000	330	307	322	315	291	342	299	332	335	289	338	351	347	170	183
4,000	338	321	332	327	301	345	317	342	338	307	346	355	354	207	231
5,000	341	331	337	334	314	347	322	347	341	314	353	358	355	229	263
6,000	343	340	342	339	320	348	329	349	343	324	355	363	356	242	284
7,000	344	344	346	342	323	348	331	352	345	338	358	363	357	261	301
8,000	347	346	348	345	325	348	336	354	350	347	359	364	357	276	308
9,000	349	350	350	347	330	348	340	355	352	348	360	364	358	286	314
10,000	353	351	352	348	335	352	344	356	354	349	362	365	360	292	320
20,000	356	360	359	359	350	363	351	362	364	355	365	.....	363	333	352
30,000	361	362	364	363	359	365	357	365	365	357	366	.....	364	355	364
40,000	365	365	365	364	362	.....	361	.....	.....	362	.....	.....	365	358	364
50,000	.....	.....	366	364	362	.....	362	.....	.....	362	.....	.....	.....	360	366
60,000	.....	.....	.....	365	364	.....	364	.....	.....	363	.....	.....	.....	362	.....
75,000	.....	.....	.....	.....	365	.....	366	.....	.....	364	.....	.....	.....	365	.....
100,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	365	.....	.....	.....	.....	.....

EVAPORATION NEAR AUSTIN, TEX.

LOCATION.—At reservoir on Hill ranch, 1,000 feet from ranch house, 5 miles south of Austin, Travis County. Elevation, 475 feet above sea level.

RECORDS AVAILABLE.—April, 1916, to September 30, 1920.

EQUIPMENT.—Two evaporation pans, one floating on surface of reservoir and the other on land about 30 feet from reservoir; auxiliary equipment consists of hook gage, rain gage, anemometer, maximum and minimum thermometers, and psychrometer.

ACCURACY.—Observations made daily at 8 a. m. Observer's work good

COOPERATION.—Computations made by United States Weather Bureau.

Evaporation near Austin, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Temperature (° F.).					Mean relative humidity (per cent).	Wind.		Rainfall (inches).	Evaporation (inches).	
	Air.			Water.			Average velocity (miles per hour).	Prevailing direction.		Floating pan.	Land pan.
	Mean maximum.	Mean minimum.	Mean.	Floating pan (mean).	Land pan (mean).						
1919.											
October	81.4	58.0	69.7	66.0	62.9	87.1	1.9	East	3.56	3.314	5.882
November	63.8	45.7	54.8	54.5	51.7	85.9	2.3	North	4.55	2.142	2.878
December	a 62.3	40.5	51.4	49.2	a 47.7	b 89.0	2.6	West	3.70	1.542	2.507
January	a 57.0	35.7	46.4	d 48.8	c 44.3	d 92.6	3.3	Northwest	4.63	.....	.....
February	59.9	39.5	49.7	49.7	a 45.9	a 82.1	3.4	South	2.33	2.572	1.933
March	69.4	45.3	57.4	57.1	51.9	83.9	2.8	East	2.63	3.225	4.191
April	78.1	55.4	66.8	66.2	60.5	88.0	1.7	South	3.37	4.192	5.772
May	81.3	61.5	71.4	72.2	68.1	89.0	.9	South	5.36	3.755	5.523
June	85.9	67.0	76.4	77.3	73.3	90.0	1.1	East	9.17	4.197	6.974
July	90.4	70.8	80.6	80.4	77.3	92.9	.3	South	13.86	5.172	5.785
August	92.2	70.6	81.4	82.9	81.5	92.6	.6	South	2.65	6.140	6.693
September	86.5	66.8	76.6	77.0	d 76.0	a 93.9	1.0	East	3.12	.....	4.830
The year	75.7	54.7	65.2	65.1	61.8	88.9	1.8	.....	58.93	.....	.....
1920.											
October	80.3	64.2	72.2	72.2	69.5	94.6	1.3	South	10.70	.....	3.537
November	68.9	46.5	57.7	57.7	53.1	84.9	2.0	North	1.48	2.500	3.155
December	b 60.8	35.8	48.3	b 45.8	b 44.8	b 87.7	2.7	North	1.49	1.579	1.889
January	54.1	36.1	45.1	b 45.9	b 43.1	b 89.9	3.3	North	5.43	1.532	1.901
February	64.6	42.9	53.8	54.1	48.9	86.3	2.8	North	.41	1 986	2.733
March	71.5	44.1	57.8	56.4	50.7	69.3	3.7	North	1.33	4.871	6.146
April	81.3	53.2	67.2	64.6	58.0	67.6	2.9	South	1.25	6.625	6.779
May	86.2	65.9	76.0	75.4	71.8	82.0	1.7	East	7.04	6.030	6.323
June	89.1	67.0	78.0	79.3	75.2	81.9	.6	Southeast	3.98	5.184	6.392
July	95.1	71.2	83.2	80.7	77.3	76.5	.9	South	.68	6.909	8.469
August	91.3	70.7	81.0	79.7	77.3	86.3	.5	South	3.63	5.567	6.154
September	92.1	66.8	79.4	77.2	73.7	81.2	.8	South	2.00	5.289	6.881
The year	77.9	55.4	66.6	65.8	62.0	82.4	1.9	.....	39.42	.....	60.359

a One day missing. b Two days missing. c Three days missing. d Four days missing.

NOTE.—Evaporation from floating pan estimated for parts of February, March, August, September, November, 1919; January, February, March, May, August, and September, 1920. Evaporation from land pan estimated for parts of February, July, August, October, and November, 1919; January and March, 1920.

COLORADO RIVER AT COLUMBUS, TEX.

LOCATION.—At county highway bridge half a block from county jail, 400 feet below Galveston, Harrisburg & San Antonio Railway bridge, in eastern edge of Columbus. Colorado County.

DRAINAGE AREA.—37,000 square miles [6] (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—August 2, 1902, to December 31, 1911; May 22, 1916, to September 30, 1920. Records of stage have been obtained by the United States Weather Bureau since January 1, 1903.

GAGE.—Gurley graph water-stage recorder, inspected by A. S. Lowrey. From August 2, 1902, to December 16, 1907, gage heights were obtained by measuring with a tagged chain and lead weight from point on top of bridge pier to water surface. Mott tape and weight gage on downstream handrail of bridge, property of the United States Weather Bureau, was read from December 17, 1907, to February 9, 1917, when regulation United States Geological Survey chain gage was installed and used until present Gurley water-stage recorder was installed on April 30, 1919. All gages referred to same datum.

[6] Revised since publication of Water-Supply Paper 308.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Channel straight above and below station for 400 feet. Right bank composed of firm earth; high and not subject to overflow. Left bank of medium height; overflow likely. Bed of stream clean and sandy; shifts. A sand and gravel section 350 feet below gage may serve as low-water control; the stage-discharge relation during medium and high stages may be controlled by a bend in river below bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 33.9 feet at 7 a. m. November 14 (discharge, 55,100 second-feet); minimum stage, 5.35 feet at 7 a. m. October 7 (discharge, 94 second-feet).

Maximum stage recorded during year ending September 30, 1920, 34.6 feet at 6 a. m. October 14 (discharge, 55,800 second-feet); minimum stage, 7.18 feet from 4 a. m. to 6 p. m. July 28 (discharge, 639 second-feet).

1902–1911; 1916–1920: Maximum stage recorded, 35.8 feet April 27, 1908 (revised discharge, 60,300 second-feet); minimum stage, 4.2 feet September 9 and 10, 1910 (discharge, 10 second-feet).

DIVERSIONS.—Considerable water is diverted for irrigation in the drainage basin above Austin, but between Austin and Columbus little water is diverted. The station is above the irrigated rice belt, which comprises several thousand acres. Records of the Board of Water Engineers for the State of Texas show that about 36,000 acres have been declared irrigated above Austin.

REGULATION.—Flow at Columbus during low stages partly controlled by storage at Lake Austin.

ACCURACY.—Stage-discharge relation not permanent. Rating curve fairly well defined below 55,000 second-feet. Gage read to hundredths twice daily to April 30, 1919, after that date operation of water-stage recorder satisfactory except as indicated in footnote to daily-discharge table. Mean of two readings a day may not be true index of daily gage height. Mean daily gage heights obtained from recorder graph by inspection or by use of planimeter. Daily discharge ascertained by applying mean daily gage height to rating table, or by shifting-control method. Records fair for low and medium stages. By comparison with records on Colorado River at Wharton, it appears probable that discharge above 20,000 second-feet may be too high.

COOPERATION.—Morning gage readings from October 1, 1918, to April 30, 1919, furnished by United States Weather Bureau.

Discharge measurements of Colorado River at Columbus, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 10	McCashin and Congdon	6.90	608	June 24	H B. Kinnison	23.28	26,100
Nov. 13	H. B. Kinnison	33.32	[a] 54,400	July 9	do	17.02	[b] 17,400
14	do	33.97	56,600	Aug. 6	do	10.34	3,610
14	do	33.39	52,400	29	do	13.99	9,390
15	do	24.18	21,800	Oct. 7	Gowans and Snow	12.37	5,360
15	do	22.59	19,100	Dec. 19	H. B. Kinnison	11.54	[c] 6,250
1919.				1920.			
Jan. 4	C. E. McCashin	9.58	2,870	Feb. 25	Kinnison and Pritchett	10.36	3,260
20	Ellsworth and Kinnison	9.94	2,760	May 13	H. B. Kinnison	14.16	8,710
				July 1	do	9.62	2,410
Apr. 21	C. E. McCashin	9.28	2,590	Aug. 4	Ellsworth and Kinnison	7.48	838
May 30	Ellsworth and Kinnison.	16.28	11.300				

[a] Surface velocity observed and coefficient of 0.94 used to reduce to mean velocity.
[b] Surface velocity observed and coefficient of 1.00 used to reduce to mean velocity
[c] Made during rising stage.

Daily discharge, in second-feet, of Colorado River at Columbus, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1....	2,600	8,660	1,310	4,080	8,140	2,200	12,000	1,260	7,680	27,200	6,380	12,500
2....	2,690	12,600	1,430	3,720	6,880	2,100	8,180	1,860	13,300	24,100	5,460	10,500
3....	1,420	10,700	1,600	3,180	5,140	1,990	7,310	1,610	11,400	17,300	4,840	7,440
4....	862	7,560	1,940	2,710	4,440	1,880	10,800	2,430	6,440	14,700	4,250	5,840
5....	540	5,050	1,680	2,290	4,180	1,750	8,040	3,380	4,680	12,800	3,810	4,660
6....	470	3,730	1,580	2,180	3,810	1,690	5,920	2,860	4,190	10,700	3,440	3,930
7....	185	2,890	1,290	1,930	8,140	1,700	4,770	8,950	3,540	8,750	3,120	3,690
8....	3,420	2,410	1,160	1,880	6,730	1,660	4,540	24,500	3,100	8,070	2,870	3,460
9....	1,170	5,770	1,010	1,530	5,050	1,440	5,280	13,400	3,420	14,100	2,710	3,220
10....	570	31,100	960	1,440	4,100	1,610	7,220	7,900	11,800	19,400	3,280	2,990
11....	364	46,000	843	1,360	3,570	1,610	5,830	11,200	10,400	10,700	2,940	2,750
12....	1,160	49,200	882	1,200	3,310	1,440	4,310	15,500	9,000	7,870	3,070	2,520
13....	595	52,900	4,360	1,200	3,370	1,520	3,610	18,700	7,050	6,310	2,630	2,280
14....	372	54,300	7,290	1,120	2,860	1,540	3,280	13,400	.....	8,660	2,500	2,120
15....	392	28,200	4,700	1,360	2,580	1,620	2,820	13,200	.....	8,640	2,760	2,720
16....	14,900	11,800	2,050	17,700	2,450	1,520	2,520	11,500	.....	6,260	2,400	3,990
17....	15,900	8,300	4,080	7,170	2,300	1,420	2,320	11,500	.....	5,210	2,200	3,970
18....	10,400	6,370	4,050	4,440	2,280	1,320	3,290	12,100	.....	5,420	2,000	3,300
19....	6,460	6,580	3,440	2,280	2,860	1,260	3,210	14,100	.....	5,320	1,900	6,400
20....	5,040	5,680	2,890	2,070	3,570	1,240	2,390	13,000	.....	4,270	1,800	7,480
21....	3,650	6,000	2,960	4,100	3,480	1,200	2,340	12,000	.....	4,380	2,260	8,440
22....	2,760	4,130	1,920	10,500	5,050	1,200	2,100	8,970	27,600	29,600	4,150	7,550
23....	2,170	2,710	2,620	17,200	3,860	1,090	1,970	7,440	26,400	33,200	7,380	11,900
24....	2,140	2,100	9,150	17,900	3,430	1,100	1,880	.....	25,200	46,100	19,000	30,700
25....	2,700	3,460	32,800	18,100	3,200	1,290	1,720	.....	28,200	46,900	22,700	41,600
26....	5,590	3,020	33,300	22,300	2,920	1,400	1,610	15,100	37,600	38,100	15,200	48,500
27....	24,100	2,000	20,100	20,400	2,720	21,500	1,490	12,500	46,300	32,200	10,500	53,000
28....	22,300	1,680	12,100	12,700	2,450	18,100	1,390	6,280	43,400	22,600	8,700	44,000
29....	12,900	1,480	8,210	8,350	.....	19,200	1,360	9,780	38,100	13,800	8,750	21,900
30....	8,860	1,340	6,500	6,640	.....	24,500	1,470	13,200	34,100	9,610	7,530	14,800
31....	6,640	.....	5,230	7,220	.....	19,400	.....	8,700	.....	7,650	7,730	.....
1919–20.												
1....	10,800	7,530	3,790	2,800	5,950	2,800	2,950	960	2,410	2,460	888	8,390
2....	8,750	6,860	4,030	2,800	5,650	2,800	2,500	960	2,500	2,360	800	6,550
3....	7,190	6,250	6,700	2,700	5,360	2,700	2,410	993	3,790	2,140	698	5,220
4....	6,250	6,250	7,020	2,650	5,220	2,700	2,100	993	3,000	1,900	740	5,220
5....	10,400	11,000	5,950	2,800	5,080	2,600	1,780	960	2,320	1,740	836	5,650
6....	6,860	9,480	5,500	6,700	4,940	2,600	1,670	993	2,180	1,600	843	5,080
7....	5,220	7,530	4,940	7,700	4,800	2,410	1,600	993	2,800	1,520	856	4,410
8....	10,800	6,700	4,540	6,100	4,670	2,320	1,520	1,300	4,030	1,820	1,020	3,910
9....	8,750	6,100	4,410	6,100	4,540	2,280	1,520	2,460	3,910	1,670	11,200	4,280
10....	7,190	6,550	4,280	5,800	4,540	2,280	1,440	3,670	2,900	1,440	16,400	5,800
11....	24,400	14,300	4,280	5,080	4,410	2,230	1,370	2,320	2,600	1,410	9,670	18,600
12....	44,900	24,100	4,030	16,400	4,940	2,180	1,370	11,400	2,320	1,300	6,100	22,300
13....	51,400	14,100	3,910	30,000	4,540	2,140	1,300	10,200	2,100	1,160	4,670	19,700
14....	54,000	10,000	3,790	17,100	4,280	2,140	1,300	12,100	1,900	1,090	6,100	13,900
15....	39,800	8,040	3,550	16,600	4,280	2,100	1,260	25,300	1,780	1,060	4,800	11,800
16....	35,500	6,860	3,440	14,600	4,280	2,050	1,230	22,100	1,710	1,020	3,790	8,390
17....	47,000	6,100	3,330	11,400	4,410	2,010	1,200	29,500	1,670	1,060	4,030	5,950
18....	38,400	5,500	3,330	9,290	4,410	1,970	1,160	24,400	1,630	1,060	3,670	4,540
19....	29,500	5,220	4,280	7,700	4,280	1,930	1,120	16,600	1,780	993	3,670	3,670
20....	27,100	4,940	7,870	6,860	4,150	1,860	1,090	12,700	1,670	928	4,940	3,110
21....	22,500	4,670	5,500	6,400	3,910	1,780	1,060	9,860	1,740	869	5,220	2,600
22....	16,600	4,540	3,910	5,950	3,790	1,780	1,060	11,000	1,740	843	5,650	2,280
23....	13,300	4,410	3,790	9,110	3,670	1,740	1,020	10,600	1,670	812	6,700	2,050
24....	11,200	4,150	3,670	43,100	3,550	1,740	993	7,360	2,050	788	10,800	1,930
25....	11,600	4,030	3,550	39,100	3,330	1,780	993	5,500	2,800	728	11,800	1,780
26....	19,200	4,150	3,550	13,100	3,220	1,740	960	4,280	2,500	692	11,400	1,710
27....	23,300	3,790	3,330	10,400	3,110	1,780	941	3,550	1,900	656	8,930	1,630
28....	18,600	3,550	3,220	8,930	3,000	1,860	941	5,650	1,820	639	6,860	1,560
29....	12,000	3,670	3,110	7,530	2,900	2,010	947	4,670	1,820	764	9,670	1,440
30....	9,480	3,790	3,000	6,860	.....	2,650	947	3,000	2,460	686	13,700	1,340
31....	8,390	.....	3,000	6,400	.....	2,750	.....	2,500	.....	788	10,400	.....

NOTE.—Discharge interpolated June 23 and Sept. 7–12, 1919. Discharge estimated as follows: May 24 and 25, 1919, 25,000 second-feet; and June 14–21, 1919, 27,000 second-feet. Discharge determined by shifting-control method Oct. 1 to Dec. 10, 1919; Jan. 16 to Aug. 20, and Sept. 11–30, 1920. Discharge partly estimated owing to incomplete record, Jan. 12–13, 23–24, June 23–26, July 7–9, 1920. U. S. Weather Bureau gage readings used in determining discharge Dec. 20–26, 1919; May 8–13, 1920.

Monthly discharge of Colorado River at Columbus, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	24,100	185	5,270	324,000
November	54,300	1,340	12,900	768,000
December	33,300	843	5,920	364,000
January	22,300	1,120	6,780	417,000
February	8,140	2,280	4,030	224,000
March	24,500	1,090	4,600	283,000
April	12,000	1,360	4,170	248,000
May	.....	1,260	11,200	689,000
June	.....	3,100	20,600	1,230,000
July	46,900	4,270	16,400	1,010,000
August	22,700	1,800	5,750	354,000
September	53,000	2,120	12,600	750,000
The year	54,300	185	9,200	6,660,000
1919–20.				
October	54,000	5,220	20,700	1,270,000
November	24,100	3,550	7,140	425,000
December	7,870	3,000	4,280	263,000
January	43,100	2,650	10,900	670,000
February	5,950	2,900	4,320	248,000
March	2,800	1,740	2,180	134,000
April	2,950	941	1,390	82,700
May	29,500	960	8,030	494,000
June	4,030	1,630	2,320	138,000
July	2,460	639	1,230	75,600
August	16,400	698	6,030	371,000
September	22,300	1,340	6,160	367,000
The year	54,000	639	6,250	4,540,000

COLORADO RIVER AT WHARTON, TEX.

LOCATION.—At highway bridge in western edge of Wharton, Wharton County, 200 feet below Galveston, Harrisburg & San Antonio Railway bridge

DRAINAGE AREA.—37,400 square miles (measured on standard topographic maps, post-route map: and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles

RECORDS AVAILABLE.—July 12 to August 31, 1916; July 3 to August 18, 1917; July 11 to August 4, 1918; and March 19, 1919, to September 30, 1920.

GAGE.—Gurley 7-day water-stage recorder attached to pier of highway bridge near left bank, installed March 19, 1919. Prior to this date, vertical staff on right bank 75 feet below bridge. Elevation of zero of old staff gage, 1.93 feet higher than zero of recorder.

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

CHANNEL AND CONTROL.—Channel straight above and below station for a few hundred feet. Bed composed of sand and clay, and liable to shift. Both banks medium in height, composed of clay, and subject to overflow during extreme stages.

EXTREMES OF DISCHARGE.—Maximum stage during year ending September 30, 1919, from water-stage recorder, 32.45 feet at midnight June 18 (discharge, 37,600 second-feet, determined from extension of rating curve); minimum stage, 5.01 feet at 8 a. m. March 25 (discharge, 1,420 second-feet).

Maximum stage during year ending September 30, 1920, from water-stage recorder, 33.9 feet at midnight October 15 (discharge, 39,600 second-feet, ascertained from extension of rating curve); minimum stage, 4.95 feet at 6 p. m. July 29 (discharge, 518 second-feet).

1916–1920· Maximum stage recorded during periods of record, 33.9 feet at midnight, October 15, 1919 (discharge, 39,600 second-feet, determined from extension of rating curve); minimum stage, −0.90 foot at 7 a. m. August 1. 1917 (discharge 62 second-feet).

ICE.—None.

DIVERSION.—Station is in area of rice irrigation, roughly estimated to cover about 75,000 acres, about one-third of which is irrigated by diversion from Colorado River between Columbus and Wharton, and the remaining two-thirds by diversions below Wharton. During periods of maximum demand, practically the entire flow is diverted, unless the river is above ordinary stage.

REGULATION.—Flow at low and medium stages is regulated to some extent by storage in Austin Lake.

ACCURACY.—Stage-discharge relation changed during high water in September, 1919. Rating curve used during year ending September 30, 1919, fairly well defined between 200 and 30,000 second-feet; curve used for year ending September 30, 1920, well defined from 200 to 15,000 second-feet, fairly well defined to 30,000 second-feet, and extended above. Operation of water-stage recorder satisfactory, except as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height, determined by inspecting gage-height graph, or on days of considerable fluctuation by use of planimeter. Records good, except during extremely high stages.

Discharge measurements of Colorado River at Wharton, Tex., during the years ending Sept 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1919.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Jan. 23	Ellsworth and Kinnison	15.56	[a] 12,500	Aug. 13	H. B. Kinnison	8.09	3,250
Mar. 28	H. B. Kinnison	19.24	[b] 17,000	Oct. 6	do	17.47	14,400
May 6	do	7.68	3,380	Dec. 17	do	8.99	3,490
13	do	18.29	[b] 17,000				
19	do	15.56	12,700	1920.			
24	do	12.46	8,500	Feb. 27	Kinnison and Pritchett	9.13	3,760
26	do	24.00	[b] 23,300	Mar. 29	H. C. Pritchett	7.60	2,310
June 23	do	22.64	[a] 23,200	May 11	H. B. Kinnison	8.94	3,450
26	do	24.74	[a] 26,500	June 30	do	6.96	1,670
July 19	do	10.26	5,140	July 28	do	5.03	543

[a] Surface velocity observed and coefficient of 0.90 used to reduce to mean velocity.
[b] Surface velocity observed and coefficient of 0.92 used to reduce to mean velocity.

Daily discharge, in second-feet, of Colorado River at Wharton, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919.												
1							15,600	1,650	8,660	29,000	8,280	9,550
2							9,900	1,620	7,880	23,500	7,100	12,500
3							7,270	1,760	14,300	19,700	6,280	9,860
4							7,180	1,830	10,100	15,300	5,580	7,620
5							10,500	2,120	6,550	13,400	4,990	6,240
6							8,800	3,110	4,980	11,900	4,470	5,220
7							6,220	2,900	5,430	10,200	4,110	4,570
8							5,140	15,500	3,730	8,690	3,780	4,070
9							4,580	18,600	3,550	8,120	3,500	3,680
10							5,350	11,500	6,020	17,100	3,320	3,480
11							6,520	7,920	15,600	15,000	3,590	3,240
12							5,310	11,600	11,700	10,200	3,330	3,060
13							4,340	16,400	8,800	7,980	3,460	2,860
14							3,830	15,500	11,000	6,890	3,140	2,780
15							3,490	12,800	20,700	9,590	2,970	2,660
16							3,160	12,000	26,600	8,300	3,040	3,580
17							2,870	11,300	32,000	6,480	2,740	4,510
18							2,680	10,500	36,800	5,600	2,500	5,430
19						1,590	3,140	12,300	37,000	5,840	2,360	6,360
20						1,570	3,290	12,900	25,200	5,570	2,260	7,280
21						1,540	2,900	12,100	14,600	4,760	2,170	8,690
22						1,480	2,620	10,600	20,900	9,240	2,470	8,140
23						1,460	2,380	8,340	22,600	27,800	5,200	8,310
24						1,440	2,190	9,610	18,000	30,300	8,730	16,100
25						1,440	2,030	26,100	22,600	32,800	18,500	26,000
26						1,570	1,900	23,000	25,600	35,100	18,800	30,100
27						10,000	1,900	14,200	30,000	33,700	13,400	32,800
28						16,900	1,730	10,600	33,000	28,500	10,500	35,400
29						15,400	1,680	6,600	34,400	18,800	9,090	35,700
30						19,600	1,6.0	11,100	32,400	12,700	9,120	22,200
31						22,100	.....	11,500	.....	9,960	7,860	.....
1919-20.												
1	13,700	9,030	4,160	3,050	7,860	3,350	3,050	1,200	3,450	2,060	650	10,100
2	10,800	8,250	4,380	2,960	7,470	3,250	3,150	1,200	3,150	2,330	690	8,510
3	9,030	7,600	4,600	2,960	6,950	3,150	2,960	1,130	3,250	2,330	650	6,950
4	7,990	6,950	7,470	2,870	6,590	3,150	2,780	1,130	3,950	2,150	690	5,750
5	7,340	7,600	7,080	2,780	6,350	3,050	2,600	1,130	3,750	1,970	690	5,630
6	13,100	11,200	6,350	3,050	6,110	2,960	2,240	1,130	2,960	1,730	740	5,990
7	10,500	9,420	5,870	7,340	5,870	2,960	2,060	1,060	2,690	1,570	790	5,510
8	7,600	7,730	5,150	8,380	5,630	2,870	1,970	1,270	2,960	1,410	890	4,820
9	12,000	6,950	4,710	6,590	5,390	2,780	1,890	1,270	4,050	1,810	1,000	4,270
10	9,030	6,470	4,490	6,830	5,270	2,780	1,890	2,330	4,270	1,810	14,400	4,490
11	10,800	7,340	4,380	6,350	5,150	2,780	1,890	3,350	3,450	1,650	13,100	8,510
12	24,900	18,300	4,270	6,830	5,040	2,690	1,890	4,380	2,960	1,490	8,770	17,600
13	31,200	18,600	4,160	21,600	5,510	2,600	1,810	11,000	2,600	1,490	7,470	18,900
14	35,300	12,600	4,050	23,000	5,150	2,600	1,810	8,770	2,240	1,340	5,270	15,900
15	38,800	10,600	3,950	15,700	4,820	2,600	1,730	15,800	1,970	1,270	6,830	12,900
16	38,400	9,800	3,750	15,700	4,710	2,600	1,650	22,200	1,810	1,130	5,270	11,000
17	34,400	9,010	3,550	13,600	4,710	2,510	1,570	21,900	1,650	1,000	4,160	8,380
18	36,100	8,220	3,450	11,200	4,820	2,420	1,570	24,000	1,570	940	4,160	6,590
19	36,000	7,420	3,550	9,680	4,820	2,420	1,490	18,900	1,340	890	3,950	5,270
20	29,200	6,630	5,150	8,770	4,710	2,330	1,490	14,800	1,340	840	3,850	4,380
21	24,800	5,830	6,470	8,250	4,490	2,240	1,490	12,000	1,340	740		3,750
22	19,600	5,040	5,150	7,860	4,380	2,240	1,410	10,300	1,270	690		3,350
23	15,400	4,710	3,950	7,730	4,160	2,150	1,410	10,600	1,340	690		3,050
24	12,900	4,600	3,750	22,500	4,050	2,150	1,410	10,900	1,200	650	8,400	2,780
25	11,600	4,380	3,650	33,700	3,950	2,150	1,340	10,800	1,490	650		2,510
26	13,800	4,380	3,550	34,800	3,750	2,060	1,340	10,100	2,870	610		2,330
27	19,200	4,270	3,550	16,100	3,650	2,060	1,340	9,550	2,780	610		2,240
28	21,200	4,050	3,450	12,200	3,550	2,060	1,270	9,030	2,060	570	8,770	2,060
29	16,400	3,950	3,350	10,300	3,450	2,240	1,200	7,990	1,810	570	7,210	1,970
30	11,900	3,950	3,250	9,160	.....	2,240	1,200	5,750	1,730	590	10,900	1,810
31	10,200	.....	3,150	8,380	.....	2,780	.....	4,050	.....	650	12,700	.....

NOTE.—Mar. 30 to Apr. 1, 1919, gage heights partly estimated. Sept. 16–19, Nov. 16–21, 1919; July 4 and 11, 1920, discharge interpolated. Discharge estimated, Aug. 21–27, 1920; partly estimated, owing to incomplete records, Nov. 22, 1919; May 8, June 4, 5, 12, 19, 20, 25, 26, July 3, 4, 10–12, and Aug. 28, 1920.

Daily discharge, in second-feet, of North Concho River at San Angelo, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	0	0.4	.....	.....	5.3	2.3	158	31	1.7	98	1.7	9.8
2	0	0	.....	.....	5.3	2.3	252	31	1.3	47	.9	4.5
3	0	0	.....	.....	5.3	2.3	2,740	31	1.1	26	1.3	2.3
4	0	0	.....	.....	4.9	2.3	465	31	1.1	70	1.9	.8
5	0	0	.....	.....	4.5	2.3	305	28	.5	98	1.7	.2
6	0	0	.....	.....	4.5	2.3	228	26	.6	87	.9	0
7	0	257	.....	.....	4.5	2.3	117	41	1,190	47	.6	0
8	0	398	.....	.....	3.9	2.3	98	36	64	688	.3	0
9	0	138	.....	.....	3.9	1.9	47	36	3,160	158	.2	0
10	1,420	64	.....	.....	3.9	1.9	47	36	500	9.8	.1	0
11	580	22	.....	1.7	3.9	1.9	41	.....	252	22	.1	0
12	715	9.8	.....	1.7	3.9	1.7	36	.....	138	24	0	0
13	64	4.5	.....	1.7	3.9	1.7	36	.....	87	11	0	0
14	.1	1.9	.....	1.9	3.9	1.7	36	.....	33	9.8	0	0
15	0	1.9	.....	2.5	3.9	1.7	33	.....	516	7.2	0	0
16	0	1.9	.....	2.9	3.9	1.7	31	14	580	4.5	0	47
17	0	.....	.....	4.9	3.9	1.7	31	14	138	3.2	0	.....
18	0	.....	.....	6.2	3.9	1.7	31	9.8	110	1.9	0	.....
19	0	.....	.....	6.2	3.9	1.7	31	12	278	1.9	0	.....
20	4.5	.....	.....	5.8	3.2	1.7	31	5.3	269	1,060	0	.....
21	4,580	.....	.....	5.3	3.2	1.7	31	3.9	261	305	0	500
22	1,500	.....	.....	5.3	3.5	1.7	31	2.3	252	80	0	158
23	228	.....	.....	6.2	2.7	1.7	31	2.3	365	33	0	80
24	117	.....	.....	5.3	2.7	1,410	31	41	195	22	.1	47
25	80	.....	.....	5.3	2.7	2,430	31	26	87	9.8	228	9.8
26	760	.....	.....	4.5	2.5	252	31	6.6	54	6.6	278	12
27	1,810	.....	.....	4.5	2.3	117	33	4.5	98	4.5	228	14
28	335	.....	.....	5.8	2.3	98	31	2.9	158	3.9	98	9.8
29	80	.....	.....	4.5	.....	47	31	2.9	150	2.9	64	9.8
30	1.9	.....	.....	6.2	.....	47	31	1.9	98	1.9	22	9.8
31	.4	.....	.....	5.3	.....	117	.....	1.3	.....	1.9	9.8	.....
1919–20.												
1	9.8	22	22	22	9.8	16	6.6	4.5	1.9	4.9	0	1.9
2	8.5	22	22	22	9.8	16	6.6	4.5	1.9	3.3	0	3.5
3	5.3	22	22	22	9.8	16	6.6	4.5	4.5	3.3	4.1	1.7
4	4.5	22	22	22	9.8	16	6.6	4.5	4.5	1.8	1.2	1.4
5	3.9	22	22	22	9.8	16	9.8	1.3	2.9	1.8	.8	1.5
6	3,680	22	22	22	9.8	16	9.8	.9	1.9	.8	.4	1.4
7	4,840	22	22	22	9.8	16	9.8	.9	1.9	.8	.4	2.5
8	2,630	22	22	22	9.8	16	9.8	.9	1.9	.5	.4	3.6
9	1,060	22	22	22	9.8	16	9.8	.9	1.9	.4	.3	4.7
10	580	22	22	22	9.8	16	9.8	9.8	1.3	.4	.3	5.8
11	294	22	22	22	9.8	16	8.5	9.8	.9	.4	.3	6.9
12	47	22	22	22	9.8	16	8.5	4.5	.9	.4	1	7.9
13	47	19	22	22	9.8	16	8.5	2.9	.9	.4	24	6.6
14	465	14	22	22	9.8	16	8.5	1.9	.9	.2	4.1	4.5
15	305	14	22	22	9.8	16	8.5	1.9	.6	.2	50	14
16	117	14	22	22	9.8	16	8.5	1.9	.4	.2	66	16
17	80	14	22	22	9.8	16	7.2	1.9	.4	.1	540	9.8
18	41	14	22	9.8	9.8	16	6.6	1.9	.4	.1	231	6.2
19	73	14	22	9.8	9.8	14	6.6	1.9	60	.1	7.5	3.9
20	80	14	22	9.8	9.8	14	6.6	1.9	24	.1	4.9	2.5
21	150	14	22	9.8	9.8	14	6.6	1.9	13	.1	4.9	1.7
22	252	19	22	22	16	12	5.3	1.9	7.5	.1	13	1.3
23	252	22	22	22	16	12	4.5	1.9	18	0	9.6	1.1
24	252	22	22	22	16	12	4.5	1.9	7.5	0	102	.8
25	64	22	22	22	16	11	4.5	1.9	7.5	0	36	.5
26	.47	22	22	22	16	9.8	4.5	1.9	7.5	0	24	.4
27	41	22	22	9.8	16	9.8	4.5	1.9	7.5	0	14	.4
28	33	22	22	9.8	16	4.5	4.5	1.9	5.9	0	9.2	.4
29	26	22	22	9.8	16	4.5	4.5	1.9	4.9	0	4.5	.3
30	22	22	22	9.8	.....	9.8	4.5	1.9	4.9	0	4.5	.3
31	22	.....	22	9.8	.....	8.5	.....	1.9	.....	.....	1.9	.....

NOTE.—Gage readings Nov. 17, 1918, to Jan. 10, 1919, unreliable; mean discharge probably not over 2 second-feet. Discharge, May 11–15, 1919, estimated 30 second-feet; Sept. 17–20, 1919, 200 second-feet. Discharge interpolated for following days: June 20, 21, Nov. 8, 9, 1919; Jan. 1, 2, and Sept. 7–11, 1920. Discharge, Sept. 6 and 12, 1920, partly estimated; gage-height record incomplete. Records below 5 second-feet in 1919 subject to uncertainty owing to unreliability of gage readings.

Monthly discharge of North Concho River at San Angelo, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	4,580	0	396	24,300
November 1–16	398	0	56.2	1,780
January 11–31	6.2	1.7	4.46	186
February	5.3	2.3	3.79	210
March	2,430	1.7	147	9,040
April	2,740	31	170	10,100
May	41	1.3	20.2	1,240
June	3,160	.5	301	17,900
July	1,060	1.9	95	5,840
August	278	0	30.2	1,860
September		0	57.2	3,400
1919–20.				
October	4,840	3.9	501	30,800
November	22	14	19.7	1,170
December	22	22	22	1,350
January	22	9.8	18.5	1,140
Febuary	16	9.8	11.5	662
March	16	4.5	13.7	842
April	9.8	4.5	7.04	419
May	9.8	.9	2.71	167
June	60	.4	6.61	393
July	4.9	0	.66	39
August	540	0	37.4	2,300
September	16	.3	3.78	225
The year	4,840	0	54.4	39,500

CONCHO RIVER NEAR SAN ANGELO, TEX.

LOCATION.—Half a mile below confluence of North Concho and South Concho rivers, 1¾ miles southeast of San Angelo, Tom Green County.

DRAINAGE AREA.—10,800 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of United States Geological Survey; scale, 1 inch =25 miles).

RECORDS AVAILABLE.—September 17, 1915, to September 30, 1920.

GAGE.—Stevens continuous water-stage recorder, installed August 9, 1917, on right bank, 1,500 feet below an old ford; inspected by engineers of United States Geological Survey. Prior to August 9, 1917, a vertical staff gage in several sections attached to trees on left bank was used. Water-stage recorder and vertical staff gage referred to same datum.

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

CHANNEL AND CONTROL.—Bed composed of solid rock and gravel. Channel straight for 1,000 feet above and below station. Right bank high, rocky, wooded, and not subject to overflow; left bank of medium height, composed of clay and gravel, covered with a scattered growth of trees, and subject to overflow at high stages. Rapids just below gage serve as control for medium and low stages; control for high stages not known.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 26.6 feet July 8, determined from flood marks on gage house (discharge, 40,500 second-feet, determined by slope method, assuming a value of 0.045 for n in Kutter's formula); minimum stage, 0.45 foot at 4 p. m. October 6 (discharge, 0.1 second-foot).

Maximum stage during year ending September 30, 1920, from water-stage recorder, 18.52 feet at 3 p. m. October 6 (discharge, about 14,500 second-feet); minimum stage, 0.50 foot at midnight July 24 (discharge, 1.8 second-feet).

1915–1920: Maximum stage recorded, 26.6 feet July 8, 1919, determined from flood marks on gage house (discharge, 40,500 second-feet, determined from slope method, assuming a value of 0.045 for n in Kutter's formula); minimum discharge, 0.1 second-foot at 4 p. m. October 6, 1918.

ICE.—None.

DIVERSIONS.—Flow at low stage materially affected by diversions above station. About a mile above mouth of South Concho River a storage dam has been constructed by the San Angelo Light & Power Co. for waterworks. Records of the Board of Water Engineers for the State of Texas show that about 7,500 acres have been declared irrigated by water above the station, and about 3,500 acres by diversions below station.

REGULATION.—Storage at the dam of the San Angelo Light & Power Co. has slight effect on flow at station; no regulation of consequence on North Concho River.

ACCURACY.—Stage-discharge relation practically permanent, except when affected by aquatic growth on control. Rating curve well defined below 800 second-feet; above, it is based on determination of discharge (40,500 second-feet), at crest of flood on July 8, 1919, using Kutter's formula with the value of 0.045 for n, and is subject to error. Between 800 and 40,500 second-feet curve was drawn with discharge as a function of $A\sqrt{d}$. Operation of water-stage recorder unsatisfactory as indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height, determined by inspecting gage-height graph, or for days of considerable fluctuation by use of planimeter, or by indirect method for shifting control during periods when aquatic growth affected stage-discharge relation or as otherwise noted in footnote to daily-discharge table. Records good for low and medium stages and poor for high stages.

Discharge measurements of Concho River near San Angelo, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1920.		*Feet.*	*Sec.-ft.*
Oct. 7	Kinnison and Gowans..	0.60	1.6	Nov. 15	D. A. Dudley.....	1.64	78.0
				Jan. 5	.....do.....	1.74	93.8
1919.				Mar. 24	.....do.....	1.63	71.5
Jan. 11	Ellsworth and Congdon	1.28	28.8	Apr. 8	.....do.....	1.28	32.9
May 14	J. E. Powers.....	1.73	95.5	May 27	.....do.....	.99	16.7
June 19	C. E. Ellsworth.....	2.26	240	June 19	.....do.....	3.22	[b] 586
20	.....do.....	3.47	790	July 7	.....do.....	.66	4.50
July 8	Dudley and Twichell..	26.60	[a] 40,500	Sept. 2	.....do.....	2.39	290
Aug. 4	.....do.....	1.38	39.0				

[a] Discharge determined by slope method, using a value of 0.045 for n in Kutter's formula.
[b] Made during falling stage

Daily discharge, in second-feet, of Concho River near San Angelo, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	0.7	134	14			20	160	23	46	945	57	34
2	1.0	122	14			23	108	21	49	.....	46	28
3	.8	108	18			51	2,020	19	46	.....	38	21
4	.8	90	19			42	980	18	33	.....	37	19
5	.7	84			35	35	272	50	32	.....	31	17
6	.6	78		30		28	146	42	29	.....	16	10
7	1.5	404				6.8	94	57	801	.....	12	8.3
8	1.3	544			29	3.8	74	194	185	.....	6.6	7.9
9	1.4	154			31	3.0	67	103	3,750	.....	4.5	7.6
10	1,620	76			31	3.4	51	57	6,300	.....	4.0	7.9
11	1,780	15			33	3.3	48	536	1,600	.....	244	7.9
12	724	14		25	42	3.7	38	1,000	480	.....	86	7.6
13	152	12		22	28	3.8	33	300	253	.....	37	6.0
14	62	11		24	24	4.0	33	122	188	.....	16	4.2
15	37	9.5		26	24	4.0	27	74	680	.....	5.0	86
16	33	8.3		38	25	4.0	23	64	1,910	.....	3.1	774
17	38	7.9		44	24	4.7	22	46	500	.....	2.7	404
18	29	7.9	30	41	24	3.8	21	49	296	.....	3.3	316
19	19	8.3		37	25	6.3	21	67	332	.....	3.7	97
20	368	7.9		36	22	3.8	20	37	580	.....	738	76
21	4,680	6.8		134	24	4.0	21	29	464	.....	227	630
22	2,460	7.4		132	21	5.2	21	28	598	.....	272	516
23	752	7.9		60	21	5.5	20	26	1,650	.....	424	792
24	352	9.1		45	22	837	18	1,340	684	.....	78	251
25	204	10		39	21	3,970	18	436	440	.....	204	149
26	886	10		38	21	1,730	19	152	440	.....	380	117
27	1,840	11		38	21	508	25	92	1,850	.....	178	103
28	626	12		38	19	230	27	70	1,530	86	86	94
29	304	12		37	.....	130	27	62	738	78	97	92
30	194	13		37	.....	101	25	57	734	74	64	90
31	152	.....		37	.....	166	.....	50	.....	67	44	.....
1919-20.												
1	84	.....	74	78	92	80	35	12	10	22	2.2	80
2	82	.....	70	80	92	70	34	12	14	14	5.7	251
3	76	.....	74	82	92	67	38	12	12	10	10	122
4	78	.....	78	80	92	65	37	12	15	12	4.2	82
5	74	.....	82	99	92	59	39	12	22	14	3.7	88
6	6,430	.....	82	99	94	60	35	10	44	6.6	3.4	92
7	6,800	.....	84	97	94	65	33	12	37	3.5	3.3	140
8	2,380	120	84	90	92	65	35	12	28	3.8	2.8	188
9	608	101	80	84	90	64	31	11	20	4.0	2.5	149
10	416	84	80	84	94	70	35	26	14	3.5	2.4	105
11	404	82	82	112	94	62	30	16	15	3.7	2.4	
12	424	80	84	112	101	53	23	18	12	5.0	35	
13	265	78	80	101	101	54	22	16	16	3.7	214	
14	.....	80	82	92	97	51	22	18	22	3.5	53	60
15	.....	82	82	90	92	39	26	18	16	3.1	227	
16	.....	86	86	88	86	35	22	19	12	2.5	286	
17	.....	82	88	86	88	33	24	18	16	3.0	468	
18	.....	80	92	84	88	33	22	16	9.1	2.3	140	50
19	.....	76	97	84	88	33	19	16	424	2.5	67	50
20	.....	79	92	86	88	37	18	16	152	2.5	49	48
21	.....	82	90	78	88	34	16	14	68	2.4	82	44
22	.....	90	86	97	88	38	14	13	50	2.4	608	44
23	.....	99	84	97	86	45	12	17	1,300	2.3	576	45
24	.....	84	80	92	84	62	18	22	276	2.1	742	42
25	.....	78	80	90	80	41	19	18	108	2.0	223	
26	.....	70	80	90	80	38	19	20	80	2.4	127	
27	.....	72	80	88	84	39	17	16	67	2.4	94	40
28	.....	92	78	88	82	33	15	11	53	2.4		
29	.....	86	80	90	80	36	13	14	45	2.3	80	
30	.....	80	80	90	.....	37	12	14	30	2.5		
31	.....	.....	78	92	.....	38	.....	12	.....	2.4		

NOTE.—No record Oct. 14 to Nov. 7, 1919 (discharge ranged between 3,530 and 74 second-feet as shown by maximum and minimum gage heights). Discharge partly estimated owing to breaks in record: Nov. 8, 21, Dec. 2, and 4, 1919; Aug. 27, Sept. 2, 10, and 18, 1920. Discharge interpolated Nov. 20 and Dec. 3, 1919. Indirect method for shifting control used during the following periods: Oct. 1–9, 1918; Mar. 26 to Aug. 11, and Sept. 18–30, 1920. Braced figures show estimated mean discharge for periods included.

Monthly discharge of Concho River near San Angelo, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	4,680	0.6	559	34,400
November	544	6.8	66.5	3,960
December	.....	.....	28.2	1,730
January	134	.....	40.6	2,500
February	.....	19	27.8	1,540
March	3,970	3.0	256	15,700
April	2,020	18	149	8,870
May	1,340	18	168	10,300
June	6,300	29	907	54,000
August	738	2.7	111	6,820
September	774	4.2	159	9,460
1919–20.				
October, 1–13	6,800	74	1,390	35,800
November, 8–30	120	70	84.5	3,850
December	97	70	82.2	5,050
January	112	78	90.3	5,550
February	101	80	89.6	5,150
March	80	33	49.5	3,040
April	39	12	24.5	1,460
May	26	10	15.3	941
June	1,300	9.1	99.6	5,930
July	22	2.0	4.86	299
August	742	2.2	140	8,610
September	251	.....	76.0	4,520

CONCHO RIVER NEAR PAINT ROCK, TEX.

LOCATION.—At Concho, San Saba & Llano Valley Railroad bridge a quarter of a mile below mouth of Kickapoo Creek and 2 miles northwest of Paint Rock, Concho County.

DRAINAGE AREA.—11,800 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—September 20, 1915, to September 30, 1920.

GAGE.—Stevens continuous water-stage recorder attached to downstream end of middle pier of railroad bridge, installed September 16, 1920, inspected by engineers of United States Geological Survey. Prior to September 16, 1920, gage was vertical staff, attached to same pier; read by Oscar Skaggs.

DISCHARGE MEASUREMENTS.—Made by wading or from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of solid rock, smooth, clean, free from vegetation, and permanent. Channel straight for 500 feet above and below gage. Right bank 30 feet high, solid rock, clean, and not subject to overflow; left bank of medium height, sloping, wooded, and subject to overflow during high water. Permanent control during low and medium stages at a shoal in solid rock, 400 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 13.5 feet at 7.30 a. m. June 10 (discharge, 21,300 second-feet); no flow, October 1–9.

Maximum stage recorded during year ending September 30, 1920, 12.0 feet at 9.30 a. m. October 7 (discharge, 16,900 second-feet); minimum stage, 0.80 foot, August 1–5 (discharge, 0.80 second-foot).

1915–1920: Maximum stage recorded, 13.5 feet at 7.30 a. m. June 10, 1919 (discharge, 21,300 second-feet); no flow during periods of every year except 1920.

ICE.—None.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that about 11,000 acres have been declared irrigated by diversions from Concho River, practically all of which are above the station. Flow during low stages is materially affected by diversions.

REGULATION.—Ten storage dams of small capacity are located between this station and San Angelo. An abandoned dam, 12 feet in height, known as "Four-Mile dam," is 4 miles below San Angelo, and a small dam, 8 feet in height, has been constructed for storage on Sims ranch just above the station. None of the dams appreciably affect the flow by storing water, except during extremely low stages.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 1,000 second-feet; fairly well defined between 1,000 and 6,000 second-feet, and extended above. Gage read to hundredths once a day to September 7, 1920. No record September 8–15; discharge interpolated. September 16–30, Stevens water-stage recorder; operation satisfactory. Daily discharge ascertained by applying mean daily gage height to rating table, except as noted above. Records good except for extremely high stages.

Discharge measurements of Concho River near Paint Rock, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height	Discharge.
1918.		*Ft.*	*Sec.-ft.*	1920.		*Ft.*	*Sec.-ft.*
Oct. 5	Kinnison and Gowans..	0.57	0	Jan. 17	D. A. Dudley.....	1.78	104
				Apr. 8	.....do.....	1.28	19.0
1919.				July 1	.....do.....	1.48	42.0
Jan. 9	Ellsworth and Congdon	1.38	31.3	Sept. 17	.....do.....	1.64	72.2
May 13	J. E. Powers.....	2.70	457				
Aug. 6	Dudley and Twichell...	1.33	23				
Nov. 12	D. A. Dudley.....	1.78	98.6				

Daily discharge, in second-feet, of Concho River near Paint Rock, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1....	0	66	20	44	37	19	79	159	37	720	68	29
2....	0	58	19	30	165	19	441	30	37	315	62	29
3....	0	55	19	29	70	18	5,620	20	37	235	53	28
4....	0	51	19	28	62	44	2,460	19	37	165	40	27
5....	0	44	20	28	58	38	432	16	37	135	30	26
6....	0	38	20	28	55	34	113	13	37	108	24	25
7....	0	7,240	20	28	49	30	103	11	235	83	19	23
8....	0	2,030	21	28	55	29	98	8.2	500	30	13	21
9....	0	333	21	28	43	19	70	7.5	8,010	7,210	12	20
10....	3,480	315	21	27	38	12	62	6.8	15,200	1,720	10	19
11....	5,320	295	21	26	30	11	57	2,820	3,810	720	7.9	19
12....	1,280	130	21	26	28	9.2	4,220	1,500	500	315	7.9	17
13....	600	44	21	25	26	7.5	44	235	275	165	4.8	16
14....	360	41	21	30	25	6.5	33	108	182	156	.1	16
15....	58	36	21	38	37	5.5	26	672	150	135	.1	.16
16....	44	33	21	37	41	5.1	23	275	4,340	122	.1	1,450
17....	36	30	30	34	38	4.6	19	62	500	108	4.8	1,120
18....	30	28	75	41	33	4.1	17	30	275	100	13	525
19....	28	26	53	41	29	3.8	16	900	900	96	8.2	165
20....	26	24	44	38	25	3.6	15	600	450	3,480	4.8	150
21....	5,240	22	37	38	24	3.4	13	198	600	970	.8	575
22....	6,810	20	37	1,200	23	4.8	12	34	660	550	108	600
23....	1,540	19	37	153	22	4.6	11	30	4,690	198	810	900
24....	963	25	37	79	22	2,300	9.2	11,400	810	165	360	525
25....	600	24	37	68	21	7,210	6.8	1,540	900	135	108	235
26....	500	23	37	55	21	2,820	4.8	235	235	108	900	165
27....	2,240	22	37	44	20	1,580	4.3	108	4,160	100	550	135
28....	900	21	37	49	20	970	44	83	1,200	96	405	122
29....	600	21	37	46	.....	191	20	44	1,720	88	165	96
30....	360	20	37	43	.....	159	500	44	1,280	81	4.8	62
31....	165	.....	62	38	.....	98	.....	44	.....	75	30	.....

Daily discharge, in second-feet, of Concho River near Paint Rock, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1....	62	182	108	83	98	77	24	11	14	40	0.8	75
2....	62	165	108	81	98	77	23	11	14	30	.8	98
3....	53	153	108	81	98	75	22	11	14	20	.8	220
4....	44	141	108	79	98	72	20	11	17	16	.8	135
5....	37	130	106	113	98	72	20	11	16	13	.8	135
6....	8,010	119	103	108	98	72	19	11	16	12	9.2	108
7....	12,700	108	103	106	98	70	19	9.6	16	11	4.8	103
8....	7,690	575	103	100	103	70	19	9.2	26	10	3.4	101
9....	840	360	103	98	103	68	16	9.2	26	11	2.4	98
10....	500	159	103	98	103	68	12	9.2	23	11	1.8	96
11....	500	122	100	103	103	66	12	9.2	20	11	1.4	93
12....	405	103	98	106	100	66	25	9.2	19	11	6.2	91
13....	360	100	96	106	100	62	22	9.2	14	10	6.8	89
14....	275	98	96	124	100	55	19	9.2	13	10	243	87
15....	198	96	96	122	100	51	16	9.2	14	9.2	1,630	85
16....	159	106	103	113	98	44	13	20	13	8.2	780	83
17....	441	106	103	108	93	43	11	17	12	8.2	291	75
18....	315	103	103	103	88	41	11	16	14	8.2	165	66
19....	191	103	103	96	88	38	11	15	13	8.2	119	57
20....	165	103	108	96	88	37	11	14	275	10	83	51
21....	275	103	106	96	88	36	11	16	108	9.2	62	49
22....	6,410	106	106	122	86	36	11	16	62	8.2	44	46
23....	1,450	106	100	113	83	34	11	15	2,240	8.2	378	44
24....	970	106	93	108	83	34	11	14	840	7.5	1,280	44
25....	387	103	88	98	83	62	11	13	235	7.5	550	43
26....	198	103	93	96	83	58	11	13	119	7.5	251	41
27....	185	103	90	96	83	51	11	13	83	6.2	135	38
28....	159	100	86	108	83	34	11	12	70	3.8	108	37
29....	135	108	83	103	79	30	11	12	58	2.1	96	37
30....	119	108	83	98	.....	28	11	12	48	1.4	88	43
31....	108	.....	83	93	.....	25	.....	12	.....	1.4	79	.....

Monthly discharge of Concho River near Paint Rock, Tex., for the years ending Sept. 30, 1919 and 1920.

Month	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	6,810	0	1,010	62,100
November	7,240	19	371	22,100
December	62	19	31	1,910
January	1,200	25	79	4,860
February	165	20	40	2,220
March	7,210	3.4	505	31,100
April	5,620	4.3	486	28,900
May	11,400	6.8	686	42,200
June	15,200	37	1,730	103,000
July	7,210	30	603	37,100
August	900	.1	123	7,560
September	1,450	16	239	14,200
The year	15,200	0	493	357,000
1919–20.				
October	12,700	37	1,400	86,100
November	575	96	139	8,270
December	108	83	99	6,090
January	124	81	102	6,270
February	103	79	93	5,350
March	77	25	53	3,260
April	24	11	15	892
May	20	9.2	12	738
June	2,240	12	148	8,810
July	40	1.4	11	676
August	1,630	.8	207	12,700
September	220	37	79	4,700
The year	12,700	.8	198	143,000

SAN SABA RIVER AT MENARD, TEX.

LOCATION.—At steel highway bridge in Menard, Menard County, 80 miles above mouth of stream.

DRAINAGE AREA.—1,140 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—September 14, 1915, to September 30, 1920.

GAGE.—Chain gage attached to floor on downstream side of highway bridge; read by W. H. and W. A. Cannon or H. E. Jones.

DISCHARGE MEASUREMENTS.—Made by wading or from downstream side of bridge.

CHANNEL AND CONTROL.—Channel straight 800 feet above and 100 feet below station; water flows through a series of shoals and ponds; channel above gage somewhat obstructed by reeds and grass, but below the gage the flow is only slightly obstructed at times. Right bank composed of gravel and clay, wooded, sloping, high, and not subject to overflow; left bank similar, but low and subject to overflow. A sand and gravel ford just below gage forms a fairly permanent control during low stages, but shifts during medium and high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 13.05 feet at 8.45 a. m. November 8 (discharge not determined); minimum discharge, 4.8 second-feet, October 8.

Maximum stage recorded for year ending September 30, 1920, 7.5 feet at 7.10 a. m. August 24 (discharge not determined); minumum discharge, 11 second-feet at 6.20 p. m. July 12.

1915–1920: Maximum stage recorded, 13.6 feet at 2.30 a. m. September 16, 1915 (discharge not determined); no flow July 12–14, 19–31, Aug. 1–4, and 26–31, 1918.

ICE.—None.

DIVERSIONS.—Considerable land is irrigated with water diverted above station. Noyes canal on right side of river which serves a considerable area diverts a short distance above gage. Records of the Board of Water Engineers for State of Texas show that about 4,300 acres have been declared irrigated by diversions above the station, and about 7,700 acres by diversions below the station.

REGULATION.—Flow unregulated by storage or water-power plants but is largely controlled at low stages during irrigation season by diversion to Noyes canal.

ACCURACY.—Stage-discharge relation not permanent. Rating curve for 1919 fairly well defined below 110 second-feet; curve for 1920 fairly well defined between 25 and 250 second-feet extended above. Gage read to hundredths twice daily. Daily discharge determined by applying mean daily gage height to rating table, except as noted in footnote to daily-discharge table; indirect method for shifting control used, October 1, 1919, to September 30, 1920. Records fair below 150 second-feet and poor above.

Discharge measurements of San Saba River at Menard, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1920.		*Feet.*	*Sec.-ft.*
Oct. 5	Kinnison and Gowans	1.96	20.8	Jan. 20	D. A. Dudley	2.18	46.3
1919.				Mar. 6	do	2.03	28.3
Jan. 9	Ellsworth and Congdon	2.07	39.1	26	do	2.06	28.3
May 17	J. E. Powers	2.56	109	Apr. 24	do	2.20	37.7
18	do	2.29	60.1	June 1	do	2.04	31.8
July 25	Dudley and Twichell	2.00	36.1	July 10	do	2.22	58.8
Nov. 17	D. A. Dudley	2.26	59.1				

Daily discharge, in second-feet, of San Saba River at Menard, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	17	22	40	36	39	39	27	27	25	59	41	42
2	18	23	37	36	39	40	27	28	27	58	42	44
3	15	23	36	32	39	39	27	27	25	61	42	42
4	12	24	38	32	40	40	27	27	26	58	40	40
5	20	23	34	31	39	40	27	26	25	59	42	36
6	16	25	36	33	40	39	26	27	25	58	42	36
7	6.4	25	32	32	41	39	27	27	25	402	42	36
8	4.8	.....	32	32	40	40	27	27	112	422	42	36
9	8.0	.....	31	33	40	39	26	26	.....	71	42	36
10	28	160	33	34	39	29	28	26	45	52	42	38
11	393	91	36	29	40	23	28	27	34	52	42	36
12	138	48	38	35	39	24	28	27	25	47	41	37
13	37	37	42	34	39	23	28	26	27	46	42	38
14	27	48	40	41	40	24	28	25	25	45	44	38
15	24	40	39	45	40	25	28	26	27	45	42	42
16	21	39	38	42	39	24	28	.....	35	45	42	66
17	24	42	34	39	40	24	28	212	112	47	42	91
18	19	40	33	38	40	24	28	45	89	45	42	58
19	21	38	40	37	40	25	28	36	70	46	42	55
20	22	41	49	40	39	23	28	29	114	47	42	56
21	27	38	36	37	39	24	28	26	82	54	44	120
22	27	40	40	38	40	25	26	27	.....	47	49	.....
23	22	38	44	38	40	25	28	25	153	47	47	.....
24	22	40	49	38	40	25	28	26	48	47	42	.....
25	21	55	40	38	39	26	27	27	.....	44	42	40
26	33	49	42	38	40	25	28	24	.....	42	45	35
27	35	45	39	48	40	25	26	25	64	45	45	34
28	22	40	38	41	39	26	26	25	58	44	44	33
29	18	39	38	39	.....	26	27	26	59	41	45	33
30	14	41	36	39	.....	26	26	26	58	40	42	35
31	21	.....	34	39	.....	25	.....	27	.....	41	42	.....
1919–20.												
1	39	41	55	43	42	40	29	39	31	47	38	31
2	40	43	54	43	44	37	29	37	32	45	37	34
3	40	41	54	43	44	37	29	37	33	43	36	33
4	40	40	54	44	44	35	29	34	32	39	36	33
5	41	40	54	43	44	31	29	33	33	38	37	33
6	39	42	54	43	44	28	31	33	33	40	33	31
7	39	41	55	44	44	28	31	33	33	40	35	32
8	39	42	54	43	44	29	31	32	33	42	32	32
9	40	45	54	43	43	27	30	32	33	43	30	32
10	39	49	54	43	42	29	32	32	33	57	29	31
11	40	52	54	43	42	29	30	29	33	52	28	31
12	41	54	54	44	43	28	32	26	33	18	29	30
13	39	56	54	44	41	28	32	26	35	22	31	29
14	40	56	54	43	41	28	32	26	34	21	37	27
15	41	56	52	43	43	26	30	26	34	22	568	27
16	43	56	44	40	43	26	30	26	36	21	676	26
17	49	56	42	40	42	27	31	26	35	23	187	26
18	47	56	42	38	43	27	39	26	34	21	210	26
19	41	58	42	39	43	28	40	27	35	29	88	30
20	40	58	42	40	44	27	38	26	42	31	58	29
21	38	56	42	38	42	28	38	27	47	27	50	29
22	39	58	44	38	44	26	38	28	47	26	46	27
23	39	56	42	39	44	28	38	28	47	22	49	37
24	39	56	42	40	43	26	38	28	45	26	956	36
25	39	56	42	40	42	26	39	28	46	26	191	38
26	39	55	42	40	43	26	38	27	48	27	103	41
27	41	56	43	42	43	28	38	28	49	28	55	39
28	41	56	42	42	42	72	38	28	46	31	47	40
29	44	56	44	44	42	29	37	29	46	29	43	49
30	41	56	44	42	.....	31	39	28	46	29	41	45
31	41	.....	44	44	.....	33	.....	30	.....	35	33	.....

NOTE.—Indirect method for shifting control used during following periods: Oct. 1, 1918, to May 15, June 27 to Sept. 21, 1919. Discharge for following days was not determined because stage as given was beyond limits of rating curve: Nov. 8, 1918, 13.05 feet; Nov. 9, 3.96 feet; May 16, 1919, 6.50 feet; June 9, 4.27 feet; June 22, 4.79 feet; June 25, 7.27 feet; June 26, 4.29 feet; Sept. 22, 9.45 feet; Sept. 23, 8.75 feet; and Sept. 24, 1919, 3.80 feet.

Monthly discharge of San Saba River at Menard, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	393	4.8	36.6	2,250
December	49	31	37.9	2,330
January	48	29	36.9	2,270
February	41	39	39.6	2,200
March	40	23	29.1	1,790
April	28	26	27.3	1,620
July	422	40	72.8	4,480
August	49	40	42.7	2,630
1919–20.				
October	49	38	40.6	2,500
November	58	40	51.4	3,060
December	55	42	48.2	2,960
January	44	38	41.8	2,570
February	44	41	42.9	2,470
March	72	26	30.6	1,880
April	40	29	33.8	2,010
May	39	26	29.5	1,810
June	49	31	38.1	2,270
July	57	18	32.3	1,990
August	956	28	125	7,690
September	49	26	32.8	1,950
The year	956	18	45.7	33,200

SAN SABA RIVER NEAR SAN SABA, TEX.

LOCATION.—About 200 feet above Beveridge highway bridge, 1 mile below mouth of China Creek, 2 miles northwest of San Saba, San Saba County, 3 miles below mouth of Richland Creek, and 4 miles above mouth of Simpson Creek.

DRAINAGE AREA.—3,000 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—December 30, 1904, to December 31, 1906; September 11, 1915, to September 30, 1920. Miscellaneous discharge measurements previous to 1904.

GAGE.—Vertical and inclined staff, on right bank; read by G. M. Pool. From December 30, 1904, to December 31, 1906, gage heights were obtained by measuring with a tape from a reference point on the bridge to the water surface. Relation between datum used 1904–1906 and that of present gage is not known.

DISCHARGE MEASUREMENTS.—Made by wading or from downstream side of bridge.

CHANNEL AND CONTROL.—Channel straight above and below station for 100 feet. Bed composed of rock and gravel; shifts. Left bank composed of gravel and clay, wooded, high, and not subject to overflow; right bank consists of clay and gravel, wooded, sloping, medium in height, and subject to overflow during high water. A shoal at a ford about 75 feet below gage serves as control during medium and low stages; control is free from vegetation and shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 30.7 feet September 23 (discharge, 11,700 second-feet, determined from extension of rating curve; minimum stage, 1.10 feet at 6.40 p. m. October 1 and 6.10 p. m. October 2 (discharge, 9.5 second-feet).

Maximum stage recorded during year ending September 30, 1920, 14.2 feet on night of October 16-17, determined from flood marks on gage (discharge, 4,340 second-feet); minimum stage, 1.64 feet at 6.45 p. m. July 8 (discharge, 68 second-feet).

1904–1906; 1915–1920: Maximum stage recorded, 31.7 feet August 7, 1906 (discharge not determined); no flow August 9 and 10, 1918.

ICE.—None.

DIVERSIONS.—Considerable water is diverted from stream and tributaries above station. There are also diversions below the station, but none in vicinity of station. Flood water from Brady Creek at Brady is stored for municipal uses; capacity of reservoir not known, but probably small. Records of the Board of Water Engineers for the State of Texas show that about 9,300 acres have been declared irrigated by diversions above station and about 2,700 acres by diversions below station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves well defined between 5 and 6,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used October 1, 1918, to September 30, 1919, October 13 to December 19, 1919, and January 7 to April 20, 1920. Records fair.

Discharge measurements of San Saba River near San Saba, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft*	1919.		*Feet.*	*Sec.-ft.*
Oct. 10	Kinnison and Gowans.	4.03	646	Aug. 8	Dudley and Twichell...	2.08	130
11	A. K. Gowans.....	12.86	3,800	Nov. 4	D. A. Dudley.....	2.97	356
12	Kinnison and Gowans.	18.71	a6,250				
12	.....do.....	14.71	4,690	1920.			
12	.....do.....	12.42	3,540	Mar. 2	.....do.....	2.78	245
13	.....do.....	5.17	989	31	.....do.....	2.42	181
				Apr. 25	.....do.....	2.20	156
1919.				June 3	.....do.....	3.00	326
Jan. 13	Ellsworth and Congdon	1.89	96.4	July 12	.....do.....	1.98	112
May 21	J. E. Powers.....	2.75	292				

a Surface velocity observed over part of the section.

Daily discharge, in second-feet, of San Saba River near San Saba, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	16	71	116	136	223	124	130	59	94	532	186	202
2	15	70	107	132	223	124	124	52	96	365	175	184
3	17	60	101	126	212	122	122	53	108	329	168	170
4	17	58	98	120	198	122	124	53	107	294	159	161
5	16	54	94	114	191	120	114	1,060	96	257	150	152
6	21	48	91	108	200	120	108	301	86	228	141	147
7	21	347	92	108	184	116	105	218	78	221	136	143
8	22	5,140	91	105	175	122	99	430	74	233	128	141
9	21	11,300	91	101	163	130	136	132	266	311	126	136
10	276	1,760	91	98	156	134	101	108	4,010	329	126	128
11	3,370	594	88	98	154	128	92	512	2,960	257	124	126
12	6,060	365	88	98	150	124	89	864	547	223	122	122
13	834	264	88	96	150	124	89	1,010	316	186	116	118
14	438	99	88	99	145	120	89	249	274	175	110	116
15	214	252	88	112	141	124	84	900	177	163	105	342
16	156	191	84	159	136	128	83	2,270	259	145	103	1,630
17	112	145	86	228	150	130	77	1,530	2,090	141	99	684
18	86	124	99	269	177	124	77	609	489	141	172	304
19	72	112	249	247	186	110	77	424	951	126	588	247
20	67	107	666	242	182	107	77	1,160	1,100	4,430	205	1,860
21	58	103	449	212	184	101	72	344	696	5,490	2,950	242
22	708	99	200	2,510	156	94	67	212	1,240	1,440	909	7,730
23	1,670	103	4,830	547	150	94	62	166	3,860	588	1,030	9,160
24	567	99	741	329	139	112	59	147	1,340	403	684	5,830
25	214	99	342	264	134	2,000	57	182	2,610	319	435	2,160
26	143	128	233	223	128	373	57	170	3,150	269	744	1,330
27	573	230	193	822	128	209	58	205	3,930	240	684	888
28	230	159	170	576	126	166	59	163	3,830	223	550	708
29	152	147	156	337	.....	147	63	130	2,320	214	324	588
30	92	122	147	276	.....	296	71	108	696	205	254	558
31	78	.....	145	242	.....	168	.....	101	.....	195	214	.....

Daily discharge, in second-feet, of San Saba River near San Saba, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	470	426	560	268	356	244	184	127	131	102	94	117
2	384	398	500	268	356	244	178	136	148	91	84	129
3	356	384	500	268	356	244	174	131	370	88	188	131
4	343	356	456	268	343	233	168	131	226	91	224	141
5	317	343	456	398	343	222	174	131	215	85	172	134
6	330	343	456	745	343	222	170	134	163	79	124	134
7	441	356	456	560	343	222	176	620	154	75	370	1,270
8	651	3,700	441	441	343	222	178	905	143	70	168	141
9	777	1,720	398	412	330	222	174	196	136	145	122	127
10	530	1,400	370	356	330	222	174	233	129	163	104	112
11	1,400	841	370	1,000	330	222	172	398	126	122	94	104
12	560	713	370	2,310	426	222	165	244	120	114	89	101
13	456	590	356	1,200	370	222	165	188	163	129	87	96
14	384	590	356	809	330	222	166	178	141	104	95	95
15	356	590	343	651	317	211	170	184	120	91	938	92
16	356	590	330	620	328	211	168	412	120	88	1,000	91
17	3,380	560	330	590	338	203	165	268	120	91	1,540	91
18	938	500	330	560	348	203	161	194	116	84	560	91
19	713	470	370	530	358	203	152	166	198	85	292	99
20	560	470	370	500	268	198	150	152	163	182	268	92
21	470	456	343	470	268	205	148	150	131	132	200	92
22	777	456	330	470	268	205	145	145	117	95	159	89
23	2,620	426	317	441	268	205	148	139	120	95	141	84
24	1,140	426	317	441	268	205	147	141	116	95	188	83
25	620	426	304	441	268	233	154	139	114	89	161	81
26	560	412	292	441	256	233	154	138	111	83	682	83
27	560	398	292	412	256	213	141	138	108	79	317	81
28	485	651	292	412	244	196	138	138	108	84	218	85
29	456	682	279	398	244	190	129	134	111	168	170	88
30	441	620	279	370	.....	184	131	131	110	124	139	85
31	456	.....	268	370	.....	182	.....	134	.....	124	120	.....

NOTE.—Discharge, Nov. 9, 1918, Sept. 22 and 23, 1919, determined from extension of rating curve and is subject to considerable error. Discharge, Feb. 16–19, 1920, interpolated.

Monthly discharge of San Saba River near San Saba, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	6,060	15	526	32,400
November	11,300	48	748	44,500
December	4,830	84	329	20,200
January	2,510	96	294	18,100
February	223	126	166	9,220
March	2,000	94	200	12,300
April	136	57	87	5,180
May	2,270	52	449	27,600
June	4,010	74	1,260	75,000
July	5,490	126	602	37,000
August	2,950	99	387	23,800
September	9,160	116	1,210	72,000
The year	11,300	15	521	377,000
1919–20.				
October	3,380	317	719	44,200
November	3,700	343	676	40,200
December	560	268	369	22,700
January	2,310	268	562	34,600
February	426	244	317	18,200
March	244	182	215	13,200
April	184	129	161	9,580
May	905	127	215	13,200
June	370	108	145	8,630
July	182	70	105	6,460
August	1,540	84	294	18,100
September	1,270	81	141	8,390
The year	3,700	70	327	237,000

NORTH LLANO RIVER NEAR JUNCTION, TEX.

LOCATION.—About 500 feet above remains of old Wilson dam, 1 mile below mouth of Bear Creek, 2½ miles above North Llano highway bridge, 3 miles northwest of Junction, Kimble County, and 4 miles above confluence of North Llano and South Llano rivers.

DRAINAGE AREA.—803 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—September 14, 1915, to September 30, 1920.

GAGE.—Overhanging chain gage on left bank; read by J. L. Sparkman, A. T. Copple, and W. M. Keen.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge 2½ miles below station.

CHANNEL AND CONTROL.—Bed composed of solid rock. Channel straight above and below for 400 feet, with a series of pools and rapids. Left bank high, clean, and not subject to overflow; right bank low, wooded, and subject to overflow during high stages. One channel at all stages; current sluggish at gage during low and medium stages. A solid rock ledge of approximately 2 feet vertical fall at site of old dam serves as a permanent control for medium and low stages, except slight effect from accumulation of moss during low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 10.8 feet at 6 a. m. September 22 (discharge not determined); minimum stage, 0.82 foot October 8, 1918 (discharge, 0.3 second-foot).

Maximum stage recorded during year ending September 30, 1920, 4.4 feet at 9 a. m. May 13 (discharge not determined); minimum stage, 1.26 feet July 23–29 and August 3 to 6 (discharge, 12 second-feet).

1915–1920: Maximum stage recorded, 18.00 feet during night of September 15, 1915 (discharge not determined); no flow during periods in 1917 and 1918.

ICE.—None.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that about 1,200 acres have been declared irrigated by diversion above the station. During low stages, such diversions materially reduce flow at station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent for low and medium stages, except as slightly affected by aquatic growth on control. Rating curves used November 8, 1918, to September 30, 1919, and October 1, 1919, to September 30, 1920, fairly well defined between 1 and 120 second-feet; extended above. Gage read to hundredths twice daily and oftener during floods. Daily discharge determined by applying mean daily gage height to rating table; indirect method used October 1 to November 7, 1918. Records good for low and medium stages.

Discharge measurements of North Llano River near Junction, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Ft.*	*Sec.-ft.*	1919.		*Ft.*	*Sec.-ft.*
Oct. 4	Kinnison and Gowans.	0.94	[a] 0.5	Nov. 19	D. A. Dudley.....	1.69	94.6
1919.				1920.			
Jan. 8	Ellsworth and Congdon	1.35	21.4	Jan. 20	.....do.....	1.62	70.8
8	.....do.....	1.35	21.0	Mar. 5	.....do.....	1.55	49.1
May 19	J. E. Powers.....	1.70	108	June 1	.....do.....	1.43	33.4
July 25	Dudley and Twichell..	1.54	46.7				

[a] Estimated.

Daily discharge, in second-feet, of North Llano River near Junction, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	1.2	8.4	19	21	33	21	30	49	33	153	29	77
2	1.0	7.2	19	21	33	21	34	36	49	127	29	67
3	.9	7.2	19	21	30	21	37	30	31	120	27	67
4	.9	7.2	19	23	34	21	33	30	30	100	26	64
5	.9	8.4	19	23	36	21	33	36	30	97	24	55
6	.7	9.6	19	23	30	21	30	30	30	86	24	.....
7	.4	9.6	18	23	30	21	27	25	30	97	22	.....
8	.3	.....	18	21	30	21	25	25	30	103	20	.....
9	.9	.....	18	21	30	21	33	26	44	80	20	.....
10	7.2	93	18	21	30	21	29	30	64	70	20	.....
11	6.6	83	18	21	30	21	23	117	58	58	20	.....
12	6.0	70	16	21	30	21	23	124	55	55	20	.....
13	36	64	16	21	30	21	23	39	49	52	20	.....
14	14	58	16	22	30	21	21	39	39	44	20	.....
15	1.6	47	16	22	30	21	21	39	39	44	20	.....
16	1.6	39	16	21	30	21	21	39	49	42	20	.....
17	1.6	36	16	21	34	21	21	39	58	39	18	131
18	1.6	36	16	21	30	21	21	93	36	36	17	100
19	1.5	33	16	21	27	21	21	93	42	36	17	86
20	1.5	31	21	21	33	21	21	93	97	47	17	86
21	11	30	23	16	29	21	21	93	117	67	.....	103
22	70	27	23	117	25	21	19	80	77	47	.....	.....
23	20	30	34	93	21	21	19	67	55	44	.....	.....
24	18	23	30	39	21	49	18	97	.....	52	.....	.....
25	29	23	25	25	21	110	17	61	.....	49	172	.....
26	21	23	24	25	21	86	17	61	.....	44	134	.....
27	19	23	23	42	21	58	17	49	.....	37	127	.....
28	17	23	23	44	21	31	17	34	.....	34	153	.....
29	15	21	21	39	.....	30	17	33	216	31	114	.....
30	12	21	21	33	.....	30	168	30	180	29	107	.....
31	8.4	.....	21	34	.....	30	.....	39	.....	29	86	.....
1919-20.												
1	.....	132	75	49	59	49	38	32	32	20	16	38
2	.....	129	75	49	59	59	38	32	26	18	16	158
3	.....	122	75	49	59	59	38	32	26	16	12	68
4	.....	114	75	49	59	59	38	32	26	18	12	59
5	.....	114	78	78	59	54	38	29	26	20	12	54
6	.....	114	71	68	59	54	39	29	26	18	75	49
7	.....	140	64	54	59	49	41	26	26	16	33	45
8	.....	147	61	51	59	49	41	26	24	22	22	38
9	.....	122	61	49	59	49	41	26	24	25	22	38
10	.....	114	61	49	59	49	41	24	24	26	18	38
11	.....	107	61	78	59	49	41	26	22	26	18	38
12	.....	100	61	78	59	49	41	26	22	23	18	35
13	208	93	61	59	59	49	41	.....	22	22	16	35
14	196	93	61	59	59	49	38	.....	22	20	.....	32
15	196	93	61	59	59	45	38	68	22	18	.....	32
16	196	93	61	59	59	45	38	61	22	18	.....	29
17	188	93	61	59	59	41	35	49	22	18	.....	28
18	173	93	61	59	59	41	35	41	22	18	129	26
19	173	100	56	59	56	41	35	41	22	16	100	26
20	165	100	56	61	54	41	35	41	22	16	71	26
21	162	93	51	59	54	41	35	41	45	15	64	26
22	.....	89	51	75	54	41	35	41	35	14	59	26
23	196	86	51	78	49	41	33	41	26	12	154	26
24	177	86	51	71	49	38	32	38	25	12	75	24
25	158	82	51	71	49	54	32	35	24	12	61	24
26	158	78	51	71	49	47	32	32	22	12	56	24
27	150	78	51	71	49	41	32	29	22	12	51	23
28	147	96	51	71	49	41	32	29	22	12	38	22
29	143	86	51	71	49	38	32	26	22	12	38	.....
30	143	78	51	71	.....	38	32	26	22	16	38	111
31	143	.....	51	71	.....	38	.....	26	.....	16	38	.....

NOTE.—No record Sept. 6-15, 1919. Discharge for following days not determined, because stage was above the limit for which rating curve was defined by discharge measurements:

Day.	Gage height.	Day.	Gage height.	Day.	Gage height.	Day.	Gage height.	Day.	Gage height.
1918.	*Feet.*	1919.	*Feet.*	1919.	*Feet.*	1919.	*Feet.*	1920.	*Feet.*
Nov. 8...	4.06	Aug. 21...	5.54	Sept. 26...	2.77	Oct. 5...	2.07	May 13...	2.90
9...	2.91	22...	4.04	27...	2.63	6...	2.28	14...	2.14
		23...	2.46	28...	2.49	7...	2.14	Aug. 14...	2.91
1919.		24...	2.00	29...	2.40	8...	2.33	15...	3.80
June 24...	2.36	Sept. 16...	2.31	30...	2.32	9...	2.14	16...	2.70
25...	3.02	22...	6.39	Oct. 1...	2.24	10...	2.06	17...	2.09
26...	3.13	23...	6.58	2...	2.17	11...	2.02	Sept. 29...	2.52
27...	2.84	24...	6.83	3...	2.12	12...	2.01		
28...	2.46	25...	3.39	4...	2.10	22...	2.72		

Monthly discharge of North Llano River near Junction, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	36	0.3	10.5	646
November		7.2		
December	34	16	20.0	1,230
January	117	21	30.2	1,860
February	36	21	28.6	1,590
March	110	21	29.3	1,800
April	168	17	28.6	1,700
May	124	25	54.1	3,330
June		30		
July	153	29	62.9	3,870
August		17		
1919-20.				
November	147	78	102	6,070
December	78	51	59.9	3,680
January	78	49	63.1	3,880
February	59	49	56.0	3,220
March	59	38	46.4	2,850
April	41	32	36.6	2,180
June	45	22	24.8	1,480
July	26	12	17.4	1,070

NOTE.—See footnote to daily-discharge table.

LLANO RIVER NEAR JUNCTION, TEX.

LOCATION.—About 100 feet north of Kerrville-Junction road, a quarter of a mile northeast of Oliver ranch house, 3 miles below confluence of North Llano and South Llano rivers, 3½ miles east of Junction, Kimble County, and 4 miles above creek entering river from south.

DRAINAGE AREA.—1,700 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—September 13, 1915, to September 30, 1920.

GAGE.—Vertical staff, graduated from 0 to 7.5 feet, attached to tree on right bank, and inclined staff, graduated from 7.6 to 19.5 feet, a few feet upstream from vertical staff; read by Sadie Oliver.

DISCHARGE MEASUREMENTS.—Made by wading at Mason road crossing a quarter of a mile above gage or from cable 400 feet above gage.

CHANNEL AND CONTROL.—Bed composed of solid rock, clean, and permanent. Channel straight for 700 feet above and 350 feet below the gage. Left bank of medium height, slightly wooded, and subject to overflow during high water; right bank clean, high, and not subject to overflow. One channel at all stages except during extreme floods, when a small part of the flow may follow a slough that leaves the river a short distance above the gage, passes to the south of Oliver ranch house, and enters the main stream below the gage. Such conditions do not occur, however, at intervals more frequent than 10 to 15 years and will not greatly affect records. Rock ledge 75 feet below gage, forming a fall of approximately 3 feet, serves as permanent control for low and medium stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 15.0 feet at 11 a. m. September 27 (discharge not determined); minimum stage, 1.42 feet during October 6 and 7 (discharge, 35 second-feet).

Maximum stage recorded during year ending September 30, 1920, 10.0 feet at 9 a. m. May 14 (discharge not determined); minimum stage, 1.68 feet during July 28 to August 12 (discharge, 109 second-feet).

1915–1920: Maximum stage recorded, 26.3 feet at 3 a. m. September 16, 1915 (discharge not determined); minimum stage, 1.32 feet during August 23–28, 1918 (discharge, 13 second-feet).

ICE.—None reported.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that about 2,500 acres have been declared irrigated by diversions above station and about 1,300 below station. Diversions materially reduce flow at station during low stages.

REGULATION.—Slight regulation from water-power plant on South Llano River at Junction, Tex.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 24 and 250 second-feet. Gage read to hundredths once daily, oftener during high water, but one reading daily may not be true mean owing to slight regulation by power plant at Junction. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent for low and medium stages; determination of discharge above 400 second-feet may be considerably in error.

Discharge measurements of Llano River near Junction, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 4	Kinnison and Gowans..	1.42	30.6	Nov. 18	D. A. Dudley.....	1.99	253
1919.				1920.			
Jan. 8	Ellsworth and Congdon	1.60	78.8	Jan. 21	.....do.....	1.86	197
8	.....do.....	1.60	77.9	Mar. 4	.....do.....	1.80	153
May 19	J. E. Powers.....	1.92	222	June 2	.....do.....	1.74	130
July 24	Dudley and Twichell...	1.74	151				

Daily discharge, in second-feet, of Llano River near Junction, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	39	69	94	84	116	84	77	102	94	165	94	306
2	39	69	94	84	116	84	91	58	87	112	94	306
3	39	69	94	84	116	84	91	58	116	112	87	306
4	39	63	94	77	116	84	91	58	116	112	87	306
5	37	63	94	77	116	84	77	48	87	112	87	306
6	35	63	94	77	116	84	112	48	87	112	87	306
7	35	63	94	77	116	84	112	48	87	156	80	306
8	39	.....	87	77	116	84	98	48	80	120	80	306
9	39	.....	87	77	109	80	98	102	80	112	74	260
10	39	.....	87	77	109	74	98	170	218	112	74	260
11	39	.....	87	72	102	74	77	.....	160	112	63	208
12	39	.....	87	72	102	74	77	.....	160	112	52	208
13	39	208	87	72	102	74	77	.....	116	105	52	208
14	39	208	87	72	102	74	66	213	116	102	52	208
15	74	208	87	72	102	74	66	213	116	91	48	208
16	74	208	87	72	98	74	66	213	87	91	44	208
17	74	160	102	72	98	74	66	213	87	91	44	208
18	74	160	102	72	98	74	60	198	87	91	39	208
19	69	142	102	72	98	74	60	198	87	91	39	208
20	69	142	102	72	98	74	58	198	87	134	39	208
21	69	142	94	434	98	74	48	198	87	134	.....	318
22	69	142	94	250	91	74	48	198	84	160	.....	.....
23	69	142	94	189	91	74	48	198	84	160	.....	.....
24	69	116	94	116	91	229	48	198	203	142	.....	.....
25	69	116	94	116	84	109	48	198	213	142	.....	.....
26	69	109	94	116	84	94	48	198	.....	109	.....	.....
27	69	109	94	116	84	94	48	198	.....	109	440	378
28	69	94	94	239	84	80	48	198	.....	102	403	378
29	69	94	94	189	.....	80	44	165	213	102	366	378
30	69	94	94	151	.....	77	44	147	203	94	306	378
31	69	.....	94	116	.....	77	.....	98	.....	94	306	.....
1919–20.												
1	378	428	239	189	198	179	179	134	151	116	109	160
2	318	403	239	189	198	179	179	125	134	118	109	403
3	318	403	239	179	198	179	179	125	125	120	109	198
4	318	403	239	179	198	160	179	125	125	125	109	198
5	318	403	239	179	198	179	179	125	142	125	109	160
6	318	390	239	179	198	179	179	125	142	125	109	160
7	306	390	239	179	198	179	179	125	142	125	109	142
8	306	390	239	179	189	179	179	125	134	125	109	142
9	318	390	229	179	189	179	179	198	125	125	109	134
10	318	318	229	179	189	179	179	179	125	125	109	134
11	318	330	229	198	189	179	170	179	125	125	109	134
12	318	330	229	198	189	179	170	179	125	125	109	116
13	312	318	229	198	189	179	160	170	116	125	116	116
14	312	295	229	198	189	179	151	.....	116	125	.....	116
15	306	272	218	198	189	179	151	.....	116	125	208	116
16	306	272	218	198	189	179	151	198	116	125	198	116
17	306	260	218	198	189	184	142	198	116	125	160	116
18	306	260	218	198	189	179	142	189	116	116	160	116
19	306	260	218	198	189	179	142	189	260	116	160	116
20	306	260	218	198	189	179	142	189	160	116	184	116
21	306	260	208	193	189	179	142	189	142	116	170	116
22	.....	260	208	198	179	179	142	189	134	116	170	116
23	505	250	198	198	179	229	134	189	116	116	170	116
24	492	250	198	198	179	198	134	179	116	116	170	116
25	466	250	198	198	179	189	134	179	116	112	160	116
26	440	250	189	189	179	189	134	179	116	112	160	116
27	440	239	189	189	179	189	134	179	116	112	160	116
28	440	239	189	198	179	179	134	179	116	109	160	116
29	428	239	189	198	179	179	134	179	116	109	160	.....
30	428	239	189	198	.....	179	134	179	116	109	160	575
31	428	.....	189	198	.....	179	.....	160	.....	109	160	.....

NOTE.—Discharge, July 1–3, 1920, interpolated. Rating curve not sufficiently well defined to permit determination of discharge for following days:

Day.	Gage height.	Day.	Gage height.	Day.	Gage height.	Day.	Gage height.	Day.	Gage height.
1918.	*Feet.*	1919.	*Feet.*	1919.	*Feet.*	1919.	*Feet.*	1920.	*Feet.*
Nov. 8....	3.00	May 11....	3.80	Aug. 21....	7.78	Sept. 22...	14.00	May 14....	10.00
9....	2.90	12....	8.62	22....	8.00	23...	15.00	15....	2.90
10....	2.70	13....	2.83	23....	4.90	24...	13.20	Aug. 14....	2.93
11....	2.70	June 26....	3.91	24....	3.88	25...	3.60	Sept. 29...	2.90
12....	2.70	27....	5.52	25....	2.80	26...	3.20		
		28....	3.01	26....	2.68	Oct. 22....	2.70		

Monthly discharge of Llano River near Junction, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	74	35	55.8	3,430
November	.....	63	.....	.....
December	102	87	93.0	5,720
January	434	72	114	7,010
February	116	84	102	5,660
March	229	74	84.8	5,210
April	112	44	69.7	4,150
May	.....	48	.....	.....
June	.....	80	.....	.....
July	165	91	116	7,130
August	.....	39	.....	.....
September	.....	208	.....	.....
1919–20.				
November	428	239	308	18,300
December	239	189	217	13,300
January	198	179	192	11,800
February	198	179	188	10,800
March	229	160	182	11,200
April	179	134	156	9,280
June	260	116	130	7,740
July	125	109	119	7,320

NOTE.—See footnote to table of daily discharge.

BARTON SPRINGS AT AUSTIN, TEX.

LOCATION.—Barton Springs issue from channel of Barton Creek, 1,600 feet above Bee Cave highway bridge, half a mile above confluence of Barton Creek and Colorado River, and half a mile southwest of Austin, Travis County.

RECORDS AVAILABLE.—October 1, 1918, to September 30, 1920. Daily records of flow of Barton Creek, which closely approximate flow of Barton Springs, as the ordinary flow of the creek is from the springs, have been published from April 25, 1917, to September 30, 1918. Miscellaneous discharge measurements of Barton Creek were made from 1894 to 1906, and during 1916 and 1917.

DISCHARGE MEASUREMENTS.—Made by wading Barton Creek above and below the springs, in order to determine the flow of springs as indicated in the following table:

Discharge measurements of Barton Creek and determination of discharge of Barton Springs at Austin, Tex., during years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Discharge of creek below springs.	Discharge of creek above springs	Discharge of springs.	Date.	Made by—	Discharge of creek below springs.	Discharge of creek above springs.	Discharge of springs.
1918.					1919.				
Oct. 18	H. B. Kinnison	14.1	0	14.1	Oct. 25	L. D. Snow	399	270	129
Nov. 18	do	17.6	0	17.6	Nov. 5	do	198	97	101
Dec. 2	A. K. Gowans.	16.5	0	16.5	15	do	162	57.5	104
14	Ellsworth and Gowans	15.2	0	15.2	26	do	122	29.6	92.4
1919.					Dec. 20	T. Twichell	102	23.9	78.1
Jan. 10	Kinnison and Hank	26.7	.....	.....	1920.				
Feb. 11	A. K. Gowans.	87.8	.....	.....	Jan. 3	do	82.0	11.0	71.0
27	Hank and Gowans	116	60.0	56.0	17	do	275	136	139
Mar. 14	R. J. Hank	75.0	20.2	54.8	31	Twichell and Pritchett	249	159	90
Apr. 10	do	105	35.7	69.3	Feb. 21	T. Twichell	141	46.8	94.2
May 6	do	1,450	.....	.....	Mar. 2	do	116	29.1	86.9
21	Ellsworth and Hank	249	160	89	20	do	81.3	10.0	71.3
July 15	Ellsworth and Dudley	95.0	34.0	61.0	Apr. 13	do	72.3	.4	71.9
Aug. 12	T. Twichell	132	79.0	53.0	24	do	64.0	.3	63.7
12	do	.....	.....	[a] 7.7	May 8	do	56.0	0	56.0
Sept. 11	do	63.7	6.9	56.8	22	do	164	63.4	101
29	D. A. Dudley	187	103	84	June 7	do	133	41.3	91.7
Oct. 8	do	228	158	70	22	do	69.8	[b] .5	69.3
					July 7	do	69.8	[b] .5	69.3
					21	do	58.6	0	58.6
					Aug. 24	do	121	44.5	76.5
					Sept. 20	do	61.4	[b] .5	60.9

[a] Measurement made at spillway of concrete oval of one spring.
[b] Estimated.

GUADALUPE RIVER BASIN.

GUADALUPE RIVER NEAR COMFORT, TEX.

LOCATION.—On Comfort-Kerrville road 100 feet upstream from "Boerner crossing," 3½ miles west of Comfort, Kerr County.

DRAINAGE AREA.—909 square miles (measured on topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—December 16, 1917, to September 30, 1920.

GAGE.—Vertical staff in two sections on left bank; read by James B. Saylor and Robert Faust.

DISCHARGE MEASUREMENTS.—Low-water measurements made by wading. No high-water section available.

CHANNEL AND CONTROL.—Bed composed of rock, sand, and gravel. Left bank composed of clay, slightly wooded, and not subject to overflow. Right bank low, wooded, and subject to overflow. Control shifts during floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, about 41 feet on August 21, determined from flood marks near gage (discharge not determined); minimum stage, 1.06 feet at 2.13 p. m. October 8 (discharge, 6 second-feet).

Maximum stage during year ending September 30, 1920, occurred on October 16 (not recorded); minimum stage, 1.68 feet at 8.50 a. m. September 28 (discharge, 58 second-feet).

1917–1920: Maximum stage recorded about 41 feet on August 21, 1919, determined from flood marks near gage (discharge not determined); minimum stage, 1.06 feet at 2.13 p. m. October 8, 1918 (discharge, 6.0 second-feet).

ICE.—None reported.

DIVERSIONS.—Few pumping plants along stream about 7 miles above station. Records of the Board of Water Engineers for State of Texas show that a total of about 400 acres have been declared irrigated by diversion above the station.

REGULATION.—At Kerrville and Center Point dams are constructed and water used for mill purposes, but the effect of the regulation is slight, except during low stages.

ACCURACY.—Stage-discharge relation changes during floods. Rating curve fairly well defined below 400 second-feet and extended above. Gage read to hundredths once daily, except as shown in footnote to daily-discharge table. One reading a day may not be true index to discharge at low stages owing to storage and intermittent pumping above gage and to rapid fluctuations during flood stages. Daily discharge determined by applying mean daily gage height to rating table; indirect method used October 6, 1918, to September 30, 1919. Discharge above 400 second-feet determined from extension of rating curve and subject to considerable error. Records fair.

Discharge measurements of Guadalupe River near Comfort, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 22	McCashin and Congdon.	2.55	211	Feb. 2	Ellsworth and Congdon.	2.12	146
Nov. 30	E. P. Congdon.....	1.68	56.9	Dec. 17	C. E. Ellsworth.....	2.96	361
				1920.			
				Sept. 8	McCashin and West...	1.99	114

Daily discharge, in second-feet, of Guadalupe River near Comfort, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	12	21	55	147	132	72	172	93	82	187	150	466
2	12	21	50	147	136	72	201	83	74	159	132	402
3	11	22	48	145	132	72	177	76	84	150	122	372
4	15	23	45	145	226	72	168	74	81	141	112	366
5	11	23	44	145	126	93	132	73	72	128	104	366
6	12	24	43	116	126	76	124	73	68	120	104	357
7	13	.....	43	83	112	61	112	73	67	810	104	350
8	6	.....	43	70	112	70	102	73	78	920	93	342
9	16	663	42	67	110	67	282	76	88	532	86	342
10	12	.....	42	66	108	67	104	145	466	434	90	312
11	42	.....	41	64	108	70	102	306	112	253	93	294
12	18	.....	40	60	108	70	102	466	88	226	93	282
13	65	.....	100	60	93	70	108	434	84	190	90	253
14	43	.....	65	61	90	73	101	226	76	154	90	.....
15	27	.....	64	64	84	70	93	177	74	154	90	.....
16	26	.....	61	154	93	70	90	670	73	154	90	.....
17	25	.....	199	112	102	64	83	312	73	132	86	.....
18	16	.....	197	112	108	61	76	233	90	120	83	.....
19	19	.....	176	112	102	58	76	154	154	112	61	.....
20	19	.....	169	112	93	56	73	145	132	110	61	.....
21	19	.....	136	108	90	56	70	124	108	466	.....	.....
22	223	.....	813	.....	84	58	67	112	108	635	.....	.....
23	88	.....	.....	.....	76	60	70	154	108	434	.....	.....
24	57	.....	880	.....	81	61	73	154	88	466	.....	.....
25	43	.....	402	.....	81	1,100	73	143	90	282	.....	.....
26	38	.....	201	.....	76	726	73	132	652	372	.....	.....
27	33	.....	177	201	73	466	73	101	880	286	.....	.....
28	28	.....	154	182	73	282	73	90	670	201	.....	.....
29	30	.....	150	154	.....	226	154	83	312	177	.....	635
30	27	59	147	132	.....	214	132	83	226	168	532	635
31	23	.....	147	132	.....	201	.....	90	.....	154	499	.....

Daily discharge, in second-feet, of Guadalupe River near Comfort, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	775	.....	775	342	372	297	372	172	177	168	108	112
2	775	.....	775	327	372	282	342	170	253	159	108	93
3	775	.....	740	327	372	282	282	168	226	154	101	61
4	775	.....	740	396	372	282	268	168	201	148	101	112
5	775	.....	740	466	372	282	253	163	196	143	93	109
6	775	.....	740	372	372	282	248	154	.....	132	104	107
7	775	880	740	372	357	282	242	154	.....	130	.....	104
8	.....	880	740	357	357	282	242	150	670	130	740	110
9	.....	862	740	357	357	282	226	150	282	130	670	104
10	.....	845	740	357	357	282	216	150	253	130	282	104
11	.....	845	740	514	357	282	211	150	201	121	201	104
12	.....	845	740	670	357	282	206	150	191	112	177	100
13	.....	845	740	670	357	282	206	150	189	104	154	97
14	880	845	556	670	357	275	201	.....	187	101	810	97
15	880	845	372	466	350	268	201	845	187	93	.....	93
16	.....	845	372	466	342	268	196	656	177	101	253	93
17	.....	845	372	466	342	268	196	466	177	101	201	93
18	.....	845	357	419	327	253	189	253	177	102	177	91
19	.....	775	357	372	327	253	182	242	201	104	172	88
20	.....	775	357	357	312	248	177	226	201	101	154	86
21	.....	740	357	372	312	248	177	201	201	97	147	83
22	.....	740	357	372	312	248	177	201	187	93	142	76
23	.....	740	357	466	312	242	172	198	177	90	136	70
24	.....	740	357	740	312	242	172	196	177	90	141	67
25	.....	740	342	556	312	466	172	191	206	90	145	67
26	.....	740	342	372	312	372	172	191	201	90	150	64
27	.....	740	342	357	297	253	172	187	194	90	141	61
28	880	740	342	357	297	250	172	177	187	90	136	58
29	845	810	342	357	297	248	172	177	177	108	134	112
30	845	792	342	372	.....	248	172	177	177	112	132	76
31	845	.....	342	372	.....	248	.....	177	.....	108	124	.....

NOTE.—Discharge interpolated or estimated for following days: Oct. 6, 20, and 27, 1918; Feb. 16, Mar. 2, 23, 30, Apr. 20, 27, May 4, 11, 18, 25, June 1, 8, 15, 22, July 6, 13, 20, 27, Aug. 3, 10, 17, 31, Sept. 7, Oct. 5, Nov. 9, 16, 23, 30, Dec. 7, 14, 21, and 28, 1919; Jan. 4, 11, 18, 25, Feb. 1, 15, 22, 23, 29, Mar. 7, 14, 21, 28, Apr. 4, 11, 18, 25, May 2, 9, 16, 23, 30, June 13, 20, 27, July 4, 11, 18, 25, Aug. 1, 22, 29, Sept. 5, 6, 12, 18, 19, and 26, 1920. Rating curve not defined for high stages to permit determination of discharge for following days:

Day.	Gage height.	Day.	Gage height.	Day.	Gage height.	Day.	Gage height.	Day.	Gage height.
1918.	*Feet.*	1919.	*Feet.*	1919.	*Feet.*	1919.	*Feet.*	1919.	*Feet.*
Nov. 7	13.5	Sept. 14	9.0	Sept. 25	6.5	Oct. 18	8.9	Nov. 3	5.2
8	5.35	15	11.75	26	5.9	20	7.0	4	5.2
Dec. 23	14.3	16	11.3	27	5.3	21	6.5	5	5.0
1919.		17	5.7	Oct. 8	9.2	22	9.8	6	4.8
		18	5.5	9	6.2	23	7.9		
Jan. 22	7.03	19	5.5	10	5.1	24	6.1	1920.	
23	6.9	20	5.5	11	5.1	25	4.8	May 14	8.2
24	6.85	23	13.1	13	5.2	27	4.8	June 7	5.7
25	6.83	24	9.1	17	10.4	Nov. 1	5.8	Aug. 7	18.5
26	5.9								

Monthly discharge of Guadalupe River near Comfort, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	223	a 6	33.2	2,040
February	226	73	105	5,830
March	1,100	56	156	9,590
April	282	67	111	6,600
May	670	73	169	10,400
June	880	67	179	10,700
July	920	110	285	17,500
1919–20.				
November 7–30	880	740	804	38,300
December	775	342	524	32,200
January	740	327	433	26,600
February	372	297	340	19,600
March	466	242	277	17,000
April	372	172	213	12,700
July	168	90	114	7,010
September	112	61	89.7	5,340

a Minimum probably due to diversions above gage.

NOTE.—See footnote to daily-discharge table.

GUADALUPE RIVER AT NEW BRAUNFELS, TEX.

LOCATION.—At highway bridge on San Antonio-Austin post road, 700 feet below International & Great Northern Railway bridge, 1 mile below mouth of Comal River and 1 mile northeast of center of New Braunfels, Comal County.

DRAINAGE AREA.—1,760 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—March 13, 1898, to December 30, 1899; January 27, 1915, to September 30, 1920.

GAGE.—Stevens water-stage recorder, attached to downstream side of middle pier of highway bridge, inspected by engineers from Austin office. A vertical staff gage in three sections attached to trees on left bank 200 feet below highway bridge, and one section on east side of left pier of highway bridge was read from January 27, 1915, to September 28, 1917, when recorder was installed. Gage used from March 13, 1898, to December 30, 1899, was an inclined staff gage near the present highway bridge; relation between datum of inclined gage and that of the vertical staff gage not known. During normal flow, levels show 0.08 foot fall between intake of recorder and vertical staff gage location. Vertical staff gage in well of recorder set to read same as vertical staff downstream.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of solid rock with pockets of coarse gravel; banks gravel, clay, and rock, slightly wooded, high, and not subject to overflow. Rock and gravel shoal just below gage serves as control; permanent except for slight aquatic growth during low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 25.7 feet at 3 a. m. August 23 (discharge, 46,300 second-feet); minimum stage, 1.41 feet at 8 a. m. October 9 (discharge, 253 second-feet).

Maximum stage during year ending September 30, 1920, probably occurred during period, October 11–20, when water-stage recorder was not in operation; minimum stage, 1.99 feet at 4.20 p. m. September 8 (discharge, 476 second-feet).

1898–1899; 1915–1920: Maximum stage recorded, 27.2 feet at 9.30 p. m. September 17, 1915, determined by leveling from flood marks (discharge, 51,300 second-feet); minimum stage recorded, 1.23 feet at 6.20 p. m. May 30, 1918 (discharge, 188 second-feet).

ICE.—None.

DIVERSIONS.—Some water diverted for irrigation above station in Kerr and Comal counties, and for water power, waterworks, and other municipal uses in Kerr, Kendall, and Comal counties; amount not known.

REGULATION.—Flow at this point slightly regulated by operation of power plants on Comal River.

ACCURACY.—Stage-discharge relation permanent except when affected by aquatic growth on control. Rating curve well defined between 250 and 40,000 second-feet. Operation of water-stage recorder satisfactory except as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height obtained from recorder chart by inspection, or by planimeter except as shown in footnote to daily-discharge table; shifting-control method used December 1, 1919, to May 13, 1920. Records excellent except during periods when discharge was estimated.

Discharge measurements of Guadalupe River at New Braunfels, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec. ft.*
Nov. 9	H. B. Kinnison	4.08	1,810	Sept. 5	Dudley and Twichell	3.27	1,160
9	do	4.24	1,930	16	do	7.61	6,570
Dec. 2	Ellsworth and Kinnison	2.90	866	17	do	23.58	[b] 39,100
1919.				17	do	20.73	[b] 31,400
Jan. 30	Ellsworth and Congdon	2.70	845	17	do	14.26	[b] 15,100
Feb. 17	E. P. Congdon	2.34	657	Oct. 23	L. D. Snow	6.84	[c] 4,980
Apr. 5	R. J. Hank	2.72	814	Dec. 19	C. E. Ellsworth	3.66	1,370
24	C. E. Ellsworth	2.18	522	1920.			
May 29	J. E. Powers	2.38	663	Jan. 30	J. W. Pritchett	4.10	1,580
July 8	C. E. Ellsworth	7.85	[a] 6,200	Feb. 17	C. E. Ellsworth	3.72	1,300
8	do	7.75	[a] 6,100	Mar. 9	McCashin and Pritchett	3.40	1,120
8	do	6.54	[a] 4,580	May 7	D. A. Dudley	2.77	834
8	do	6.09	[a] 3,910	June 3	C. E. Ellsworth	3.00	981
9	do	5.32	3,180	28	T. Twichell	2.62	803
17	Ellsworth and Dudley	2.88	947	July 30	do	2.32	630
Aug. 20	T. T. Twichell	2.48	741	Sept. 7	McCashin and West	2.34	636
23	do	17.03	21,000				

[a] Surface velocity observed and coefficient of 0.95 used to reduce to mean velocity.
[b] Surface velocity observed and coefficients of 0.84 and 0.95 used to reduce to mean velocity.
[c] Surface velocity observed and coefficient of 0.90 used to reduce to mean velocity.

Daily discharge, in second-feet, of Guadalupe River at New Braunfels, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	327	301	355	556	764	620		852	574	1,140	1,070	
2	308	294	355	525	737	610		680	574	916	1,010	
3	298	290	347	498	720	602	900	597	852	803	976	1,600
4	287	294	343	476	764	602		566	592	737	952	
5	284	290	339	466	748	620	825	548	556	685	910	
6	280	290	339	458	786	625	786	534	556	665	880	1,120
7	284	290	335	458	786	602	754	946	543	858	852	1,100
8	287	1,210	331	444	737	615	732	655	534	4,150	836	1,100
9	277	2,520	339	427	700	597	705	597	548	3,190	869	1,080
10	277	3,210	335	419	680	597	732	592	675	1,800	898	1,030
11	323	1,100	331	415	675	588	842	1,180	825	1,300	852	1,000
12	335	720	327	411	695	584	695	1,540	836	1,130	836	958
13	294	574	343	407	655	579	660	1,600	685	1,060	786	922
14	287	507	343	407	650	584	655	1,300	602	1,000	770	988
15	274	574	359	440	630	584	650	1,010	574	976	726	1,830
16	277	552	431	561	606	584	630	880	630	952	705	5,760
17	280	625	387	606	630	566	620	830	764	910	695	25,000
18	280	462	399	602	645	556	606	1,040	650	886	685	4,820
19	284	399	705	579	665	548	602	904	615	842	759	3,580
20	290	379	1,530	556	685	552	597	803	695	808	640	3,060
21	294	371	958	670	695	548	588	798	720	1,430	705	2,670
22	359	363	754	4,040	700	538	588	726	635	5,790	5,760	6,860
23	498	359	1,380	2,040	675	538	584	690	847	3,090	25,200	29,200
24	928	359	5,600	2,060	665	543	570	742	874	2,270	17,800	11,200
25	502	359	2,120	1,260	655	748	570	690	2,270	1,910	4,140	8,040
26	597	351	1,220	1,040	635	3,060	561	841	2,360	1,700	2,800	5,350
27	453	355	922	958	630	1,480	552	1,130	3,940	1,510	2,360	4,400
28	367	355	776	916	625	1,290	552	737	4,720	1,400	2,150	3,900
29	339	363	695	946	.....	976	864	660	2,500	1,260		3,560
30	319	379	645	830	.....	852	836	606	1,470	1,190	2,200	3,290
31	304	.....	597	792	.....	781	.....	584	.....	1,130		.....
1919-20.												
1	3,080	3,080	1,620	1,280	1,540	1,210	1,210	852	1,000	782	635	
2	2,860	4,020	1,670	1,280	1,540	1,180	1,360	852	940	764	620	
3	2,750	2,970	1,580	1,280	1,490	1,180	1,120	852	1,000	754	615	
4	2,750	2,860	1,580	1,240	1,490	1,180	1,060	825	940	737	606	670
5	2,590	2,750	1,540	1,320	1,490	1,150	1,030	825	1,030	732	602	
6	2,640	2,640	1,580	1,360	1,490	1,150	1,030	825	1,000	898	606	
7	3,920	2,590	1,540	1,440	1,440	1,150	1,030	852	1,060	792	680	645
8	4,620	2,490	1,540	1,360	1,440	1,120	1,030	940	1,280	737	4,140	615
9	3,420	2,490	1,490	1,320	1,440	1,120	1,030	880	1,540	710		620
10	3,540	2,590	1,480	1,280	1,440	1,120	1,000	852	1,180	695		615
11		2,540	1,460	1,280	1,440	1,120	1,030	825	1,060	685		606
12		2,340	1,450	1,670	1,440	1,120	1,000	825	1,030	680		606
13		2,290	1,440	2,040	1,440	1,090	970	825	1,030	670		597
14		2,190	1,420	1,900	1,400	1,090	940	2,960	940	660		592
15		2,190	1,410	1,800	1,360	1,090	940	5,470	940	655		588
16	10,000	2,140	1,400	1,760	1,320	1,090	970	3,510	910	650		588
17		2,090	1,390	1,720	1,320	1,090	970	1,940	880	645		584
18		2,040	1,370	1,620	1,320	1,090	940	1,540	852	640		584
19		1,990	1,360	1,580	1,320	1,060	910	1,360	880	635		579
20		1,900	1,400	1,580	1,280	1,060	910	1,210	852	625	750	570
21	5,250	1,850	1,360	1,540	1,280	1,060	910	1,150	880	615		570
22	4,620	1,850	1,400	1,490	1,280	1,060	880	1,090	880	610		570
23	5,000	1,800	1,360	1,800	1,280	1,090	880	1,060	910	610		570
24	4,380	1,800	1,320	1,850	1,240	1,090	880	1,030	880	606		561
25	3,900	1,760	1,320	1,760	1,240	1,150	880	1,000	852	602		561
26	3,780	1,760	1,320	1,760	1,210	1,150	880	970	825	588		556
27	3,540	1,760	1,280	1,670	1,210	1,180	852	1,000	798	588		552
28	3,420	1,720	1,280	1,620	1,210	1,120	852	970	798	588		556
29	3,190	1,760	1,280	1,580	1,210	1,090	825	940	852	588		538
30	3,420	1,760	1,280	1,580	.....	1,060	825	940	798	625		552
31	3,190	.....	1,280	1,580	.....	1,060	.....	1,030	.....	620		.....

NOTE.—Discharge estimated for following periods: Apr. 1-4, Aug. 29 to Sept. 5, Oct. 11-20, Dec. 10-18 1919, and Aug. 9 to Sept. 6, 1920; braced figures show mean discharge for periods indicated. Gage height partly estimated June 28 to July 6, July 10-16, Sept. 15 and 16, 1919, because of obstruction in intake pipe. Discharge partly estimated Oct. 10, 21, Dec. 9 and 19, 1919, and Aug. 8, 1920. Discharge, Oct. 7, 1919, and May 14-16, 1920, determined by averaging the hourly discharge.

Monthly discharge of Guadalupe River at New Braunfels, Tex., for the years ending Sept. 30, 1919, and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	928	274	348	21,400
November	3,210	290	616	36,700
December	5,600	327	782	48,100
January	4,040	407	815	50,100
February	786	606	687	38,200
March	3,060	538	747	45,900
April	.....	552	699	41,600
May	1,600	534	834	51,300
June	4,720	534	1,110	66,000
July	5,790	665	1,530	94,100
August	25,200	640	2,720	167,000
September	29,200	922	4,660	277,000
The year	29,200	274	1,300	937,000
1919–20.				
October	.....	2,590	5,670	349,000
November	4,020	1,720	2,270	135,000
December	1,670	1,280	1,430	87,900
Janauary	2,040	1,240	1,560	95,900
February	1,540	1,210	1,370	78,800
March	1,210	1,060	1,120	68,900
April	1,360	825	971	57,800
May	5,470	825	1,300	79,900
June	1,540	798	961	57,200
July	898	588	671	41,300
August	4,140	602	831	51,100
September	.....	538	600	35,700
The year	.....	538	1,570	1,140,000

GUADALUPE RIVER NEAR GONZALES, TEX.

LOCATION.—Just below Guadalupe highway bridge, 1 mile below power house of Gonzales Water Power Co., 1½ miles south of Gonzales, Gonzales, County, and 2½ miles below mouth of San Marcos River.

DRAINAGE AREA.—3,620 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—July 1, 1915, to September 30, 1920. The United States Weather Bureau has obtained records from a gage at the power house of Gonzales Water Power Co. since September 1, 1904.

GAGE.—Vertical staff in three sections on right bank just below bridge; read by Frank Wilson.

DISCHARGE MEASUREMENTS.—Made from cable, one-fourth mile below gage, or by wading. Measurements made from highway bridge, above stage of 22 feet when banks are overflowed at cable section.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; channel below station straight for 500 feet, but above is broken by an island and is straight for not more than 50 feet. Banks composed of gravel and clay; medium height; wooded along water's edge on the right, and for some distance back on the left. Banks are overflowed at a stage of about 22 feet. At bridge, left bank protected by levee which is not overflowed, except during unusually high stages; right bank at bridge subject to overflow at stage of about 27 feet. Position of control not known. At a stage of about 22 feet (discharge, 11,400 second-feet) water begins to enter an old channel, locally known as "Cross Timbers" on right bank 2 miles above gage and returns to main channel below gage. Consequently, all records of discharge greater than 11,400 second-feet do not represent the total flow of the stream, but only that in the main channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 30.0 feet at 8.30 a. m. July 24 (discharge, 22,800 second-feet); minimum stage, 0.02 foot at 5.45 p. m. October 20 (discharge, 155 second-feet).

Maximum stage recorded during year ending September 30, 1920, 32.8 feet October 13, estimated by comparison with United States Weather Bureau gage at Gonzales dam (discharge, 30,400 second-feet): minimum stage, 2.06 feet at 7.40 a. m. September 26 (discharge, 698 second-feet).

1915–1920: Maximum stage occurred October 13, 1919 (see above); minimum stage occurred October 20, 1918 (see above).

ICE.—None.

DIVERSIONS.—Some water diverted above the station for irrigation and municipal uses, but the amount is small in comparison with the total run-off. As rainfall is nearly sufficient for general farming, irrigation is intermittent and it is extremely difficult to estimate the amount of water used.

REGULATION.—Flow at this point regulated somewhat by operation of water-power plants in the drainage above. Power house of Gonzales Water Power Co. is located 1 mile above station.

ACCURACY.—Stage-discharge relation not permanent. Rating curve fairly well defined between 300 and 28,000 second-feet. Gage read to hundredths twice daily. Mean of two readings daily may not be true mean for day, owing to power regulation above. Daily discharge determined by applying mean daily gage height to rating table, or by shifting-control method as noted in footnote to daily-discharge table. Records fair.

Discharge measurements of Guadalupe River near Gonzales, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Ft.*	*Sec.-ft.*	1919.		*Ft.*	*Sec.-ft.*
Oct 31	McCashin and Congdon.	1.19	524	Oct. 19	D. A. Dudley.....	30.70	[b]27,600
Nov. 1	H. B. Kinnison.....	1.07	456	20	.....do.....	28.74	[c] 18,760
1919.				20	.....do.....	27.67	[c] 18,170
Jan. 6	C. E. McCashin.....	1.90	845	21	.....do.....	24.95	[c] 14,140
23	.....do.....	19.13	[a] 9,530	23	.....do.....	20.42	[d] 9,100
24	.....do.....	14.65	5,910	1920.			
25	.....do.....	6.55	2,710	Feb. 4	Ellsworth and Pritchett	6.36	2,550
Feb. 7	Ellsworth and Congdon	2.44	1,100	Mar. 15	McCashin and Pritchett	4.25	1,590
Mar. 12	A. K. Gowans.....	1.73	795	June 24	T. Twichell.....	6.28	2,270
May 30	J. E. Powers.....	2.47	1,040	July 28	Ellsworth and Twichell	2.58	883
July 18	Ellsworth and Dudley..	5.06	1,850	Sept. 13	McCashin and West....	2.41	832

[a] Surface velocity observed and coefficient of 0.96 used to reduce to mean velocity.
[b] Discharge in one channel measured; in three channels estimated.
[c] Water in two channels. Discharge measured in main channel only; flow in second channel not included. Surface velocity observed and coefficient of 0.93 used to reduce to mean.
[d] Surface velocity observed and coefficient of 0.93 used to reduce to mean.

Daily discharge, in second-feet, of Guadalupe River near Gonzales, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	383	419	506	912	1,170	884	996	3,180	936	4,240	2,190	2,440
2	374	413	542	845	1,130	876	1,020	1,220	2,230	3,100	2,070	2,200
3	371	299	500	842	1,150	929	5,040	1,050	1,560	2,430	1,890	2,040
4	386	347	494	834	1,100	866	6,470	890	1,230	2,470	1,760	1,880
5	383	368	506	737	1,200	856	1,720	848	1,070	1,950	1,760	1,860
6	185	395	497	740	1,110	828	1,280	786	901	1,810	1,700	1,820
7	413	401	542	761	1,090	898	1,130	978	852	2,190	1,620	1,700
8	515	428	479	707	1,100	894	1,070	3,180	831	2,450	1,560	1,760
9	368	479	509	701	1,060	810	1,020	3,800	890	4,130	1,540	1,770
10	374	1,400	518	698	1,080	806	974	1,380	2,240	5,420	1,770	1,680
11	374	2,450	527	695	1,010	786	960	1,590	4,100	3,200	2,770	1,670
12	542	1,660	518	689	988	758	971	4,090	2,240	2,350	1,680	1,520
13	395	1,030	1,560	668	982	758	982	6,650	1,200	2,010	1,510	1,530
14	404	782	810	674	954	750	915	3,100	1,090	1,870	1,450	1,480
15	380	828	1,490	680	932	754	880	1,670	1,930	1,720	1,400	2,440
16	392	940	698	786	904	754	898	1,480	4,920	1,620	1,340	5,120
17	419	943	578	1,200	964	750	838	2,120	10,300	1,580	1,290	5,600
18	539	826	683	1,080	908	758	828	2,100	12,900	1,870	1,300	7,200
19	287	710	2,680	884	932	744	800	1,350	12,900	1,600	1,240	13,400
20	155	635	3,660	876	988	737	786	1,840	3,290	1,650	1,450	14,100
21	434	810	1,670	1,170	985	747	768	1,620	2,190	1,970	1,700	7,560
22	419	957	1,700	2,540	1,020	719	772	1,170	4,230	4,680	4,470	4,310
23	452	566	2,530	8,580	999	713	775	1,050	2,250	15,300	4,020	4,580
24	497	599	2,640	7,270	1,030	707	764	5,060	1,600	20,200	7,880	9,690
25	515	605	3,660	2,620	971	1,010	747	6,460	3,160	12,800	12,000	17,300
26	2,100	554	4,060	1,870	929	1,590	731	4,140	9,050	5,850	17,700	18,000
27	4,870	557	1,720	1,580	908	2,170	719	1,590	11,700	3,160	13,200	13,300
28	3,900	545	1,240	1,390	904	1,940	719	1,490	15,600	3,300	5,680	10,800
29	2,220	557	1,110	1,310	.....	1,430	731	1,270	13,400	3,000	3,210	6,710
30	530	506	1,050	1,310	.....	1,270	3,940	1,040	7,510	2,720	3,160	5,650
31	491	.....	964	1,090	.....	1,080	.....	964	.....	2,350	3,020	.....
1919–20.												
1	4,860	4,680	2,390	1,760	2,670	1,830	1,510	1,300	1,680	1,340	915	950
2	4,460	4,410	2,350	1,760	2,630	1,790	1,790	1,300	1,720	1,300	915	985
3	4,180	4,590	2,350	1,720	2,550	1,790	1,790	1,300	3,150	1,230	915	950
4	3,510	4,770	2,390	1,720	2,550	1,790	1,720	1,300	2,110	1,540	915	950
5	6,660	4,050	2,310	1,790	2,470	1,760	1,580	1,300	1,720	1,540	915	880
6	8,470	3,870	2,270	3,420	2,470	1,680	1,510	1,260	2,230	1,160	880	950
7	10,100	3,740	2,230	3,420	2,390	1,650	1,440	1,230	2,150	1,120	1,020	915
8	12,800	3,600	2,230	2,710	2,390	1,650	1,440	2,990	2,710	1,260	1,370	880
9	8,540	3,460	2,190	2,470	2,390	1,650	1,480	3,740	1,870	1,160	3,460	880
10	5,710	4,230	2,110	1,990	2,310	1,650	1,440	2,110	2,110	1,090	4,910	880
11	11,200	3,960	2,070	1,870	2,350	1,650	1,440	1,580	1,830	1,090	2,750	880
12	17,500	3,600	2,030	5,360	2,470	1,680	1,440	1,300	1,680	1,060	2,190	775
13	30,400	3,240	2,030	11,400	2,390	1,650	1,400	1,260	1,620	1,060	2,510	810
14	17,500	3,110	1,990	11,200	2,310	1,620	1,370	1,910	1,870	1,020	4,770	845
15	17,200	2,990	1,950	4,640	2,270	1,620	1,370	11,200	1,620	1,020	4,050	810
16	14,200	2,910	1,950	3,030	2,150	1,580	1,370	22,800	1,480	1,020	1,790	810
17	23,600	2,870	1,910	2,870	2,110	1,580	1,370	28,200	1,440	1,020	1,440	775
18	21,400	2,830	1,910	2,750	2,110	1,580	1,370	14,600	1,440	950	1,370	810
19	24,600	2,790	2,630	2,590	2,110	1,580	1,370	4,770	1,480	950	1,300	740
20	18,900	2,710	2,430	2,510	2,110	1,540	1,340	3,070	1,480	985	1,230	810
21	13,900	2,670	2,190	2,510	2,070	1,540	1,340	2,630	1,440	950	1,160	845
22	12,300	2,590	2,070	2,470	2,030	1,540	1,340	2,430	1,720	915	1,480	810
23	10,500	2,550	1,990	2,790	2,030	1,540	1,340	2,350	1,830	950	2,830	775
24	7,540	2,590	1,950	6,660	1,990	1,510	1,300	2,110	2,270	915	1,790	810
25	7,280	2,510	1,910	10,700	1,950	1,540	1,370	2,030	1,650	915	1,120	775
26	6,300	2,510	1,870	5,660	1,870	1,580	1,340	1,910	1,400	915	1,090	710
27	5,560	2,510	1,870	3,280	1,830	1,620	1,340	1,870	1,340	915	1,020	775
28	5,260	2,390	1,830	3,030	1,830	1,620	1,300	1,910	1,370	880	1,020	740
29	5,060	2,390	1,790	2,910	1,830	1,580	1,300	2,150	1,510	915	985	810
30	4,860	2,350	1,790	2,790	.....	1,540	1,300	1,760	1,340	880	950	710
31	4,820	.....	1,790	2,710	.....	1,510	.....	1,720	.....	1,160	950	.....

NOTE.—Daily discharge determined by indirect method for shifting control during following periods: Oct. 1 to Nov. 10, Dec. 27, 1918, to June 16, 1919, July 1–22, 1919, Jan. 27 to Mar. 5, and May 20 to Sept. 30, 1920. Oct. 13, 18, 1919, and May 16–17, 1920, water over road and gage not read. Probable stage estimated by comparison with United States Weather Bureau records at Gonzales dam. Discharge interpolated, Oct. 29 and Nov. 18, 1918. Minimum flow in October, 1918, probably caused by regulation at power plant above station. Records of discharge above 11,400 second-feet represent flow in main channel only; see "Channel and control."

Monthly discharge of Guadalupe River near Gonzales, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	4,870	155	776	47,700
November	2,450	299	734	43,700
December	4,060	479	1,310	80,600
January	8,580	668	1,510	92,800
February	1,200	904	1,020	56,600
March	2,170	707	954	58,700
April	6,470	719	1,340	79,700
May	6,650	786	2,230	137,000
June	15,600	831	4,610	274,000
July	20,200	1,580	4,030	248,000
August	17,700	1,240	3,530	217,000
September	18,000	1,480	5,700	339,000
The year	20,200	155	2,310	1,670,000
1919-20.				
October	30,400	3,510	11,300	695,000
November	4,770	2,350	3,250	193,000
December	2,630	1,790	2,090	129,000
January	11,400	1,720	3,760	231,000
February	2,670	1,830	2,230	128,000
March	1,830	1,510	1,630	100,000
April	1,790	1,300	1,430	85,100
May	28,200	1,230	4,240	261,000
June	3,150	1,340	1,780	106,000
July	1,540	880	1,070	65,800
August	4,910	880	1,740	107,000
September	985	710	835	49,700
The year	30,400	710	2,960	2,150,000

NOTE.—See footnote to daily-discharge table.

GUADALUPE RIVER BELOW CUERO, TEX.

LOCATION.—Three-fourths mile upstream from Heards Bridge on Arneckville road, 1 mile south of Dietze farmhouse, 2 miles below Clinton Bridge, 2½ miles southeast of Cuero, Dewitt County, 4 miles below Schleicher Bridge, and 8 miles below dam used for power development.

DRAINAGE AREA.—5,020 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—August 6, 1916, to September 30, 1920. (Fragmentary from May 29, 1919, to August 10, 1920.) From December 26, 1902, to December 31, 1906, and August 19, 1915, to August 6, 1916, a station was maintained at Schleicher's Bridge, 4 miles above this point. Discharge at two sites practically the same.

GAGE.—Stevens water-stage recorder on left bank, inspected by E. B. Dietze.

DISCHARGE MEASUREMENTS.—Made from cable 40 feet upstream from gage, or by wading.

CHANNEL AND CONTROL.—Channel straight above and below station for 1,000 feet. Bed composed of gravel and small rock; clean and shifts slightly. Left bank composed of sand and dirt, covered with brush and open timber, and is 20 feet high, but at stages above a gage height of 20 feet is overflowed, the water submerging an area for one-fourth mile back from river; right bank composed of sand and dirt, covered with brush and trees on sloping side and cultivated land on top; high, and not subject to overflow. Rock and gravel rapids 250 feet below gage serve as a control during low and medium stages; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage during year ending September 30, 1919, probably occurred during period July 23–28, when recorder was not in operation, and reached a height of about 30 feet as determined from flood marks on gage house (discharge, 55,000 second-feet); minimum stage, from water-stage recorder, 0.87 foot from 5 to 11 a. m. October 1 (discharge, 225 second-feet).

Maximum stage recorded during year ending September 30, 1920, 19.6 feet October 24 (discharge, 15,200 second-feet); minimum stage from water-stage recorder 1.68 feet at 2 a. m. September 18 (discharge, 703 second-feet).

1916–1920: Maximum stage in 1919 (see above); minimum stage from water-stage recorder, approximately 0.58 foot from 9 to 10 a. m. November 1, 1917 (discharge, 80 second-feet, determined from extension of rating curve and possibly slightly in error.

ICE.—None.

DIVERSIONS.—There are numerous small diversions above station for irrigation and municipal uses, but flow is probably not materially affected thereby except possibly during extremely low stages.

REGULATION.—Flow partly regulated during low and medium stages by operation of water-power plants upstream, chiefly by a plant about 8 miles above.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 200 and 15,000 second-feet. Water-stage recorder not in operation from July 11, 1919, to August 18, 1920. Daily discharge ascertained by applying mean daily gage height to rating table. Mean daily gage height from recorder-graph determined by inspection or on days of considerable fluctuations by use of planimeter. Records fair.

Discharge measurements of Guadalupe River below Cuero, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 11	McCashin and Congdon	1.30	488	May 31	J. E. Powers	2.89	1,360
30	....do	3.70	2,010	July 19	Ellsworth and Dudley	3.78	2,160
Nov. 1	H. B. Kinnison	1.36	525	Oct. 24	D. A. Dudley	19.60	15,100
Dec. 1	E. P. Congdon	1.07	360	1920.			
1919.				June 25	T. Twichell	4.03	2,300
Jan. 6	C. E. McCashin	1.79	757	Aug. 5	....do	2.38	1,190
24	Ellsworth and Kinnison	13.95	[a] 11,200	15	....do	6.83	4,780
Feb. 12	H. B. Kinnison	2.32	1,100	Sept. 12	McCashin and West	2.12	938
Mar. 12	A. K. Gowans	2.06	981				

[a] Surface velocity observed and coefficient of 1.10 used to reduce to mean velocity.

Daily discharge, in second-feet, of Guadalupe River below Cuero, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	315	535	469	1,070	1,370	1,000	1,500	3,940	.....	13,000	.....	.....
2	491	553	559	1,000	1,250	985	1,320	5,080	.....	12,100	.....	.....
3	475	442	559	920	1,250	1,060	1,760	2,030	.....	.....	2,050	.....
4	355	474	518	848	1,360	1,040	5,610	1,390	.....	.....	.....	.....
5	431	486	524	781	1,430	991	9,010	1,240	4,830	828	.....	.....
6	442	458	508	823	1,490	926	4,120	1,130	4,540	1,950	.....	.....
7	403	524	513	823	1,390	887	1,740	2,810	4,530	1,580	.....	1,620
8	270	559	480	787	1,230	874	1,440	6,550	3,640	1,320	.....	.....
9	589	408	403	763	1,160	874	1,250	5,730	3,440	1,230	.....	.....
10	577	763	458	721	1,160	874	1,090	7,950	4,600	.....	1,980	.....
11	727	2,210	524	715	1,100	874	978	6,280	6,550	.....	.....	.....
12	1,730	2,720	547	589	1,050	848	985	5,050	7,660	.....	.....	.....
13	1,820	2,400	2,000	661	991	817	972	5,220	7,640	.....	.....	.....
14	939	1,320	3,480	697	991	811	1,110	8,000	5,260	.....	.....	1,680
15	559	1,160	5,830	805	978	861	1,060	5,680	4,420	.....	.....	.....
16	502	1,950	2,670	4,480	932	817	952	2,420	6,470	.....	.....	.....
17	486	2,730	900	6,740	972	842	906	1,900	10,400	.....	3,580	.....
18	386	2,120	739	6,390	972	793	874	2,800	11,800	.....	.....	.....
19	474	1,230	2,720	2,360	960	817	854	3,450	13,800	.....	.....	.....
20	315	861	6,000	1,140	946	787	835	2,170	14,800	.....	.....	.....
21	408	1,180	6,890	1,030	1,020	787	829	2,620	.....	.....	.....	.....
22	649	2,530	3,160	2,820	1,020	811	823	2,280	.....	5,560	.....	.....
23	1,600	2,040	2,100	7,400	1,020	823	848	1,520	4,830	.....	.....	.....
24	1,260	991	2,330	10,200	1,060	887	861	2,580	4,700	.....	6,360	.....
25	932	757	3,660	10,300	1,060	1,080	811	6,580	3,600	.....	.....	.....
26	1,310	906	4,440	4,880	985	2,660	811	9,520	4,000	.....	.....	.....
27	5,520	958	4,540	2,400	998	3,510	848	11,700	9,220	.....	.....	.....
28	7,880	805	2,540	1,860	972	3,200	894	11,100	11,400	.....	.....	.....
29	9,970	703	1,640	1,590	.....	2,780	926	.....	12,100	4,750	.....	.....
30	3,520	583	1,360	1,460	.....	2,000	978	.....	12,800	.....	.....	.....
31	745	.....	1,220	1,430	.....	1,740	.....	1,520	.....	3,420	4,700	.....
1919-20.												
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,060
2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	998
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,100
4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,100
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,170	1,030
6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	978
7	.....	.....	.....	4,460	.....	.....	.....	.....	.....	.....	.....	1,200
8	.....	.....	2,720	.....	.....	.....	.....	.....	.....	.....	.....	1,090
9	.....	6,620	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,060
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,100	1,060
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,700	991
12	.....	.....	.....	4,780	.....	.....	.....	.....	.....	.....	3,820	984
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,350	991
14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,580	1,010
15	.....	.....	2,350	.....	.....	1,980	.....	.....	.....	.....	4,300	984
16	.....	4,460	.....	.....	.....	.....	.....	.....	.....	.....	4,620	939
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,500	946
18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,750	887
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,680	900
20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,520	932
21	.....	.....	2,580	.....	.....	.....	.....	.....	.....	.....	1,450	913
22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,380	926
23	.....	3,740	.....	.....	.....	.....	.....	.....	.....	.....	1,600	939
24	15,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,950	900
25	.....	.....	.....	.....	.....	.....	.....	.....	2,350	.....	2,350	887
26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,560	854
27	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,420	913
28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,280	894
29	.....	.....	2,420	.....	.....	.....	.....	.....	.....	.....	1,200	906
30	.....	3,020	.....	.....	.....	.....	.....	.....	.....	.....	1,170	1,560
31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,140	.....

NOTE.—No record Mar. 9–11, May 15, 28, 1919, gage height interpolated. No record for periods not published. Gage heights partly estimated June 11, 14–16, 20, 23–30, July 1, 2, 1919, Aug. 30 to Sept. 12, 1920. Discharge from July 22, 1919, to Aug. 4, 1920, determined from one daily gage height reading on the days recorded; Aug. 5–18, 1920, two staff gage readings daily.

Monthly discharge of Guadalupe River below Cuero, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	9,970	270	1,490	91,600
November	2,730	408	1,180	70,200
December	6,890	403	2,070	127,000
January	10,300	589	2,530	156,000
February	1,490	932	1,110	61,600
March	3,510	787	1,230	75,600
April	9,010	811	1,570	93,400
May 1–28	11,700	1,130	4,600	255,000
The period				930,000
1920.				
August 10–31	4,700	1,140	2,290	99,900
September	1,560	854	998	59,400

NOTE.—See footnote to daily-discharge table.

SAN MARCOS RIVER AT SAN MARCOS, TEX.

LOCATION.—Just below Cape Ginning Co.'s mill, 300 feet southwest of main San Marcos-Luling highway, 1 mile southeast of San Marcos, Hays County, 1¼ miles above mouth of Blanco River, and 1½ miles below dam of San Marcos Utilities Co. and large springs that furnish a constant supply for the stream.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—June 10, 1915, to January 19, 1916; March 13, 1916, to September 30, 1920. Miscellaneous measurements made from 1894 to 1903.

GAGE.—Stevens water-stage recorder on left bank, 300 feet below Cape Ginning Co.'s mill. Gage used June 10, 1915, to January 19, 1916, was vertical staff gage attached to the sewer trestle of San Marcos Utilities Co., 1,000 feet below Austin-San Antonio highway bridge, 1¼ miles above present site. Relation between datum of staff gage and that of water-stage recorder not known.

DISCHARGE MEASUREMENTS.—Made by wading or from San Marcos-Luling highway bridge half a mile above gage.

CHANNEL AND CONTROL.—Bed composed of gravel and sand with heavy aquatic growth which causes changes in control during practically the entire year. Channel straight for 200 feet above and below the station. Water clear, deep, and with scarcely any sediment except during floods, caused by local rains. Left bank wooded, high, and not subject to overflow; right bank wooded, low, and subject to overflow, the water spreading back a short distance to a second bank.

EXTREMES OF DISCHARGE.—Maximum stage during year ending September 30, 1919, from water-stage recorder, 15.54 feet at 5 p. m. July 21 (discharge not determined); minimum stage, 0.40 foot at 12.30 p. m. October 4 (discharge, 35 second-feet).

Maximum stage during year ending September 30, 1920, 30 feet May 15, determined from flood marks on recorder house (discharge not determined); minimum stage, 1.75 feet at 8 p. m. September 30 (discharge, 134 second-feet).

1915–1920: Maximum stage recorded in 1920 (see above); minimum stage, 0.34 foot at 12.50 p. m. September 26, 1918 (discharge, 11 second-feet).

ICE.—None.

DIVERSIONS.—A concrete dam just above the San Marcos-Luling road bridge makes a pond for Roger's resort and serves as a diversion dam for an irrigation plant on left bank; diversions intermittent, but when used takes about 95 second-feet from

river. A water wheel is used to pump the water for irrigation and the water that passes through it is returned to the river above Cape Ginning Co.'s dam. About 1,000 feet above the station is a dam constructed for the purpose of creating a pond from which water was pumped to the lands on the south bank. Only pumping plant or diversions between station and mouth of Blanco River is about 250 feet below gage. Beckman dam just below mouth of Blanco River is used to impound water for irrigation. During ordinary stages in San Marcos and Blanco rivers, this dam backs water up San Marcos River a distance of three-quarters of a mile, but flood stages in Blanco River create backwater at the station. Records of the Board of Water Engineers of Texas show that about 1,000 acres have been declared irrigated in Hays County by diversions from San Marcos River. A large part of this area is located above the station. Little water is used for irrigation, as ordinarily the rainfall is sufficient to mature crops. Water is diverted above the station by the San Marcos Utilities Co. for municipal uses.

REGULATION.—Flow during low and medium stages regulated by dams above, the greatest effect being that produced by the power dam of the San Marcos Utilities Co. in the upper part of San Marcos, near the springs. This dam backs water over the springs that form the source of supply of the river during ordinary stages. Water is stored at this point throughout the afternoon and evening and released during the morning. Large fluctuations are also caused by operation of water wheel at Cape Ginning Co.'s mill.

ACCURACY.—Stage-discharge relation not permanent owing to moss and weeds in channel. Rating curve fairly well defined between 40 and 360 second-feet. Operation of water-stage recorder not satisfactory, as indicated in the footnote to daily-discharge table. Daily discharge ascertained by indirect method for shifting control, using mean daily gage height determined by inspecting recorder graph, or for days of considerable fluctuation by planimeter. Records fair.

Discharge measurements of San Marcos River at San Marcos, Tex., during the years ending Sept. 30, 1919, and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 8	R. J. Hank	0.77	45.7	Nov. 9	L. D. Snow	3.60	338
Dec. 3	Gowans and Kinnison	1.39	83.4	Dec. 19	C. E. Ellsworth	3.08	257
21	Ellsworth and Kinnison	2.46	165	31	Ellsworth and Pritchett	3.10	218
1919.				1920.			
Feb. 9	Ellsworth and Congdon	2.09	123	Jan. 20	....do	2.98	235
Mar. 11	A. K. Gowans	2.05	101	Feb. 6	....do	3.22	254
Apr. 5	R. J. Hank	2.51	150	21	C. E. Ellsworth	3.00	220
24	C. E. Ellsworth	2.80	155	Mar. 17	McCashin and Pritchett	2.96	209
27	....do	2.78	147	Apr. 10	C. E. Ellsworth	2.78	196
June 2	J. E. Powers	2.75	180	May 6	D. A. Dudley	2.44	162
July 16	Ellsworth and Dudley	3.24	152	June 3	C. E. Ellsworth	3.59	243
Aug. 20	T. Twichell	3.06	149	23	T. Twichell	3.21	223
Sept. 5	Dudley and Twichell	2.83	155	July 27	Ellsworth and Twichell	2.63	181
Oct. 23	L. D. Snow	4.45	350	Sept. 6	McCashin and West	2.39	189

Daily discharge, in second-feet, of San Marcos River at San Marcos, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	83	82	93	132	122	121	140	135	169	170	.....	.....
2	81	81	93	131	123	121	162	141	175	155	.....	.....
3	79	84	93	131	122	121	153	133	171	151	.....	164
4	78	84	93	129	122	123	149	131	161	150	.....	165
5	76	85	95	129	126	122	145	137	161	143	.....	166
6	76	86	94	128	130	122	150	194	163	150	.....	163
7	75	85	94	128	123	114	150	254	147	146	.....	163
8	72	87	96	126	121	107	150	160	162	198	.....	160
9	72	88	96	125	116	109	156	170	154	147	.....	158
10	71	88	99	126	115	108	151	162	164	147	.....	157
11	75	87	100	125	114	100	153	196	166	140	.....	154
12	74	88	102	124	118	103	158	241	157	149	.....	159
13	76	88	108	124	117	106	157	173	150	144	.....	160
14	75	89	115	124	117	106	150	155	143	131	.....	163
15	77	90	142	132	117	116	150	167	155	138	.....	237
16	74	89	146	127	123	134	154	139	267	154	.....	205
17	76	90	145	125	126	130	147	150	264	136	.....	176
18	75	90	144	126	124	129	145	154	174	130	.....	169
19	76	91	145	126	126	130	149	156	169	126	.....	169
20	77	92	161	124	124	131	146	156	170	123	146	167
21	77	93	143	138	124	129	148	153	160	.....	145	170
22	78	92	144	239	123	122	146	155	164	.....	148	218
23	78	91	218	154	124	125	147	156	162	225	156	431
24	78	92	197	144	124	127	149	157	158	.....	150	220
25	78	93	150	143	122	138	145	164	222	.....	.....	205
26	84	93	143	141	120	133	149	164	208	.....	.....	194
27	81	93	141	140	120	130	134	163	200	.....	.....	187
28	80	93	138	138	120	132	142	160	280	.....	.....	188
29	81	92	138	137	.....	129	173	162	165	.....	.....	178
30	80	91	137	136	.....	126	138	167	158	.....	.....	182
31	82	.....	136	131	.....	134	.....	171	.....	.....	.....	.....
1919–20.												
1	179	354	.....	212	305	.....	212	189	.....	218	174	194
2	174	372	.....	212	282	.....	218	174	.....	212	174	200
3	169	372	.....	206	260	.....	218	189	206	212	169	200
4	174	372	.....	206	267	.....	200	179	206	189	174	200
5	179	372	.....	232	267	.....	212	174	212	194	174	194
6	238	381	.....	225	267	.....	212	189	290	194	174	194
7	408	381	.....	218	260	.....	212	174	245	212	435	189
8	206	381	.....	218	260	.....	206	179	212	189	274	189
9	194	381	.....	212	267	.....	212	184	206	189	194	189
10	218	381	.....	206	267	.....	206	184	200	174	189	194
11	.....	.....	.....	232	260	.....	206	189	200	184	184	200
12	354	.....	.....	305	260	.....	206	184	200	184	206	194
13	338	.....	.....	267	260	.....	200	218	194	184	.....	189
14	363	.....	.....	.....	252	.....	206	435	206	179	290	194
15	.....	.....	.....	.....	252	.....	212	.....	200	179	232	200
16	.....	.....	.....	.....	238	.....	194	.....	206	174	218	189
17	.....	.....	.....	.....	245	206	200	.....	206	179	218	189
18	509	.....	.....	.....	245	206	200	.....	200	189	218	179
19	471	346	252	.....	238	194	194	.....	212	184	218	184
20	490	.....	252	260	232	200	194	.....	200	184	212	184
21	399	.....	245	260	232	194	194	.....	206	184	212	184
22	372	.....	245	267	238	206	206	.....	212	179	206	189
23	354	.....	238	390	238	206	206	.....	212	179	206	189
24	354	.....	245	329	.....	200	184	.....	206	179	206	184
25	338	.....	238	313	.....	206	189	.....	200	184	206	179
26	346	.....	238	297	.....	200	184	.....	206	174	200	179
27	346	.....	225	290	.....	206	179	.....	200	179	200	184
28	346	.....	225	282	.....	200	170	.....	225	169	200	184
29	354	.....	225	282	.....	200	174	.....	212	179	200	174
30	354	.....	212	282	.....	200	189	.....	206	184	200	179
31	354	.....	212	346	.....	206	.....	.....	.....	169	194	.....

NOTE.—Discharge not determined for following days because stage, as given, was above limit for which rating curve is defined: July 21, 1919, 8.69 feet; July 22, 7.35 feet; Oct. 11, 13.3 feet; Oct. 15, 6.5 feet; Oct. 16, 6.6 feet; Oct. 17, 8.7 feet; Aug. 13, 1920, 5.8 feet; no record for other periods for which discharge is not given. Discharge partly estimated, Nov. 19 and Dec. 19, 1919; Jan. 13, 20, Feb. 23, Mar. 17, June 3, and Sept. 10, 1920.

Monthly discharge of San Marcos River at San Marcos, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	84	71	77.3	4,750
November	93	81	88.9	5,290
December	218	93	127	7,810
January	239	124	135	8,300
February	130	114	122	6,780
March	138	100	122	7,500
April	173	134	150	8,930
May	254	131	164	10,100
June	280	143	177	10,500
July 1–20	198	123	146	5,790
August 20–24	156	145	149	1,480
September 3–30	431	154	187	10,400
1919–20.				
December 19–31	252	212	235	6,060
February 1–23	305	232	256	11,700
March 17–31	206	194	202	6,010
April	218	174	200	11,900
May 1–14	435	174	203	5,640
June 3–30	290	194	210	11,700
July	218	169	186	11,400
September	200	179	189	11,200

NOTE.—See footnote to table of daily discharge.

SAN MARCOS RIVER AT OTTINE, TEX.

LOCATION.—At highway bridge one-fourth mile southwest of Ottine, Gonzales County, 4 miles below mouth of Plum Creek, and 10 miles above confluence of San Marcos and Guadalupe rivers.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—June 22, 1915, to September 30, 1920.

GAGE.—Chain gage attached to upstream handrail of bridge; read by J. H. Kaine. Gage used from June 22 to October 12, 1915, was a vertical staff under the highway bridge, but gage heights have been reduced to datum of succeeding gage by means of a curve showing relation between readings of the two gages. Gage used from October 13, 1915, to March 15, 1920, was vertical staff in four sections attached to trees on left bank about 400 feet above bridge.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand, rock, and gravel; shifts. Bank high and wooded; not overflowed except by extremely high water. Channel straight above and below the station for 150 feet. Low-stage control for gage used before March 15, 1920, formed by shoal 200 feet below gage. During high stages in Guadalupe River backwater changes stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 34.6 feet at 8 a. m. July 23 (discharge, 11,100 second-feet, determined from extension of rating curve); minimum stage, 1.20 feet at 6 a. m. October 6 (discharge, 60 second-feet).

Maximum stage recorded during year ending September 30, 1920, 37.5 feet at 7.30 a. m. May 16 (discharge, not determined); minimum stage, 2.6 feet at 6 p. m September 25 (discharge, 196 second-feet).

1915–1920: Maximum stage recorded in 1920 (see above paragraph); minimum stage, 1.06 feet at 7 p. m. August 26 and 27, 1917, and 6.30 p. m. July 31, 1918. (discharge, 26 second-feet).

ICE.—None.

DIVERSIONS.—Small amounts of water are diverted above the station for irrigation and municipal uses, but only a small part of the total run-off is used (see "San Marcos River at San Marcos"). Little, if any, water is diverted below the station.

REGULATION.—Flow regulated by the operation of a small cotton gin a short distance above the station. The operation of several small water-power plants in the upper drainage basin near San Marcos and Martindale does not materially affect the flow at this station.

ACCURACY.—Stage-discharge relation not permanent. Rating curve fairly well defined from 50 to 7,500 second-feet; extended above. Gage read twice daily to hundredths October 1, 1918, to May 6, 1919, and to tenths May 7, 1919, to September 30, 1920, but mean of two readings a day may not be true mean owing to power regulation above. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used January 22, 1919, to September 30, 1920. Records fair.

Discharge measurements of San Marcos River at Ottine, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Ft.*	*Sec.-ft.*	1919.		*Ft.*	*Sec.-ft.*
Oct. 31	McCashin and Congdon.	1.58	91.0	Oct. 24	L. D. Snow.....	10.77	1,990
1919.				1920.			
Jan. 6	C. E. McCashin.....	2.28	195	Feb. 6	Ellsworth and Pritchett	6.20	805
Feb. 7	Ellsworth and Congdon	3.30	341	Mar. 16	McCashin and Pritchett	[a] 4.22	460
8	.....do.....	3.03	299	June 24	T. Twichell.....	7.25	935
Mar. 11	A. K. Gowans.....	2.58	213	July 27	Ellsworth and Twichell	3.16	275
June 1	J. E. Powers.....	3.10	294	Sept. 14	McCashin and West....	3.04	269
July 18	Ellsworth and Dudley..	4.65	494				

[a] Gage moved this date; new datum.

Daily discharge, in second-feet, of San Marcos River at Ottine, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	72	87	83	217	368	273	154	1,070	312	1,920	850	395
2	73	80	83	185	350	254	612	359	1,930	850	778	386
3	73	83	82	174	341	241	5,440	191	843	694	706	324
4	76	82	83	162	386	236	1,140	140	452	449	606	324
5	70	83	74	175	350	229	326	204	353	341	625	324
6	66	82	97	190	341	224	316	217	294	577	596	316
7	112	81	99	196	348	220	364	1,410	319	577	625	333
8	71	81	104	198	343	224	277	4,610	319	998	539	290
9	71	465	110	166	268	227	277	1,560	319	1,760	467	324
10	73	174	99	166	261	212	248	932	2,220	766	706	333
11	95	185	93	166	251	214	254	1,610	2,940	634	644	299
12	74	143	93	162	248	186	268	5,440	657	539	530	282
13	79	143	3,350	156	243	188	268	4,190	319	395	521	307
14	74	143	1,940	148	232	186	266	750	231	359	413	341
15	74	135	156	186	220	186	244	526	1,740	440	413	3,060
16	72	142	143	62	209	180	244	545	5,170	440	503	6,180
17	72	132	137	848	209	220	234	364	7,650	440	503	1,330
18	71	109	261	214	243	219	227	1,190	8,870	494	577	3,690
19	66	99	2,630	80	260	196	232	1,450	3,000	377	503	778
20	65	110	1,400	146	260	212	217	1,120	1,010	449	503	625
21	65	101	932	81	234	196	217	490	2,990	706	663	802
22	70	99	375	6,000	244	169	215	329	2,030	7,640	2,200	886
23	72	97	670	5,280	263	188	194	338	558	9,810	2,870	3,560
24	81	95	2,440	1,110	277	219	196	4,000	316	6,330	790	5,780
25	81	93	1,060	596	294	461	194	4,330	3,670	4,510	503	2,620
26	958	104	411	485	288	648	190	2,320	5,880	2,000	404	1,210
27	4,830	99	348	440	277	461	178	657	8,120	706	413	838
28	568	98	294	386	273	300	145	524	5,990	1,190	467	814
29	114	95	170	377	.....	251	3,530	380	2,000	1,340	422	1,040
30	116	95	86	404	.....	236	2,210	336	1,010	998	404	838
31	98	.....	158	404	.....	236	.....	322	.....	886	386	.....

Daily discharge, in second-feet, of San Marcos River at Ottine, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919-20.												
1	776	1,330	776	492	824	680	547	348		438	280	366
2	728	970	752	492	752	680	642	331		438	280	366
3	604	1,200	848	510	776	623	623	314	800	420	280	366
4	704	1,120	824	474	872	661	492	314		402	280	366
5	1,170	1,100	642	623	824	704	456	314		384	263	384
6	.....	1,140	680	2,510	872	661	402	297	728	348	280	297
7	.....	1,040	604	1,590	776	566	366	314	2,150	348	246	297
8	.....	995	680	1,070	776	547	384	3,180	776	348	1,560	297
9	1,810	995	642	824	728	566	384	1,560	800	348	1,810	212
10	1,250	2,630	623	680	824	528	384	456	704	348	848	297
11	.....	1,330	604	661	752	528	384	474	776	331	566	297
12	.....	1,020	623	6,630	776	528	384	331	704	314	1,480	348
13	.....	1,070	585	6,510	848	528	384	314	824	297	3,750	263
14	.....	824	680	3,550	752	528	366	2,930	776	314	4,260	280
15	.....	752	604	1,170	680	528	384	6,740	623	297	1,270	331
16	.....	776	604	970	680	492	384	11,900	510	314	680	331
17	.....	680	661	896	680	456	384	8,280	474	280	566	280
18	.....	680	642	800	824	456	348	3,750	456	280	528	331
19	.....	680	848	824	728	456	366	2,390	547	314	474	229
20	.....	623	752	800	680	438	366	1,300	547	331	456	331
21	.....	604	824	896	680	438	366	896	456	297	456	263
22	.....	566	704	920	680	438	366	848	510	280	3,270	263
23	.....	566	642	1,330	680	420	348	752	1,120	297	1,040	229
24	2,010	585	661	7,150	680	420	348	642	1,270	297	547	246
25	.....	642	604	5,410	728	438	331	704	776	297	492	212
26	.....	680	510	1,900	728	492	348	776	420	246	420	229
27	.....	704	510	1,250	680	492	314	752	420	246	456	229
28	.....	680	510	1,200	704	456	314	1,300	528	280	456	263
29	1,510	661	510	1,170	680	420	331	752	456	280	348	229
30	1,480	752	510	1,120	.....	402	348	740	456	510	348	229
31	1,270	.....	510,	1,040	.....	420	.....	730	.....	420	314	.....

NOTE.—No record, Oct. 6–8, 11–23, and 25–28, 1919; May 30–31, and June 1–5, 1920. Discharge, May 30, 31, and June 1–5, 1920, estimated by comparison with other records. Braced figures show estimated mean discharge for periods included. Discharge above 2,000 second-feet Aug. 1, 1919, to Mar. 15, 1920, subject to considerable error because of uncertain changes in datum of high-water section of gage.

Monthly discharge of San Marcos River at Ottine, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	4,830	65	276	17,000
November	465	80	120	7,140
December	3,350	74	583	35,800
January	6,000	62	631	38,800
February	386	209	281	15,600
March	648	169	248	15,200
April	5,440	145	629	37,400
May	5,440	140	1,350	83,000
June	8,870	231	2,380	142,000
July	9,810	341	1,600	98,400
August	2,870	386	682	41,900
September	6,180	282	1,290	76,800
The year	9,810	62	841	609,000
1919-20.				
November	2,630	566	913	54,300
December	848	510	651	40,000
January	7,150	474	1,790	110,000
February	872	680	747	43,000
March	704	402	516	31,700
April	642	314	395	23,500
May	11,900	297	1,770	109,000
June	2,150	420	927	55,200
July	510	246	334	20,500
August	4,260	246	913	56,100
September	384	212	289	17,200
The period	.....	.....	.....	560,000

NOTE.—See footnote to daily-discharge table.

SAN ANTONIO RIVER BASIN.

SAN ANTONIO RIVER AT SAN ANTONIO, TEX.

LOCATION.—At South Alamo Street Bridge in San Antonio, Bexar County, 4 miles below San Antonio Springs, source of normal flow of river, and 1¼ miles above mouth of San Pedro Creek.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—January 26, 1915, to September 30, 1920. Miscellaneous discharge measurements were made from 1895 to 1906.

GAGE.—Gurley graph water-stage recorder on right bank at downstream side of bridge. Gage used from January 26, 1915 to February 28, 1916, was vertical staff attached to downstream side of middle pier of Commerce Street Bridge. Gage used from February 29, 1916, to April 8, 1920, was vertical staff attached to upstream side of second bent of Presa Street Bridge. Relation of readings on different gages not determined. Discharge at various gages is probably not materially different.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Channel is straight for 100 feet below gage and curved above. Bed composed of sand, gravel, and silt. Control formed by gravel bar; shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 7.70 feet at 1 p. m. September 15 (discharge, 2,380 second-feet); minimum stage, 0.58 foot on several days during November and December (discharge, 7.0 second-feet).

Maximum stage recorded during year ending September 30, 1920, 7.8 feet at Presa Street gage on night of October 16, determined from flood marks on gage (discharge, 2,430 second-feet, determined from extension of rating curve); minimum stage, 1.43 feet at South Alamo Street gage at 4 p. m. September 13, owing to regulation at power dam above gage (discharge, 97 second-feet). Minimum natural flow stage, 1.73 feet on September 30 (discharge, 119 second-feet).

1914–1920: Maximum stage recorded, 14.0 feet at 5.30 p. m. October 23, 1914 (discharge, 4,700 second-feet, determined from extension of rating curve); minimum stage, 0.58 foot on several days during November and December, 1918 (discharge, 7.0 second-feet).

ICE.—None.

DIVERSIONS.—Quantity of water diverted above gage not known but is believed to be immaterial. Considerable land is irrigated from diversions below the gage.

REGULATION.—The operation of water wheels at the Guenther flour mill just above the gage causes frequent but unimportant fluctuations in stage.

ACCURACY.—Stage-discharge relation not permanent owing principally to aquatic growth on control. Some of the change that occurred during the period of April 8 to July 1, 1920, may have been caused by movement of débris deposited in river during installation of water-stage recorder. Rating curve used October 1, 1918, to April 7, 1920, for staff gage at Presa Street well defined below 250 second-feet and fairly well defined from 250 to 1,500 second-feet; curve used April 8 to September 30, 1920, for recording gage at South Alamo Street, well defined from 115 to 150 second-feet. Staff gage read to hundredths twice daily and oftener during high water. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used October 1, 1918, to October 5, 1919, December 31, 1919, to January 31, 1920, and March 12 to July 8, 1920. Records good except those obtained by indirect method for shifting control, which are fair.

The normal flow of San Antonio River comes from springs within the city limits, but two tributaries from the north furnish considerable run-off at times of heavy precipitation. Changes in stage during low flow are believed to be due to pumping from deep wells for the city water supply and the use of artesian water for irrigation in areas adjacent to the river for it is thought that the wells draw from the underground reservoir that feeds the river by springs.

Discharge measurements of San Antonio River at San Antonio, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet*	*Sec.-ft.*
Oct. 12	McCashin and Congdon.	0.63	10.9	Dec. 16	C. E. Ellsworth.....	2.06	200
Nov. 29	E. P. Congdon.....	.59	7.6	30	Ellsworth and Pritchett	2.04	194
1919.				1920.			
Jan. 23	A. K. Gowans.....	.86	35.5	Jan. 23	.....do.....	2.15	281
Feb. 3	Ellsworth and Congdon	.94	40.4	Feb. 1	D. A. Dudley.....	2.10	218
Mar. 12	E. P. Congdon.....	.90	34.5	19	C. E. Ellsworth.....	2.13	206
Apr. 17	Ellsworth and Quarles..	.98	41.7	Mar. 10	McCashin and Pritchett.	2.10	212
May 14	C. E. Ellsworth.....	1.08	45.8	Apr. 8	C. E. Ellsworth.....	[a] 1.91	182
June 27	R. J. Hank.....	1.40	98.0	May 7	D. A. Dudley.....	1.86	162
July 21	Twichell and Dudley..	1.76	160	June 27	T. Twichell.....	2.04	162
Sept. 3	D. A. Dudley.....	1.34	89.4	July 9	C. E. Ellsworth.....	2.00	146
15	Dudley and Twichell...	6.35	1,440	30	T. Twichell.....	1.92	135
15	.....do.....	4.32	689	Sept. 7	McCashin and West....	1.78	127
16	.....do.....	1.82	146				

[a] New gage put in operation; datum changed.

Daily discharge, in second-feet, of San Antonio River at San Antonio, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1.....	12	11	8.0	11	39	34	34	38	42	70	104	87
2.....	12	8.5	7.5	11	37	34	93	39	40	102	102	86
3.....	12	11	8.0	10	39	34	42	38	40	72	100	83
4.....	12	9.0	8.0	12	76	38	41	38	37	70	100	81
5.....	11	8.5	8.0	9.5	39	34	45	38	35	72	100	81
6.....	11	9.0	8.5	11	37	33	47	36	35	129	100	81
7.....	10	7.5	8.0	14	36	32	50	43	35	79	100	81
8.....	10	9.0	8.0	11	36	34	50	39	34	73	100	81
9.....	11	8.0	7.5	11	36	33	50	36	34	72	100	81
10.....	11	8.5	7.5	12	37	33	48	37	110	72	96	81
11.....	70	9.0	7.5	9.5	39	32	48	138	38	73	94	81
12.....	10	9.5	8.0	10	42	32	48	47	41	73	92	81
13.....	10	10	11	10	42	31	48	46	34	76	90	81
14.....	10	17	7.0	11	38	32	48	47	36	76	88	98
15.....	10	17	7.5	50	35	31	47	47	35	74	87	1,820
16.....	10	9.5	7.0	13	34	24	45	145	35	76	81	126
17.....	10	8.5	7.5	10	52	24	41	60	35	74	81	166
18.....	10	9.0	50	10	34	24	40	50	34	74	80	126
19.....	10	10	119	10	41	25	40	56	32	73	100	126
20.....	10	10	12	11	37	25	37	49	32	70	81	126
21.....	11	10	8.0	260	36	24	36	48	31	119	112	132
22.....	41	10	9.0	154	34	24	34	47	30	634	81	586
23.....	11	9.5	124	35	33	24	33	46	30	430	81	170
24.....	10	8.0	13	39	34	33	32	139	35	111	81	143
25.....	12	8.5	12	36	36	63	31	46	145	102	81	143
26.....	58	8.5	12	57	34	30	31	47	601	105	104	143
27.....	14	9.5	11	63	35	30	31	46	102	120	86	143
28.....	8.0	7.0	11	37	35	32	31	46	80	105	86	152
29.....	11	7.5	11	38	.....	32	159	45	72	108	87	152
30.....	10	7.5	11	38	.....	32	39	43	70	105	87	152
31.....	11	.....	12	38	.....	34	.....	43	.....	105	86	.....

Daily discharge, in second-feet, of San Antonio River at San Antonio, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	152	398	211	201	213	213	238	168	170	162	135	127
2	152	245	236	203	213	213	193	164	172	161	137	126
3	152	232	209	205	213	213	191	166	175	159	135	126
4	152	232	209	207	213	213	185	163	172	157	135	126
5	152	230	209	338	213	213	181	162	168	154	135	128
6	363	230	209	243	213	213	176	163	150	152	134	129
7	220	230	207	236	213	209	176	164	152	150	143	128
8	180	230	205	234	213	209	182	163	151	148	133	127
9	170	230	205	230	213	209	182	164	151	146	136	126
10	170	230	205	232	213	209	185	167	151	144	135	125
11	985	230	205	238	213	209	185	166	152	144	134	124
12	273	230	205	478	213	207	185	166	153	147	133	123
13	295	230	205	299	213	205	184	181	153	145	146	125
14	205	230	205	271	213	207	184	182	154	144	135	123
15	700	230	205	266	220	207	184	168	153	143	133	123
16	1,040	230	203	262	222	205	184	167	152	143	137	123
17	328	230	201	260	222	203	182	168	153	141	136	123
18	251	230	226	260	222	203	181	168	153	138	135	121
19	251	230	226	262	222	201	182	170	156	142	134	120
20	251	230	211	264	222	199	181	170	162	139	134	123
21	275	230	209	266	222	197	181	168	157	137	134	122
22	249	230	209	269	217	197	178	170	157	137	134	122
23	240	226	209	315	217	195	178	170	164	135	135	121
24	240	224	209	280	217	193	178	171	157	135	133	120
25	240	220	207	264	217	207	178	170	158	133	133	119
26	243	217	205	251	217	203	184	170	159	135	131	119
27	243	217	205	245	217	201	170	168	161	133	131	123
28	243	213	199	238	217	201	170	168	164	132	129	120
29	243	213	197	232	213	199	171	168	162	134	128	120
30	243	213	197	226	.....	195	168	167	161	138	130	119
31	243	.....	199	220	.....	191	.....	170	.....	136	128	.....

NOTE.—Discharge, June 26, July 22, and Sept. 15, 1919, determined from extension of rating curve and subject to considerable error. Discharge, Apr. 25 and July 4–8, 1920, estimated or interpolated.

Monthly discharge of San Antonio River at San Antonio, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	70	8.0	15.1	928
November	17	7.0	9.52	566
December	124	7.0	17.7	1,090
January	260	9.5	33.9	2,080
February	76	33	38.7	2,150
March	63	24	31.5	1,940
April	159	31	46.6	2,770
May	145	36	53.6	3,300
June	601	30	66.3	3,950
July	634	70	116	7,130
August	112	80	91.9	5,650
September	1,820	81	186	11,100
The year	1,820	7.0	58.8	42,700
1919–20.				
October	1,040	152	295	18,100
November	398	213	233	13,900
December	236	197	208	12,800
January	478	201	258	15,900
February	222	213	216	12,400
March	213	191	204	12,500
April	238	168	183	10,900
May	182	162	168	10,300
June	175	150	158	9,400
July	162	132	143	8,790
August	146	128	134	8,240
September	129	119	123	7,320
The year	1,040	119	194	141,000

SAN ANTONIO RIVER AT CALAVERAS, TEX.

LOCATION.—One-fourth mile south of San Antonio & Arkansas Pass Railway station in town of Calaveras, Wilson County, 1 mile below mouth of Calaveras Creek, and 10 miles below mouth of Medina River.

DRAINAGE AREA.—1,870 square miles (measured on topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch = 25 miles.

RECORDS AVAILABLE.—March 12, 1918, to September 30, 1920.

GAGE.—Vertical staff in five sections on left bank near old brick plant; read by J. W. Dodson, C. B. Adams, and I. M. Smith.

DISCHARGE MEASUREMENTS.—Made from highway bridge half a mile upstream from gage or by wading below gage.

CHANNEL AND CONTROL.—Bed composed of sand and clay and free from vegetation; shifts. Channel straight above and below station for 150 feet. Left bank high, wooded, and not subject to overflow; right bank steep, wooded, and subject to overflow only at extremely high stages. Old bricks piled into channel form a semipermanent low-water control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 38 feet at midnight, September 24 (discharge, 15,100 second-feet, determined from extension of rating curve); minimum stage, 0.12 foot at 6.30 a. m. October 5 (discharge, 25 second-feet).

Maximum stage recorded during year ending September 30, 1920, 32.2 feet at 8.35 a. m. October 7 (discharge, 10,800 second-feet, determined from extension of rating curve); minimum stage, 2.0 feet September 30 (discharge, 146 second-feet).

1918–1920: Maximum stage recorded in 1919 (see above); minimum discharge, 15 second-feet September 14, 1918.

ICE.—None.

DIVERSIONS.—The Medina dam and reservoir, having a storage capacity of 254,000 acre-feet, is located on Medina River about 50 miles above its confluence with the San Antonio. The diversion works having a capacity of 850 second-feet are 4 miles below the Medina dam. There were probably about 10,000 acres under irrigation in this project in 1919 and 1920.

REGULATION.—The ordinary flow may be slightly affected by storage and diversions on Medina River.

ACCURACY.—Stage-discharge relation not permanent. Rating curve fairly well defined between 30 and 1,500 second-feet, and extended above by use of $A\sqrt{d}$ method, using one measurement at a discharge of 11,000 second-feet as a basis. Gage read to hundredths twice daily and oftener during floods. Mean of two daily readings may not be true index to mean for day, owing to regulation and rapidly changing stage. Shifting-control method used throughout the two-year period except November 15–26, 1918, and May 1 to June 27, 1919, when discharge was ascertained by direct application of mean daily gage height to rating table. Record fair for low and medium stages and poor for high stages.

Discharge measurements of San Antonio River at Calaveras, Tex., during the years ending Sept. 30, 1919, and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918		*Feet.*	*Sec.-ft.*	1920		*Feet.*	*Sec.-ft.*
Oct. 21	McCashin and Congdon	0.49	36.3	Jan. 21	C. E. Ellsworth	6.92	706
1919				Feb. 18	do	6.11	588
Jan. 23	A. K. Gowans	23.45	4,420	Mar. 11	McCashin and Pritchett	5.03	453
31	Ellsworth and Congdon	2.38	115	Apr. 9	C. E. Ellsworth	4.50	363
May. 13	C. E. Ellsworth	3.98	282	May 8	D. A. Dudley	3.61	270
July. 21	Dudley and Twichell	3.35	221	June 26	T. Twichell	3.48	282
22	do	19.20	3,240	July 9	C. E. Ellsworth	3.04	231
Aug. 21	T. Twichell	2.32	133	Sept. 9	McCashin and West	2.32	172

Daily discharge, in second-feet, of San Antonio River at Calaveras, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	34	47	47	64	109	89	72	282	79	168	187	120
2	33	48	46	64	108	84	93	120	79	154	179	118
3	32	47	45	59	104	85	1,150	140	82	182	174	119
4	31	46	44	57	160	82	242	99	83	470	172	112
5	28	50	42	57	215	82	120	98	74	148	165	114
6	31	46	42	56	127	88	102	94	74	146	159	114
7	32	74	42	58	102	83	99	100	72	615	155	116
8	32	102	44	68	96	83	96	187	72	645	150	113
9	31	155	44	61	100	85	95	167	64	211	144	120
10	32	51	43	58	100	135	92	98	178	167	459	114
11	34	46	45	56	97	217	86	514	306	148	162	109
12	234	44	44	53	97	93	85	1,020	122	133	146	112
13	72	44	243	54	97	81	85	312	85	130	136	114
14	52	46	146	54	91	78	84	146	70	126	130	108
15	42	358	87	64	91	74	82	115	84	126	125	3,000
16	38	268	47	242	88	68	81	463	77	121	124	5,620
17	36	88	44	134	90	64	75	348	78	114	118	7,730
18	35	76	137	74	144	64	74	154	78	113	113	10,800
19	37	49	460	68	101	61	72	108	72	104	134	10,000
20	36	46	945	64	98	62	68	113	70	102	156	6,450
21	35	45	254	64	99	60	68	100	66	158	308	3,980
22	270	46	122	3,570	90	60	68	100	66	3,380	809	2,990
23	865	52	603	7,420	91	61	68	90	68	2,660	524	5,030
24	140	103	1,410	697	87	60	68	758	76	3,240	270	12,800
25	74	84	380	424	91	73	68	470	364	956	144	13,200
26	728	64	118	172	88	300	64	286	580	542	136	8,940
27	1,480	179	86	165	85	96	64	114	3,370	494	179	6,070
28	184	167	77	300	84	74	66	98	1,990	403	205	4,340
29	77	88	72	150	.....	73	2,120	90	345	264	147	3,340
30	52	48	72	126	.....	72	1,230	87	211	212	130	3,020
31	50	.....	70	115	.....	72	.....	85	.....	195	125	.....
1919–20.												
1	2,650	1,940	742	498	678	470	361	274	310	274	208	198
2	2,340	2,680	758	498	678	456	400	262	286	262	208	179
3	2,110	2,340	790	484	663	456	428	262	710	262	198	179
4	1,940	2,030	774	484	663	428	456	262	558	274	198	179
5	1,790	1,840	742	573	663	428	414	262	348	262	198	179
6	3,900	1,680	838	918	663	428	374	251	335	262	198	179
7	8,660	1,530	742	774	648	442	374	251	348	251	198	179
8	3,870	1,430	726	618	648	442	374	274	322	240	251	179
9	2,620	1,370	710	588	648	442	361	286	310	229	208	170
10	2,480	1,370	678	543	648	543	348	274	298	229	198	162
11	6,080	1,290	678	543	633	484	348	274	286	218	198	162
12	4,220	1,270	633	1,600	663	442	348	262	286	218	198	162
13	2,510	1,180	618	1,550	838	442	335	262	335	218	274	170
14	2,340	1,130	774	982	633	442	335	1,940	335	218	387	170
15	2,240	1,080	648	902	633	442	322	742	322	208	348	170
16	5,060	1,060	588	838	603	428	322	790	298	198	251	162
17	9,040	1,050	558	726	588	414	310	442	286	198	240	162
18	9,170	1,030	558	726	588	400	310	484	240	198	229	162
19	8,790	998	694	710	588	400	298	498	310	198	218	162
20	6,740	982	633	710	573	400	298	414	361	198	218	162
21	6,400	950	648	694	573	387	298	387	694	198	218	162
22	4,350	934	618	678	558	374	298	387	588	198	218	162
23	3,330	918	742	742	558	374	286	361	442	198	229	162
24	2,980	902	742	902	543	374	274	335	322	198	218	154
25	2,680	902	573	806	543	387	286	322	274	198	208	154
26	2,400	886	558	742	528	400	286	310	274	188	198	154
27	2,210	854	543	710	498	374	298	310	274	188	198	162
28	2,030	854	543	678	484	374	274	298	298	188	198	154
29	1,790	838	528	678	470	374	274	298	298	179	198	146
30	1,570	790	513	678	.....	361	274	618	286	198	188	146
31	1,640	.....	513	678	.....	361	.....	361	.....	188	188	.....

NOTE.—Gage heights partly estimated on Sept. 18, 24, and 25, 1919, account of water overtopping gage.

Monthly discharge of San Antonio River at Calaveras, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	1,480	31	158	9,720
November	358	44	86.9	5,170
December	1,410	42	190	11,700
January	7,420	53	473	29,100
February	215	84	105	5,830
March	300	60	89	5,470
April	2,120	64	228	13,600
May	1,020	85	224	13,800
June	3,370	64	301	17,900
July	3,380	102	536	33,000
August	809	113	202	12,400
September	13,200	108	3,630	216,000
The year	13,200	31	516	374,000
1919–20.				
October	9,170	1,570	3,870	238,000
November	2,680	790	1,270	75,600
December	838	513	658	40,500
January	1,600	484	750	46,100
February	838	470	610	35,100
March	543	361	418	25,700
April	456	274	332	19,800
May	1,940	251	411	25,300
June	710	240	354	21,100
July	274	179	217	13,300
August	387	188	222	13,600
September	198	146	166	9,880
The year	9,170	146	777	564,000

SAN PEDRO CREEK AT SAN ANTONIO, TEX.

LOCATION.—At Commerce Street Bridge, 1½ blocks west of courthouse in San Antonio, Bexar County, 1½ miles above mouth of Salsamora and Martinez creeks, 1½ miles below San Pedro Springs, source of creek, and 3 miles above confluence with San Antonio River.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—July 20, 1916, to September 30, 1920.

GAGE.—Vertical staff, attached to wall of building No. 713 Commerce Street, on upstream side of bridge on left bank; read by G. H. Cumberland.

DISCHARGE MEASUREMENTS.—Made by wading below gage.

CHANNEL AND CONTROL.—Bed composed of rock, gravel, and mud; shifting. Channel straight above and below station. Banks formed by walls of buildings. City improvements have confined the stream to a small channel during low and medium stages, but during floods the streets are covered with water for several blocks. A shoal subject to shift, about 100 feet below gage, serves as control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 4.45 feet at 8.20 a. m., September 15 (discharge, 335 second-feet, determined by extension of rating curve); minimum discharge, 0.7 second-feet December 10–11.

Maximum stage recorded during year ending September 30, 1920, 3.4 feet October 16 (determined from marks on gage; discharge not determined); minimum discharge 8.2 second-feet, September 5–18.

1916–1920: Maximum stage recorded, 6.25 feet at 7.40 a. m. September 25, 1916 (discharge not determined); minimum discharge, 0.7 second-foot December 10–11, 1918.

ICE.—None.

DIVERSIONS.—None.

REGULATION.—No dams, reservoirs, or controlling works that permanently regulate the flow.

ACCURACY.—Stage-discharge relation not permenent. Rating curve poorly defined for all stages. Gage read to hundredths twice daily, but mean of two readings daily during flood stages may not be true mean, owing to rapid fluctuations. Daily discharge ascertained by indirect method for shifting control, but record for 1920 not deemed sufficiently accurate to be published. Records poor.

Entire flow of San Pedro Creek, except during times of heavy precipitation, is furnished by San Pedro Springs, and the flow at this station is believed to be that which reaches San Antonio River. Martinez and Salsamora creeks carry no water except during heavy local rains, and have been known to be dry for several years at a time.

Discharge measurements of San Pedro Creek at San Antonio, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1920.		*Feet.*	*Sec.-ft.*
Oct. 12	McCashin and Congdon	1.30	2.8	Jan. 22	Ellsworth and Pritchett	1.74	11.8
Nov. 29	E. P. Congdon	1.58	3.6	Feb. 1	D. A. Dudley	1.74	14.3
1919.				19	C. E. Ellsworth	1.68	13.6
Jan. 25	A. K. Gowans	1.39	6.0	Mar. 10	McCashin and Pritchett	1.68	12.8
Feb. 3	Ellsworth and Congdon	1.40	6.0	Apr. 8	C. E. Ellsworth	1.71	12.9
Mar. 12	E. P. Congdon	1.38	4.2	May 7	D. A. Dudley	1.68	12.6
Apr. 17	Ellsworth and Quarles	1.40	6.7	June 27	T. Twichell	1.69	11.1
May 14	C. E. Ellsworth	1.44	6.9	July 11	C. E. Ellsworth	1.65	9.7
July 21	Dudley and Twichell	2.32	52.0	30	T. Twichell	1.60	10.3
Sept. 3	D. A. Dudley	1.48	8.6	Sept. 7	McCashin and West	1.64	8.74
Dec. 17	C. E. Ellsworth	1.67	13.5				
30	Ellsworth and Pritchett	1.67	12.1				

Daily discharge, in second-feet, of San Pedro Creek at San Antonio, Tex., for the year ending Sept. 30, 1919.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.8	3.0	4.1	2.7	6.4	5.0	5.6	7.9	7.9	7.6	13	8.5
2	2.8	3.3	3.3	2.7	6.6	5.0	13	7.7	7.9	18	14	8.5
3	2.8	3.1	3.7	2.7	7.4	5.0	8.5	7.4	7.9	7.4	13	8.5
4	2.8	3.3	3.3	2.7	6.4	5.0	6.4	6.6	7.9	7.4	14	8.5
5	2.8	3.7	.9	2.8	6.2	5.0	6.4	6.6	7.9	7.4	14	8.5
6	2.8	3.7	.8	2.8	5.9	5.0	6.4	7.9	7.9	52	15	8.5
7	2.8	3.5	.9	3.0	5.9	5.0	6.4	7.9	7.9	7.6	15	8.5
8	2.8	3.9	.9	2.8	5.6	5.0	6.6	7.4	7.9	7.4	16	9.6
9	2.8	3.7	.8	3.0	5.9	5.0	6.4	6.6	17	7.4	16	8.5
10	3.5	3.9	.6	3.0	5.6	5.0	6.4	6.6	7.9	7.4	16	8.5
11	3.0	3.5	.7	3.1	5.9	5.0	6.6	41	7.9	7.4	16	8.2
12	2.8	3.7	.9	3.1	5.6	5.0	6.6	6.9	7.9	7.4	16	8.2
13	2.8	3.5	1.1	3.5	5.6	4.8	6.4	6.9	7.9	7.9	16	8.5
14	2.8	6.9	.8	13	5.6	4.8	6.6	6.9	7.9	7.6	16	20
15	2.8	3.7	.9	4.1	5.6	4.8	6.6	6.9	7.9	7.6	16	144
16	3.0	3.1	.9	3.9	5.6	5.0	6.4	6.9	8.5	7.9	16	19
17	3.0	3.3	1.0	3.9	5.6	5.0	6.4	11	9.4	7.9	15	19
18	3.0	3.7	3.7	3.7	5.6	5.0	6.4	7.4	8.5	8.2	13	11
19	3.0	3.7	34	4.4	5.4	5.0	6.4	7.4	7.9	8.5	12	10
20	3.0	3.9	1.5	4.8	5.9	5.0	6.4	7.4	7.9	8.5	12	10
21	3.1	3.7	1.4	4.8	5.2	5.0	6.2	7.4	8.5	44	48	10
22	10	5.4	1.3	5.4	5.2	5.2	6.2	7.4	8.5	48	13	14
23	3.0	4.8	20	46	5.2	5.4	6.2	7.4	11	72	9.6	13
24	3.0	4.6	1.7	6.4	5.2	5.6	6.2	21	11	18	9.4	12
25	4.4	4.6	1.7	5.6	5.2	36	6.2	7.4	12	15	9.1	12
26	6.2	4.4	1.9	6.2	5.2	6.6	5.9	7.4	79	12	8.8	12
27	3.1	3.9	2.0	48	5.2	5.6	5.9	7.2	88	14	8.8	12
28	2.8	3.7	2.0	7.6	5.2	5.4	5.9	7.2	9.4	13	8.5	12
29	3.0	3.5	2.3	6.2	.....	5.4	134	7.4	8.5	13	8.5	12
30	2.8	3.7	2.3	6.6	.....	5.4	40	7.9	9.9	13	8.5	12
31	2.8	.....	2.5	6.2	.....	5.4	.....	7.9	.....	13	8.5	.....

NOTE.—Daily discharge determined by indirect method for shifting control during following periods: Oct. 1 to Feb. 15, Feb. 21 to Mar. 25, Apr. 1 to June 25, Aug. 22 to Sept. 14.

Monthly discharge of San Pedro Creek at San Antonio, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	10	2.8	3.29	202
November	6.9	3.0	3.88	231
December	34	.6	3.35	206
January	48	2.7	7.25	446
February	7.4	5.2	5.71	317
March	36	4.8	6.14	378
April	134	5.6	12.0	714
May	41	6.6	8.93	549
June	88	7.9	13.9	827
July	72	7.4	15.6	959
August	48	8.5	14.0	861
September	144	8.2	15.5	922
The year	144	.6	9.13	6,610
1919–20.				
October	.....	12	22.7	1,400
November	.....	16	18.2	1,080
December	20	13	14.6	898
January	31	10	12.6	775
February	15	13	13.7	788
March	14	13	13.1	806
April	26	13	15.0	893
May	18	12	13.5	830
June	20	10	11.6	690
July	10	9.4	9.84	605
August	21	9.4	10.9	670
September	9.9	8.2	8.65	515
The year	.....	8.2	13.7	9,950

NUECES RIVER BASIN.

NUECES RIVER NEAR CINONIA, TEX.

LOCATION.—Just below suspension highway bridge near Oswald ranch, 2 miles east of Cinonia, Zavalla County, 8 miles northeast of Crystal City, and 20 miles above Winter Garden ranch dam.

DRAINAGE AREA.—2,060 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—July 5, 1915, to September 30, 1920.

GAGE.—Vertical staff in six sections, installed May 6, 1918, on right bank, 200 feet below highway bridge; read by C. C. Oswald. From July 5, 1915, to September 23, 1917, gage used was vertical staff in seven sections on right and left banks. September 24, 1917, to May 5, 1918, Dexter water-stage recorder near concrete control. All gages set at same datum and at approximately the same location.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading on crest of concrete control.

CHANNEL AND CONTROL.—Bed composed of clay and gravel; free from vegetation; subject to shift prior to September 23, 1917. Banks high and wooded, and not subject to overflow, except during extremely high water. Channel straight above and below station. An artificial concrete control was completed at the site of the gage on September 23, 1917; point of zero flow, 0.85 foot. The stage-discharge relation has been seriously affected at times prior to installation of artificial control by collecting of logs, leaves, and brush below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 49.1 feet, September 23, determined by leveling from flood marks (discharge not determined); no flow October 1–10.

Maximum stage recorded during year ending September 30, 1920, 26.3 feet at 7 p. m. October 17 (discharge, 4,190 second-feet, determined from extension of rating curve); minimum stage, 1.40 feet September 14–30 (discharge, 11 second-feet).

1915–1920: Maximum stage recorded in 1919 (see above). According to local residents, the greatest flood of record occurred in 1913 when the river reached a stage of 53 feet on present gage. No flow during periods in 1917 and 1918.

ICE.—None.

DIVERSIONS.—Considerable water diverted above station for irrigation; amount not known.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 700 second-feet; above 700 second-feet, extended by use of velocity-area curves, and subject to error. Gage read to half-tenths twice daily. Daily discharge determined by applying mean daily gage height to rating table. Records good for low and medium stages.

Backwater from a dam 40 feet high, about 20 miles below station extends within 2 miles of station when reservoir is full. A large part of the flow of the river is known to seep into the bed just below Uvalde and return to the surface just above the station. The condition of the underground water may have an effect on this return water and thus help equalize the flow.

Discharge measurements of Nueces River near Cinonia, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Oct. 23	McCashin and Congdon	6.95	379	May 10	C. E. Ellsworth	1.26	5.0
23	do	6.11	322	Aug. 27	D. A. Dudley	9.23	626
23	do	5.49	268				
24	do	2.54	77.2	1920.			
				Jan. 30	D. A. Dudley	4.10	161
				May 12	do	1.85	29.9
				July 16	C. E. Ellsworth	1.62	18.9

Daily discharge, in second-feet, of Nueces River near Cinonia, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1.....	0	2.4	2.2	5.0	14	7.2	7.2	5.4	14	22	15	253
2.....	0	1.9	2.2	5.0	13	7.2	59	5.0	14	55	14	229
3.....	0	1.9	1.9	4.4	11	6.4	97	5.0	14	90	14	205
4.....	0	1.9	1.9	4.4	33	6.4	48	5.0	13	92	12	181
5.....	0	1.9	1.9	4.4	53	6.4	30	6.8	11	92	11	157
6.....	0	1.9	1.9	4.4	32	6.4	18	6.1	9.4	59	10	133
7.....	0	256	2.2	4.4	17	6.4	16	5.7	7.2	48	10	109
8.....	0	28	2.2	4.4	14	6.4	14	5.7	7.2	40	9.4	97
9.....	0	15	2.2	4.4	14	6.4	12	5.7	7.2	53	8.9	85
10.....	0	11	2.1	4.4	14	6.4	8.4	5.0	6.8	50	8.0	73
11.....	.8	5.7	1.9	4.4	14	6.4	7.2	5.0	6.4	32	8.0	61
12.....	58	3.0	1.9	4.4	11	6.4	7.2	5.0	5.7	29	8.0	55
13.....	25	2.4	13	4.4	8.9	6.4	7.2	5.0	5.7	26	7.2	51
14.....	10	2.2	24	4.4	8.0	6.4	7.2	4.7	5.7	24	7.2	44
15.....	2.8	2.2	10	4.7	8.0	6.4	6.4	4.4	5.4	20	7.2	434
16.....	1.1	2.2	5.0	6.4	7.2	6.4	6.4	6.8	5.0	17	7.2	1,970
17.....	.4	1.9	3.2	6.4	15	5.7	6.1	11	4.7	15	6.4	3,850
18.....	.4	1.9	2.8	5.7	14	5.7	5.7	7.6	8.0	14	6.1	3,250
19.....	.4	1.6	18	5.7	13	5.7	5.7	6.4	8.4	12	5.7	1,470
20.....	.3	1.6	133	5.0	9.4	5.7	5.7	5.0	6.8	9.4	5.0	935
21.....	.3	1.6	74	5.4	8.0	5.7	5.7	4.4	5.7	10	5.0	688
22.....	1,960	1.6	14	2,730	7.2	5.7	5.7	4.2	4.4	18	5.0	637
23.....	455	1.6	128	296	7.2	5.7	5.7	3.2	46	36	742	.....
24.....	61	2.1	94	53	7.2	5.7	5.7	488	71	91	2,400	.....
25.....	46	2.6	21	28	7.2	6.4	5.7	816	61	94	1,250	.....
26.....	23	2.6	11	22	7.2	8.9	5.7	194	66	153	829	.....
27.....	10	2.6	8.4	28	7.2	29	5.0	53	70	77	620	.....
28.....	7.6	2.6	7.2	76	7.2	22	5.0	30	28	68	463	3,160
29.....	5.4	2.6	7.2	28	.....	17	5.0	21	21	42	388	2,290
30.....	4.2	2.6	6.8	18	.....	13	5.7	17	16	28	330	1,770
31.....	3.2	.....	5.7	15	.....	7.6	.....	14	.....	17	280	.....
1919-20.												
1.....	1,450	615	348	180	159	106	70	33	33	26	15	17
2.....	1,200	582	296	180	159	103	70	38	33	26	15	17
3.....	1,090	560	296	180	159	100	64	38	33	26	15	16
4.....	1,000	549	288	180	152	100	64	33	30	23	15	15
5.....	921	538	280	173	152	100	64	33	36	23	14	15
6.....	949	498	280	173	145	100	64	33	38	23	13	15
7.....	949	582	272	173	145	94	64	30	37	23	13	15
8.....	949	518	272	173	145	94	64	28	34	21	13	15
9.....	1,090	478	264	166	138	94	64	28	33	21	18	13
10.....	1,050	468	264	166	138	94	64	28	32	21	18	13
11.....	1,000	458	256	166	131	94	58	28	30	21	16	13
12.....	963	438	248	173	131	88	58	30	28	21	15	13
13.....	842	420	248	180	131	88	58	30	32	21	13	13
14.....	790	420	240	187	124	88	58	30	33	20	152	12
15.....	754	402	232	187	124	88	53	33	32	19	131	11
16.....	1,000	402	232	194	124	85	53	30	30	19	28	11
17.....	3,600	384	224	194	118	82	53	30	29	19	19	11
18.....	3,120	384	224	187	118	82	53	30	28	19	19	11
19.....	1,910	366	224	187	118	79	53	30	28	19	19	11
20.....	1,450	366	224	180	118	76	53	30	29	17	19	11
21.....	1,120	357	232	173	112	76	43	30	34	17	19	11
22.....	977	357	232	173	112	73	43	30	33	17	17	11
23.....	935	348	224	173	112	70	43	33	30	17	17	11
24.....	855	348	216	173	112	70	38	33	30	17	17	11
25.....	829	330	216	187	112	73	38	33	28	17	17	11
26.....	766	330	201	180	106	79	43	33	28	16	17	11
27.....	718	312	201	180	106	76	38	33	27	15	17	11
28.....	694	312	194	173	106	76	38	33	26	15	17	11
29.....	1,350	312	194	173	106	70	33	33	26	15	15	11
30.....	730	312	187	166	.....	70	33	33	26	15	15	11
31.....	637	.....	187	166	.....	70	.....	33	.....	15	15	.....

NOTE.—No record, Dec. 21, 1918, and Sept. 1-6, 1919; discharge interpolated. No record Sept. 23-27, 1919, during which period floods occurred making it impractical to estimate discharge. Discharge above 700 second-feet determined from extension of rating curve and subject to considerable error.

Monthly discharge of Nueces River near Cinonia, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	1,960	0	86.3	5,310
November	256	1.6	12.3	732
December	133	1.9	19.7	1,210
January	2,730	4.4	110	6,760
February	53	7.2	13.6	755
March	29	5.7	8.18	503
April	97	5.0	14.3	851
May	816	3.2	56.8	3,490
June	71	4.4	18.5	1,100
July	153	9.4	46.2	2,840
August	2,400	5.0	242	14,900
September 1–22	3,850	44	680	29,700
The period				68,200
1919–20.				
October	3,600	637	1,150	70,700
November	615	312	425	25,300
December	348	187	242	14,900
January	194	166	177	10,900
February	159	106	128	7,360
March	106	70	85.1	5,230
April	70	33	53.1	3,160
May	38	28	31.6	1,940
June	38	26	30.9	1,840
July	26	15	19.5	1,200
August	152	13	26.6	1,510
September	17	11	12.6	750
The year	3,600	11	200	145,000

NUECES RIVER NEAR THREE RIVERS, TEX.

LOCATION.—At San Antonio, Uvalde & Gulf Railroad bridge 1 mile west of Kittie, 2 miles southeast of Three Rivers, Live Oak County, and half a mile below mouth of Frio River.

DRAINAGE AREA.—15,600 square miles (measured on standard topographic maps; post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—July 1, 1915, to September 30, 1920.

GAGE.—Vertical staff in four sections, attached to piers of railroad bridge; read by C. L. McMahon, T. H. Hammon, J. B. Mouser, and M. C. Mouser.

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

CHANNEL AND CONTROL.—Bed composed of adobe shale; does not change greatly. Channel straight above and below station. Banks wooded, high, and not subject to overflow, except at extremely high stages. Position of high-water control not known; shoal just below gage probably forms low-water control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 46.0 feet at 5 a. m. September 18 (discharge not determined); backwater probably due to Gulf storm; minimum stage, 0.35 foot December 8–12 (discharge, 2.2 second-feet).

Maximum stage recorded during year ending September 30, 1920, 36.1 feet during morning of October 19 (discharge, 13,600 second-feet, determined from extension of rating curve); minimum stage, 1.4 feet at 9 a. m. September 29 and 8.30 a. m. September 30 (discharge, 22 second-feet).

1915–1920: Maximum stage recorded in 1919 (see above); no flow during several periods of record.

ICE.—None.

DIVERSIONS.—Records of the Board of Water Engineers for the State of Texas show that about 10,000 acres have been declared irrigated by diversions from the stream above the station.

REGULATION.—None of consequence.

ACCURACY.—Stage-discharge relation not permanent. Rating curve well defined below 7,000 second-feet; above this point extended by use of area-velocity curves and subject to error. Gage read to tenths twice daily from October 1, 1918, to September 30, 1919, and once daily thereafter. Daily discharge determined by applying mean daily gage height to rating table to October 23, 1919, and by indirect method for shifting control for remainder of period. Records fair.

Discharge measurements of Nueces River near Three Rivers, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height	Discharge.
1918.		*Ft.*	*Sec.-ft.*			*Ft.*	*Sec.-ft.*
Oct. 28	McCashin and Congdon.	16.79	4,160	Sept. 1	D. A. Dudley.....	24.95	7,100
28	.....do.....	16.21	3,970				
29	.....do.....	12.57	2,860	1920.			
Dec. 21	E. P. Congdon.....	27.14	6,270	Jan. 31	.....do.....	3.51	296
22	.....do.....	14.34	2,820	Mar. 13	McCashin and Pritchett	2.44	141
				May 9	D. A. Dudley.....	3.02	252
1919.				June 26	T. Twichell.....	1.85	67.1
May 11	C. E. Ellsworth.....	10.60	2,200	Sept. 10	McCashin and West....	2.30	87.3
12	.....do.....	14.66	3,570				

Daily discharge, in second-feet, of Nueces River near Three Rivers, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1.....	38	4,110	4.2	647	1,440	31	2,850	6,120	1,770	3,260	3,630	8,380
2.....	24	4,970	4.2	476	1,500	28	2,710	2,750	1,260	3,040	2,330	3,180
3.....	30	5,950	4.2	355	1,520	28	6,720	1,380	1,280	3,400	2,260	1,640
4.....	18	7,100	4.2	278	1,740	28	8,850	1,230	1,360	4,350	1,950	1,760
5.....	15	5,500	4.2	158	3,550	28	5,680	1,230	2,330	4,250	1,840	1,470
6.....	14	3,690	4.2	100	2,850	28	2,820	1,230	2,840	3,450	1,700	1,330
7.....	14	4,370	4.2	88	1,980	28	2,260	1,650	2,610	4,690	1,760	1,200
8.....	15	1,940	2.4	56	1,180	42	1,960	3,490	2,610	6,260	1,820	1,080
9.....	15	1,430	2.4	34	993	31	1,890	2,240	2,990	3,240	1,880	950
10.....	81	446	2.4	26	896	24	2,380	2,020	3,220	1,900	1,960	824
11.....	702	81	2.4	24	836	24	2,590	2,070	3,690	1,660	1,580	.....
12.....	2,990	16	2.4	24	616	24	2,470	3,910	3,530	1,640	556	.....
13.....	1,680	14	31	20	546	24	2,120	4,270	2,990	1,830	346	.....
14.....	616	12	920	20	436	20	1,760	3,360	2,280	2,160	189	.....
15.....	596	2,850	304	16	278	20	1,620	2,610	1,610	1,250	142	.....
16.....	702	1,640	28	16	245	20	1,700	2,360	1,320	848	114	.....
17.....	920	993	18	100	221	16	1,720	3,220	1,260	658	100	.....
18.....	596	1,190	418	42	197	14	1,450	3,890	1,200	526	88	.....
19.....	427	1,960	8,720	28	165	14	860	801	556	436	74	.....
20.....	237	1,960	11,800	24	150	14	418	626	253	355	62	.....
21.....	173	1,740	9,820	16	142	14	128	779	320	229	304	.....
22.....	2,850	1,180	2,790	2,570	128	14	74	896	658	691	3,450	.....
23.....	8,520	436	3,150	7,520	114	14	74	993	1,760	1,070	2,250	.....
24.....	9,780	100	5,760	7,620	100	14	74	1,060	1,770	3,710	790	.....
25.....	6,560	42	6,680	2,540	88	4,110	62	2,180	2,330	5,990	476	.....
26.....	3,130	20	2,800	2,250	68	11,000	52	2,570	6,820	7,520	836	.....
27.....	5,190	11	1,260	3,650	47	14,400	42	932	7,860	5,160	1,500	.....
28.....	4,650	6.2	1,590	4,050	38	13,500	34	691	4,590	3,490	2,660	.....
29.....	3,000	6.2	1,840	2,060	.....	11,500	62	956	2,680	5,170	4,710	.....
30.....	2,140	6.2	1,300	1,410	.....	7,120	3,650	1,470	2,560	5,290	6,960	.....
31.....	2,800	.....	566	896	.....	3,340	.....	1,660	.....	5,320	7,910	.....

Daily discharge, in second-feet, of Nueces River near Three Rivers, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	11,600				295	197	94	47	546	62	213	270
2	9,850				295	181	94	68	409	42	121	189
3	9,100				295	181	94	81	253	34	81	128
4	8,400				278	181	94	181	546	28	68	100
5	7,910				278	165	81	107	526	6,540	57	88
6	8,550				278	165	81	94	526	9,650	57	74
7	10,800				278	165	81	68	824	7,190	150	74
8	11,600				278	150	81	128	669	6,120	229	74
9	10,800				278	150	68	213	526	4,550	229	100
10	9,350				261	150	81	616	270	2,900	346	88
11	7,670				261	150	68	312	173	1,860	81	88
12	6,450				261	150	81	329	128	1,680	81	62
13	6,580				956	135	81	229	100	1,590	81	62
14	7,620				556	135	68	278	88	536	150	52
15	9,250				346	135	68	229	626	245	418	52
16	11,400				312	135	68	2,980	1,230	181	213	47
17	12,400				278	135	57	2,760	205	150	181	47
18	13,200				278	135	57	944	114	135	278	38
19	13,500				261	135	57	566	74	121	476	38
20	12,600				261	121	57	896	74	94	436	31
21	11,200				245	121	47	1,180	62	81	436	34
22	10,400				245	121	47	920	62	81	476	28
23	10,600				245	121	47	506	253	68	536	28
24					229	121	47	221	205	68	616	62
25					213	121	47	189	128	57	702	62
26					213	121	57	173	74	57	1,240	47
27					197	107	94	158	100	57	1,110	31
28					197	107	68	158	100	47	1,140	26
29					197	107	68	286	74	47	1,260	22
30						94	47	526	52	47	1,480	22
31						94		355		38	1,260	

NOTE.—Discharge interpolated Sept. 7–9, 1919. No record Sept. 11–14, and 19–30, 1919. Medium to high stages prevailed during those periods. Sept. 15, 16, 17, and 18, 1919, mean daily gage heights, 30.05, 37.5, 43.0, and 46.0 feet, respectively; probably affected by backwater caused by high winds from Gulf storm. No record Oct. 24, 1919, to Jan. 31, 1920.

Monthly discharge of Nueces River near Three Rivers, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	9,780	14	1,890	116,000
November	7,100	6.2	1,790	107,000
December	11,800	2.4	1,930	119,000
January	7,620	16	1,200	73,800
February	3,550	38	788	43,800
March	14,400	14	2,110	130,000
April	8,850	34	1,970	117,000
May	6,120	626	2,090	129,000
June	7,860	253	2,410	143,000
July	7,520	229	2,990	184,000
August	7,910	62	1,810	111,000
September 1–10	8,380	824	2,180	43,200
The period				1,320,000
1919–20.				
October 1–23	13,500	6,450	10,000	456,000
February	956	197	295	17,000
March	197	94	138	8,480
April	94	47	69.3	4,120
May	2,980	47	510	31,400
June	1,230	52	301	17,900
July	9,650	28	1,430	87,900
August	1,480	57	458	28,200
September	270	22	68.8	4,090

NUECES RIVER AT CALALLEN, TEX.

LOCATION.—At old pump house for city of Corpus Christi, half a mile northwest of Calallen, Nueces County, 18 miles west of Corpus Christi, 8 miles above Nueces Bay, and half a mile above edge of tidewater and breakwater dam.

DRAINAGE AREA.—16,700 square miles (measured on post-route map and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—August 12, 1915, to September 30, 1920.

GAGE.—Vertical staff attached to pipe-line support of old pump house; read by Henry Wagner or John Cunningham.

DISCHARGE MEASUREMENTS.—Made by wading at the breakwater or from cable 125 feet below gage.

CHANNEL AND CONTROL.—Bed composed of clay and gravel. Channel straight above and below station. Left bank wooded, low, and bordered by levee constructed to prevent overflow; right bank wooded, medium in height, and not subject to overflow. The breakwater dam which is a loose rock fill half a mile below, serves as control. It leaks badly and is subject to change during floods. Flood damage is repaired by dumping loose rock on the crest.

EXTREMES OF STAGE.—Maximum stage during year ending September 30, 1919, 12 feet in September; minimum stage, 1.80 feet October 9 and March 16–24.

Maximum stage recorded during year ending September 30, 1920, 7.1 feet at 4 p. m. July 12; minimum stage, 1.60 feet 4 p. m. September 24 to 8 a. m. September 27.

1915–1920: During September, 1919, the river reached a stage of about 12 feet, as determined from flood marks on the gage: This was not only the highest stage reached during the period covered by records but probably exceeds any that occurred for many years prior to the establishment of this station. Discharge indeterminate because of lowlands on left bank overflowing for a width of several miles. No flow August 23–28, 1918.

ICE.—None.

DIVERSIONS.—Considerable water taken from river for irrigation immediately above station, and river water is also used for irrigation throughout the drainage above. The city of Corpus Christi pumps water just below the gage for municipal supply. They reported a consumption of 922 acre-feet during 1918.

REGULATION.—None of consequence.

ACCURACY.—Stage-discharge relation not permanent because of leakage through and repair of the breakwater dam. Rating curve is poorly defined, Gage read to hundredths twice daily. Daily discharge not computed because of changing control and insufficient discharge measurements. Records poor.

The following discharge measurement was made by C. E. Ellsworth:

April 16, 1919: Gage height, 4.18 feet; discharge, 2,000 second-feet.

Daily gage height, in feet, of Nueces River at Calallen, Tex., for the periods, Oct. 1, 1918, to Mar. 31, 1919, and Apr. 1 to Sept 30, 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.							1920.						
1	2.65	7.18	2.15	3.67	4.10	2.05	1	2.20	2.05	2.30	2.05	2.05	3.50
2	2.32	6.55	2.10	3.15	3.70	2.00	2	2.20	2.05	2.45	2.00	1.95	3.20
3	2.12	5.95	2.00	2.97	3.60	2.00	3	2.20	2.05	2.55	2.00	1.85	2.40
4	1.98	6.15	2.00	2.65	3.82	1.95	4	2.20	2.10	2.55	2.00	1.90	2.25
5	1.95	6.55	2.00	2.60	4.22	1.90	5	2.20	2.10	2.40	2.00	1.90	2.18
6	1.90	6.90	1.92	2.55	4.45	1.90	6	2.15	2.20	2.60	2.25	1.85	2.02
7	1.88	7.20	1.95	2.45	4.85	1.90	7	2.10	2.20	2.60	4.12	1.80	1.92
8	1.85	7.40	1.95	2.32	4.25	1.90	8	2.18	2.20	2.70	4.60	1.80	1.88
9	1.80	6.85	1.95	2.25	3.85	1.85	9	2.20	2.40	2.85	5.20	1.80	1.82
10	1.88	6.00	1.95	2.20	3.60	1.85	10	2.20	2.25	2.85	5.95	1.80	1.80
11	1.98	4.70	1.95	2.17	3.15	1.85	11	2.20	2.20	2.65	6.70	2.00	1.82
12	2.30	3.00	1.95	2.15	2.95	1.85	12	2.20	2.55	2.45	7.05	2.10	1.90
13	3.25	2.55	1.95	2.10	2.90	1.85	13	2.20	2.62	2.35	6.65	2.10	1.88
14	4.20	2.40	1.90	2.10	2.85	1.85	14	2.20	2.60	2.15	5.70	2.05	1.85
15	3.75	2.75	2.10	2.10	2.75	1.82	15	2.20	2.50	2.00	3.85	2.00	1.85
16	2.95	3.12	2.70	2.10	2.60	1.80	16	2.20	2.62	2.05	2.80	2.15	1.80
17	2.85	3.30	2.65	2.22	2.50	1.80	17	2.10	3.85	2.50	2.40	2.20	1.78
18	2.80	3.30	2.70	2.35	2.42	1.80	18	2.10	4.05	3.10	2.25	2.20	1.72
19	3.15	3.30	3.50	2.50	2.35	1.80	19	2.10	4.30	3.65	2.10	2.20	1.70
10	2.90	3.60	4.35	2.50	2.35	1.80	20	2.05	3.70	2.15	2.10	2.10	1.70
21	2.85	3.95	5.35	2.72	2.30	1.80	21	2.05	2.95	2.00	2.00	2.25	1.65
22	2.82	4.30	6.90	2.95	2.30	1.80	22	2.00	3.10	1.98	2.00	2.45	1.65
23	3.30	3.95	7.65	3.80	2.20	1.80	23	2.00	3.35	1.90	2.00	2.45	1.65
24	4.62	3.60	8.30	4.70	2.17	1.80	24	2.00	3.25	1.90	2.00	2.50	1.62
25	5.30	3.00	8.40	6.00	2.15	2.30	25	2.00	2.70	2.00	2.00	2.62	1.60
26	6.05	2.52	8.10	6.90	2.10	3.15	26	2.05	2.35	2.10	2.10	2.82	1.60
27	6.85	2.35	7.88	7.25	2.05	4.25	27	2.00	2.25	2.20	1.98	3.05	1.62
28	7.42	2.22	6.80	6.70	2.00	5.15	28	2.00	2.20	2.10	1.95	3.12	1.65
29	7.85	2.20	5.75	6.20	.....	6.60	29	2.00	2.20	2.00	1.72	3.15	1.72
30	7.75	2.20	5.10	6.20	.....	7.35	30	2.10	2.20	2.00	1.70	3.25	1.68
31	7.68	.....	4.35	5.65	.....	8.60	31	.....	2.20	.....	2.02	3.40	.....

NOTE.—No gage-height record Apr. 1, 1919, to Mar. 31, 1920.

FRIO RIVER NEAR DERBY, TEX.

LOCATION.—At International & Great Northern Railway bridge 900 feet below mouth of Leona River, 400 feet below highway bridge, and 4 miles south of Derby, Frio County.

DRAINAGE AREA.—3,500 square miles (measured on post-route map; and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—August 1, 1915, to September 30, 1920

GAGE.—Vertical staff attached to railway bridge pier; read by John A. Head and E. L. Willingham.

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

CHANNEL AND CONTROL.—Bed composed of rock, sand, and gravel; channel curved above and below station, but straight at gage for 150 feet. Banks wooded, high, and not subject to overflow. A concrete dam, 50 feet below gage, serves as control during low and medium stages; position of high-water control not known. Point of zero flow, gage height 0.07 foot, except when affected by moss on control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 18.5 feet September 18 (discharge not determined); no flow during several long periods.

Maximum stage recorded during year ending September 30, 1920, 10.3 feet October 19 (discharge, 4,180 second-feet, determined from extension of rating curve); no flow during several periods.

1915–1920: Maximum stage recorded, September 18, 1919 (discharge not determined); no flow during several periods of each year.

ICE.—None.

DIVERSIONS.—Small areas are irrigated by diversion in the headwaters, but available information does not show that water is taken from the stream immediately above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except when affected by moss on control. Rating curve well defined below 2,000 second-feet; extended above. Gage read twice daily to tenths from October 1, 1918, to November 6, 1919, and March 1 to September 30, 1920, and to hundredths twice daily from November 7, 1919, to February 29, 1920, and oftener during rapid fluctuations. Daily discharge ascertained by applying mean daily gage height to rating table except from June 12 to September 30, 1920, when indirect method for shifting control was used because of growth of moss on control. Discharge for extremely low periods from March 1 to September 30, 1920, subject to large error, owing to gage being read only to nearest tenth of a foot. Records good except as otherwise noted.

Discharge measurements of Frio River near Derby, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Ft.*	*Sec.-ft.*	1920.		*Ft.*	*Sec.-ft.*
Oct. 25	McCashin and Congdon.	5.08	1,520	Jan. 28	D. A. Dudley.....	0.97	102
27	.....do.....	.78	65.5	29	.....do.....	.96	92.4
1919.				May 11	.....do.....	.56	35.3
May 10	C. E. Ellsworth.....	.33	11.3	July 16	C. E. Ellsworth.....	.19	1.1
Aug. 28	D. A. Dudley.....	5.74	1,870				

Daily discharge, in second-feet, of Frio River near Derby, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	.....	2.5	.....	7.3	77	.....	49	0.9	14	824	113	617
2	.....	1.8	.....	4.7	36	.....	213	2.7	103	393	86	533
3	.....	1.2	.....	3.4	21	.....	65	2.5	603	281	68	466
4	.....	.3	.....	2.0	19	.....	233	2.0	1,030	292	57	393
5	.....	.....	.....	1.6	23	.....	118	2.7	152	208	52	344
6	.....	.....	.....	1.4	62	.....	107	1.6	49	194	46	298
7	.....	.....	.....	1.2	175	.....	54	160	22	162	39	257
8	.....	.....	.....	.9	84	.....	27	45	12	663	35	227
9	.....	.....	.....	.9	41	.....	16	20	6.0	2,710	30	199
10	.....	.....	.....	.5	23	.....	11	12	4.0	3,040	28	175
11	32	.....	.....	.5	14	.....	6.0	6.7	2.5	900	24	155
12	162	.....	.....	.....	8.6	.....	2.7	4.7	1.8	502	21	138
13	680	.....	.....	.....	4.0	.....	1.6	2.5	1.4	379	21	122
14	312	.....	.....	.....	2.7	.....	1.2	298	.7	284	21	109
15	68	.....	.....	.3	2.7	.....	.9	267	.5	227	21	418
16	32	.....	.....	1.4	2.7	.....	.3	152	.5	191	18	1,580
17	16	.....	.....	1.4	4.0	.....	.....	722	1.4	155	16	.....
18	8.0	.....	.....	1.4	3.4	.....	.....	1,940	54	133	13	.....
19	2.7	.....	774	.7	3.4	.....	.....	44	278	113	10	.....
20	1.6	.....	3,220	.5	3.4	.....	.....	20	77	92	8.6	3,340
21	.5	.....	2,540	.3	2.3	.....	.....	13	362	82	264	2,480
22	216	.....	684	884	.9	.....	.....	12	477	248	802	1,740
23	2,260	.....	400	3,550	.7	.....	.....	5.3	344	578	3,380	2,710
24	2,880	.....	1,160	3,180	.5	.....	.....	7.3	284	2,280	.....	3,740
25	1,720	.....	2,130	1,080	.5	6.0	.....	1,110	916	3,640	.....	4,040
26	260	.....	508	227	.3	1,170	.....	2,540	1,550	2,740	3,580	3,340
27	52	.....	186	103	.....	856	.....	1,700	1,830	1,990	2,540	3,040
28	22	.....	77	964	.....	554	.....	1,330	2,780	960	1,790	2,710
29	16	.....	41	872	.....	210	1.8	194	3,340	603	1,340	2,360
30	8.0	.....	22	435	.....	105	4.0	51	3,140	267	980	2,170
31	2.7	.....	15	162	.....	55	.....	25	.....	168	725	.....

Daily discharge, in second-feet, of Frio River near Derby, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1920.												
1	1,810	2,310	175	62	86	38	27	2.7	6.0	1.8	0	2.0
2	1,540	1,630	165	62	86	38	27	2.7	6.0	1.8	0	2.0
3	1,340	2,310	158	60	84	38	17	2.7	2.7	1.8	0	4.0
4	1,140	1,460	150	58	82	38	17	2.7	9.3	6.7	0	7.3
5	980	900	145	58	79	38	16	2.7	9.3	10	0	7.3
6	940	1,810	145	60	79	38	17	2.7	17	65	0	7.3
7	750	680	145	65	75	38	17	2.7	17	60	0	7.3
8	750	680	140	68	75	36	17	9.3	17	32	0	7.3
9	1,380	680	131	66	73	32	17	86	17	13	1.4	7.3
10	1,220	715	120	62	68	38	17	126	17	13	1.4	7.3
11	980	628	111	58	68	38	17	32	9.3	12	0	7.3
12	1,140	558	105	62	68	38	17	13	6.0	5.3	0	2.0
13	1,460	505	103	72	65	38	17	9.3	2.5	2.5	.3	2.0
14	980	470	101	84	65	38	13	9.3	2.5	1.4	251	2.0
15	980	435	99	94	65	38	9.3	1,140	2.5	1.4	109	2.0
16	1,060	418	96	88	62	38	9.3	1,760	2.5	1.4	81	7.3
17	1,380	400	88	82	62	38	9.3	418	2.5	1.4	55	4.0
18	3,360	382	90	77	62	27	9.3	116	2.5	1.4	35	4.0
19	4,020	348	92	72	60	27	9.3	60	8.6	.0	24	2.0
20	3,260	323	99	68	57	27	9.3	52	2.5	.0	15	4.0
21	2,760	306	101	66	55	27	9.3	32	8.0	.0	7.3	2.0
22	2,260	284	101	63	55	27	9.3	27	8.0	.0	7.3	2.0
23	1,940	270	99	60	54	27	13	17	2.3	.0	7.3	2.0
24	1,720	248	88	63	51	27	17	17	2.3	.0	7.3	.9
25	1,540	230	81	70	46	27	17	17	2.3	.0	4.0	.9
26	1,340	222	75	84	44	17	9.3	9.3	2.0	.0	7.3	.0
27	1,140	205	72	92	42	22	9.3	13	7.3	.0	4.0	.0
28	1,060	194	68	97	41	27	9.3	13	7.3	.0	2.0	.0
29	1,460	180	68	96	38	27	8.0	9.3	7.3	.0	2.0	2.0
30	2,560	180	65	92	.....	27	6.0	9.3	2.0	.0	2.0	2.0
31	2,080	.....	62	86	.....	27	.....	9.3	.....	.0	4.0	.....

NOTE.—No flow on days for which discharge is not given except on Aug. 24–25, and Sept. 17–19, 1919, when stage was above limit for which rating curve is defined. Mean daily gage heights, Aug. 24, 17.00 feet; Aug. 25, 13.10 feet; Sept. 17, 12.30 feet; Sept. 18, 16.83 feet; and Sept. 19, 1919, 11.05 feet. Discharge above 2,000 second-feet determined from extension of rating curve and subject to error.

Monthly discharge of Frio River near Derby, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off (acre-feet).
	Maximum.	Minimum.	Mean.	
1918–19.				
October	2,880	0	282	17,300
November	2.5	0	.193	11.5
December	3,220	0	379	23,300
January	3,550	0	371	22,800
February	175	0	22.0	1,220
March	1,170	0	95.4	5,870
April	233	0	30.4	1,810
May	2,540	0	345	21,200
June	3,340	.5	581	34,600
July	3,640	82	816	50,200
The period				178,000
1919–20.				
October	4,020	750	1,620	99,600
November	2,310	180	665	39,600
December	175	62	108	6,640
January	97	58	72.5	4,460
February	86	38	63.7	3,660
March	38	17	32.3	1,990
April	27	6.0	13.9	827
May	1,760	2.7	130	7,990
June	17	2.0	6.95	414
July	65	0	7.48	460
August	251	0	20.2	1,240
September	7.3	0	3.55	211
The year	4,020	0	230	167,000

FRIO RIVER AT FOWLERTON, TEX.

LOCATION.—At Frio River dam, half a mile northeast of Fowlerton, LaSalle County, 1¼ miles below diversion for Frio Lake storage reservoir, and 8 miles below mouth of Jahuey Creek.

DRAINAGE AREA.—4,350 square miles (measured on post-route map, and topographic map of Texas, compiled in 1899 by Robert T. Hill, of the United States Geological Survey; scale, 1 inch=25 miles).

RECORDS AVAILABLE.—July 1, 1915, to August 30, 1919, when station was discontinued because break in levee above gage permitted water to flow around dam which served as control.

GAGE.—Vertical staff attached to tree on right bank 30 feet above dam; read by J. F. Martin and W. H. Newbury.

DISCHARGE MEASUREMENTS.—Made by wading below dam, or from railroad bridge a mile above.

CHANNEL AND CONTROL.—Channel straight for some distance above the station, but slightly curved below; banks about 5 feet high and not subject to overflow except during extremely high water; right bank cultivated; left bank wooded. Concrete dam about 30 feet below gage serves as permanent control at all stages, except when levees above dam were broken (see footnote to table of daily discharge). Point of zero flow, gage height 0.10 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 5.00 feet at 11 a. m. August 26 (discharge, 4,000 second-feet, determined from extension of rating curve. On August 27, 28, and September 14–20, stage was above 5 feet, but gage could not be reached because of high water. No flow for extended periods.

1915–1919: Maximum stage recorded in 1919 (see above); no flow during parts of each year.

ICE.—None.

DIVERSIONS.—Some water diverted for irrigation above station. A diversion for the Frio Lake reservoir is made 1½ miles above; other diversions are scattered; amount diverted and areas irrigated not known. A large part of the irrigated land in the drainage basin above the station is watered by wells.

REGULATION.—Flow regulated by the diversion into Frio Lake a short distance above gage; extent of regulation above Frio Lake diversion not known but probably small.

ACCURACY.—Stage-discharge relation permanent except for periods when break in levee permitted water to flow around end of dam which serves as control as noted in footnote to daily-discharge table. Rating curve fairly well defined below 1,600 second-feet, and extended above. Gage read to hundredths once daily. Daily discharge ascertained by applying mean daily gage height to rating table except as indicated in footnote to table of daily discharge. Records fair.

Discharge measurements of Frio River at Fowlerton, Tex., during the year ending Sept. 30, 1919.

Date.	Made by—	Gage height.	Dis. charge.	Date.	Made by—	Gage height.	Dis. charge.
		Ft.	*Sec.-ft.*			*Ft.*	*Sec.-ft.*
Oct. 25	McCashin and Congdon.	2.97	1,600	May 11	C. E. Ellsworth.....	0.30	12.1
27	.....do.....	1.33	348	Aug. 30	D. A. Dudley.....	1.39	[a]897

[a] Water flowing around end of dam which ordinarily acts as control.

Daily discharge, in second-feet, of Frio River at Fowlerton, Tex., for the year ending Sept. 30, 1919.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	0	.....	0	15	48	0	201	185	30	2,170	143
2	0	.....	0	8.4	10	0	150	117	1,110	2,070	88
3	0	.....	0	3.0	0	0	444	60	996	387	60
4	0	.....	0	2.4	0	0	365	26	325	306	44
5	0	.....	0	1.2	19	0	315	56	552	315	33
6	0	.....	0	0	6.6	0	185	48	398	297	26
7	0	.....	0	0	.....	0	100	37	74	193	20
8	0	.....	0	0	.....	0	52	26	30	130	18
9	0	.....	0	0	.....	0	20	20	12	270	15
10	0	.....	0	0	.....	0	8.4	15	3.0	852	15
11	56	.....	0	0	.....	0	3.0	15	1.2	1,540	12
12	78	.....	0	0	.....	0	1.8	15	0	1,500	10
13	105	.....	0	0	.....	0	1.8	12	0	420	8.4
14	100	.....	0	0	.....	0	1.8	10	0	315	8.4
15	94	.....	0	0	.....	0	1.2	10	0	234	6.6
16	52	.....	0	0	.....	0	0	185	0	157	6.6
17	0	.....	0	0	.....	0	0	178	0	117	4.8
18	0	.....	0	0	.....	0	0	164	0	88	3.0
19	0	.....	564	0	.....	0	0	528	0	69	2.4
20	0	.....	932	0	.....	0	0	325	143	60	1.8
21	0	.....	980	0	.....	0	0	164	164	69	1.2
22	868	.....	2,160	0	.....	0	0	64	178	69	.6
23	755	.....	1,100	1,590	0	0	0	10	243	456	288
24	642	0	600	1,840	0	0	0	88	325	712	564
25	1,500	0	387	2,270	0	1,640	0	117	468	1,080	2,270
26	1,420	0	432	1,200	0	2,100	0	315	852	1,840	3,980
27	365	0	528	225	0	860	0	614	1,200	2,560	.....
28	.....	0	137	52	0	570	0	1,040	1,320	2,550	.....
29	.....	0	83	30	.....	480	0	355	1,420	1,540	.....
30	.....	0	44	325	.....	193	0	150	1,840	740	897
31	.....	.....	23	201	.....	74	150	40	.....	243	.....

NOTE.—No record Oct. 23, 28–31, Nov. 1–23, Feb. 7–22, Aug. 27–29, and 31, and Sept. 1–30, caused principally by flood washing around end of dam which serves as control. Discharge interpolated, Oct. 23. On Aug. 27, 28, and Sept. 14–20 gage height exceeded 5 feet, but observer could not read gage on account of high water.

Monthly discharge of Frio River at Fowlerton, Tex., for the year ending Sept. 30, 1919.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1–27	.....	0	224	12,000
November 24–30	0	0	0	0
December	2,160	0	257	15,800
January	2,270	0	250	15,400
March	2,100	0	191	11,700
April	444	0	66.7	3,970
May	1,040	10	161	9,900
June	1,840	0	389	23,100
July	2,560	60	753	46,300

NOTE.—See footnote to daily-discharge table.

FRIO LAKE OUTLET NEAR FOWLERTON, TEX.

LOCATION.—At Frio Lake dam, 2 miles northeast of Fowlerton, La Salle County, and 1½ miles northeast of gaging station on Frio River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 1, 1915, to August 30, 1919, when station was discontinued because break in levee above gage permitted water to flow around dam which served as control.

GAGE.—Vertical staff attached to post on right bank about 100 feet above dam; read by J. F. Martin and W. H. Newbury.

DISCHARGE MEASUREMENTS.—Made by wading below dam or from railroad bridge about a mile above gage.

CHANNEL AND CONTROL.—Channel straight above and below station for some distance. Right bank clean, cultivated, about 8 feet high; left bank is wooded and is from 5 to 8 feet high; neither bank subject to overflow. Concrete dam about 100 feet below gage serves as control at all stages except when levees above dam were broken (see footnote to daily-discharge table). Point of zero flow at zero gage height.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 3.70 feet on August 27, and again in September (discharge, 5,230 second-feet); no flow for extended periods.

1915–1919: Maximum stage recorded in 1919 (see above); no flow for extended periods each year.

ICE.—None reported.

DIVERSIONS.—Lake is used for storage. Capacity not known.

REGULATION.—Flow controlled at intake on Frio River some distance above; flow of Frio River above this diversion probably not regulated.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined below 4,500 second-feet; above this, subject to considerable error. Gage read to hundredths once daily; one daily gage reading may not be true index of the mean daily discharge. Daily discharge ascertained by applying gage height to rating table. Records fair. Floods washed around end of dam which serves as control, causing loss of records as noted in footnote to daily-discharge table.

Frio Lake is a storage reservoir fed by a diversion from Frio River. The diversion is made 1½ miles above the Frio River dam and the gaging station on the river. The water released from the lake is used for irrigation. This station is maintained in conjunction with that on Frio River at Fowlerton to show the total run-off at that point.

Discharge measurements of Frio Lake outlet near Fowlerton, Tex., during the year ending Sept. 30, 1919.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	McCashin and Congdon	1.50	1,050	May 11	C. E. Ellsworth	0.15	18.7
27	....do....	.77	272	Aug. 30	D. A. Dudley	1.02	[a] 635

[a] Levee at end of dam broken and water flowing around dam.

Daily discharge, in second-feet, of Frio Lake outlet near Fowlerton, Tex., for the year ending Sept. 30, 1919.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	0	.....	0	19	72	0	312	56	22	1,340	56
2	0	.....	0	12	9.2	0	234	43	422	1,400	43
3	0	.....	0	9.0	2.4	0	299	32	714	312	43
4	0	.....	0	6.0	1.2	0	312	19	166	269	32
5	0	.....	0	4.8	97	0	187	27	299	272	27
6	0	.....	0	3.6	12	0	107	27	116	116	22
7	0	.....	0	3.6	1.2	0	64	32	38	80	19
8	0	0	0	2.4	.....	0	38	27	19	64	19
9	0	0	0	1.2	.....	0	22	22	12	211	16
10	0	0	0	1.2	.....	0	16	16	6.0	617	16
11	68	0	0	0	.....	0	9.2	14	4.8	1,020	12
12	112	0	0	0	.....	0	6.0	12	3.0	1,040	12
13	161	0	0	0	.....	0	6.0	9.2	1.2	246	9.2
14	151	0	0	0	.....	0	4.8	9.2	0	135	6.0
15	140	0	0	0	.....	0	2.4	4.8	0	116	6.0
16	60	0	0	0	.....	0	1.2	88	0	88	4.8
17	60	0	0	0	.....	0	1.2	80	0	72	4.8
18	0	0	0	0	.....	0	0	72	0	48	3.6
19	0	0	166	0	.....	0	0	299	0	43	3.6
20	0	0	575	0	.....	0	0	107	32	38	2.4
21	0	0	819	0	.....	0	0	56	32	48	1.2
22	903	0	1,400	0	.....	0	0	22	97	107	1.2
23	699	0	795	1,240	0	0	0	6.0	234	187	43
24	495	0	312	1,010	0	0	0	43	357	286	135
25	855	0	387	1,810	0	1,040	0	48	457	357	2,130
26	980	0	680	967	0	1,500	0	80	535	915	3,040
27	292	0	312	211	0	617	0	457	617	1,640	.....
28	.....	0	107	107	0	387	0	638	855	1,500	.....
29	.....	0	48	56	.....	286	0	555	967	749	.....
30	.....	0	38	405	.....	135	27	222	1,040	299	495
31	.....	.....	27	166	.....	48	.....	27	.....	116	.....

NOTE.—No record Oct. 28–31, Nov. 1–7, Feb. 8–22, Aug. 27–29, 31, and Sept. 1–30. Floods washed around end of dam in February and again in August. Gage not read Oct. 23; discharge interpolated.

Monthly discharge of Frio Lake outlet near Fowlerton, Tex., for the year ending Sept. 30, 1919.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October 1–27	903	0	184	9,850
November 8–30	0	0	0	0
December	1,400	0	183	11,300
January	1,810	0	195	12,000
March	1,500	0	129	7,930
April	312	0	55.0	3,270
May	638	4.8	102	6,270
June	1,040	0	235	14,000
July	1,640	38	443	27,200
August 1–26	3,040	1.2	220	11,300

RIO GRANDE BASIN.

RIO GRANDE NEAR SAN MARCIAL, N. MEX.

LOCATION.—In sec. 19, T. 7 S., R. 1 W., at Atchison, Topeka & Santa Fe Railway bridge 1 mile south of San Marcial. No important tributaries in immediate vicinity of station.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—January 29, 1895, to September 30, 1920.

GAGE.—Inclined staff established January 29, 1895, and destroyed by flood in 1896. Wire gage established in its place at same datum. This was soon abandoned and gage heights have since been obtained by measuring with graduated rod from bridge deck to water surface. Gage datum unchanged.

DISCHARGE MEASUREMENTS.—Made from the bridge.

CHANNEL AND CONTROL.—Bed sandy and very shifting; broken by several bridge piers. No information on control section.

EXTREMES OF DISCHARGE.—Maximum mean daily stage during year ending September 30, 1919, 15.3 feet on May 12 (discharge, 12,700 second-feet); no flow October 1–19, August 31 to September 20.

Maximum mean daily stage during year ending September 30, 1920, 16.1 feet from May 27 to June 4 (discharge, 22,500 second-feet); no flow September 14 to 18.

1895–1920: Maximum mean daily discharge, 33,000 second-feet on October 11, 1904 (gage-height, 13.75 feet); no flow for periods of varying length each year.

DIVERSIONS.—Considerable water diverted for irrigation above station.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter 1918–19. Owing to the shifting control, determinations of daily discharge are based almost entirely on frequent current-meter measurements.

COOPERATION.—Records furnished by United States Reclamation Service, and reduced to three significant figures by United States Geological Survey.

Daily discharge, in second-feet, of Rio Grande near San Marcial, N. Mex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	0	450	550	608	667	549	2,180	11,100	7,580	1,440	2,180	0
2	0	420	670	551	686	475	3,230	9,120	7,580	2,100	7,600	0
3	0	322	1,140	494	704	475	3,050	7,100	8,050	3,100	4,260	0
4	0	340	650	437	695	475	2,880	7,250	6,530	2,820	4,260	0
5	0	350	480	380	685	475	2,880	7,520	5,020	7,840	3,980	0
6	0	317	478	323	675	475	2,880	7,700	4,350	3,600	2,300	0
7	0	318	460	266	675	810	3,140	7,700	3,180	2,360	1,430	0
8	0	295	520	209	534	810	4,240	8,630	2,420	2,610	1,720	0
9	0	292	497	268	462	664	4,030	9,580	2,420	2,610	1,420	0
10	0	285	440	327	520	579	3,680	8,520	2,050	2,840	1,420	0
11	0	350	475	385	638	570	3,050	8,100	1,810	5,440	1,010	0
12	0	342	520	477	696	560	3,340	7,590	1,320	2,960	1,010	0
13	0	380	670	569	638	551	3,340	7,200	1,320	2,500	1,010	0
14	0	430	690	681	638	551	3,380	6,280	1,440	2,280	585	0
15	0	481	680	681	638	642	3,920	5,730	1,410	6,350	585	0
16	0	520	737	681	534	642	3,830	5,730	1,430	8,450	585	0
17	0	442	730	682	534	1,340	3,740	5,730	1,460	6,200	585	0
18	0	496	620	682	534	1,150	3,570	5,960	1,480	7,180	585	0
19	0	445	505	683	534	1,110	3,870	6,300	1,770	8,020	730	0
20	20	520	690	684	610	1,060	4,720	6,300	1,600	8,250	1,040	0
21	401	515	670	685	610	940	4,870	6,550	1,770	6,280	1,150	526
22	580	600	670	686	685	2,400	6,830	6,400	1,770	5,680	830	480
23	500	445	695	670	685	3,860	6,830	7,630	1,790	6,280	385	434
24	540	520	1,290	662	685	3,720	7,100	8,120	1,820	5,500	250	388
25	540	320	1,020	660	732	2,750	8,790	9,300	1,620	2,700	155	342
26	497	320	670	658	960	2,180	10,200	10,400	1,420	1,910	90	295
27	540	446	670	656	673	1,960	8,790	10,800	1,320	1,530	70	295
28	500	405	670	654	549	1,450	12,700	10,700	2,540	1,100	30	295
29	460	421	670	652	.....	1,450	11,600	9,780	4,890	1,200	10	196
30	500	443	670	650	.....	1,520	12,100	8,720	1,230	1,440	2	196
31	478	.....	635	648	.....	1,930	.....	7,950	.....	2,340	0	.....

Daily discharge, in second-feet, of Rio Grande near San Marcial, N. Mex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919-20.												
1	165	523	898	794	851	1,710	1,300	1,760	22,500	7,750	391	185
2	165	497	794	794	872	1,710	1,360	1,760	22,500	8,400	391	185
3	137	470	794	794	872	1,110	2,110	4,600	22,500	8,100	335	185
4	137	461	794	771	906	1,110	1,650	5,280	22,500	7,120	950	185
5	111	453	794	749	941	1,110	1,380	5,160	21,500	6,900	940	153
6	106	444	980	726	975	1,130	1,280	5,280	21,500	6,150	1,120	121
7	101	444	980	647	975	1,130	1,190	6,400	21,500	5,680	740	112
8	96	550	980	647	1,300	1,130	960	6,200	21,500	5,400	615	88
9	91	550	1,160	647	1,300	1,130	1,000	8,020	21,000	4,650	575	50
10	1,460	795	1,160	595	1,300	1,110	1,440	7,800	19,400	3,620	575	30
11	1,250	795	958	595	1,680	1,110	2,900	8,950	18,700	3,280	615	24
12	1,250	749	958	682	1,680	1,080	3,480	11,000	18,100	2,880	625	16
13	1,040	749	858	682	2,230	1,080	3,270	13,200	16,800	2,360	760	8
14	790	749	858	770	1,600	1,080	3,110	11,300	15,800	2,080	665	0
15	739	749	858	950	1,430	1,080	3,710	11,800	14,900	1,830	690	0
16	739	708	858	1,480	1,090	1,080	3,620	12,600	13,900	1,500	723	0
17	680	695	858	1,400	1,090	1,080	4,320	11,100	13,000	1,380	723	0
18	615	682	858	1,140	879	1,080	3,740	10,200	12,000	1,380	665	0
19	615	670	1,040	907	879	1,090	3,740	8,620	11,200	1,130	625	22
20	602	670	980	838	879	1,090	3,620	7,500	10,500	880	640	50
21	589	670	910	838	997	1,090	2,740	7,500	9,990	880	750	70
22	576	740	849	838	997	1,370	2,080	9,250	9,100	780	740	148
23	577	740	847	838	997	1,460	1,890	12,200	8,160	600	725	200
24	578	740	846	842	1,960	2,370	1,800	13,100	7,250	587	900	200
25	579	845	845	842	4,840	2,610	1,800	13,400	6,820	567	750	205
26	579	860	831	842	4,110	2,430	1,840	14,900	6,370	547	580	210
27	472	750	816	835	2,700	1,930	2,090	22,500	6,700	527	475	170
28	472	680	802	835	2,160	1,640	2,370	22,500	6,070	507	410	130
29	472	820	868	840	1,710	1,580	2,090	22,500	5,650	460	370	120
30	472	898	868	846	.....	1,520	1,920	22,500	7,430	450	320	111
31	550	.....	868	851	.....	1,300	.....	22,500	.....	391	245	.....

NOTE.—River frozen over Dec. 26, 1918, to Jan. 7, 1919; discharge estimated.

Monthly discharge of Rio Grande near San Marcial, N. Mex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	580	0	179	11,000
November	600	285	408	24,300
December	1,290	440	662	40,700
January	686	209	560	34,400
February	960	462	638	35,400
March	3,860	475	1,230	75,600
April	12,700	2,180	5,290	315,000
May	11,100	5,730	7,920	487,000
June	8,050	1,230	2,810	167,000
July	8,450	1,100	4,030	248,000
August	7,600	0	1,330	81,800
September	526	0	115	6,840
The year	12,700	0	2,110	1,530,000
1919-20.				
October	1,460	91	542	33,300
November	898	444	672	40,000
December	1,160	794	896	55,100
January	1,480	595	834	51,300
February	4,840	851	1,520	87,400
March	2,610	1,080	1,370	84,200
April	4,320	960	2,330	139,000
May	22,500	1,760	11,000	676,000
June	22,500	5,650	14,500	863,000
July	8,400	391	2,860	176,000
August	1,120	245	633	38,900
September	210	0	99.3	5,910
The year	22,500	0	3,100	2,250,000

RIO GRANDE BELOW ELEPHANT BUTTE DAM, N. MEX.

LOCATION.—In T. 13 S., R. 4 W., 1 mile below Elephant Butte dam, in Sierra County. Nearest tributary, Mescal Canyon, enters half a mile downstream.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 1, 1916, to September 30, 1920.

GAGE.—Stevens water-stage recorder on left bank, 1 mile below dam.

DISCHARGE MEASUREMENTS.—Made from car and cable at gage.

CHANNEL AND CONTROL.—Bed composed of compact gravel; probably permanent. Control at gravel bar at mouth of Mescal Canyon, which shifts.

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

REGULATION.—Flow controlled by Elephant Butte dam which forms reservoir having capacity of 2,638,000 acre-feet.

EXTREMES OF DISCHARGE.—No data.

COOPERATION.—Records furnished by United States Reclamation Service, and reduced to three significant figures by United States Geological Survey.

Daily discharge, in second-feet, of Rio Grande below Elephant Butte dam, N. Mex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	1,080	1,020	15	15	15	572	1,040	2,220	1,980	1,900	1,750	1,440
2	1,060	910	15	15	15	568	1,040	2,250	1,980	1,480	1,750	1,440
3	1,050	785	15	15	15	695	1,060	2,270	2,000	1,900	1,770	1,440
4	1,050	750	15	15	15	785	1,060	2,270	1,910	1,900	1,780	1,450
5	1,050	680	15	15	15	777	1,090	2,300	1,860	1,900	1,780	1,450
6	1,040	575	15	15	15	800	1,150	2,300	1,860	1,900	1,780	1,440
7	1,030	540	15	15	15	806	1,040	2,320	1,860	1,880	1,670	1,440
8	1,020	540	15	15	15	800	1,080	2,320	1,870	1,860	1,750	1,420
9	1,020	570	15	15	15	814	1,080	2,150	1,870	1,900	1,730	1,420
10	1,020	700	15	15	300	806	1,090	2,050	1,870	1,900	1,720	1,410
11	1,020	700	15	15	450	800	1,090	2,120	1,880	1,900	1,540	1,400
12	1,020	685	15	15	450	800	1,110	2,010	1,880	1,900	1,200	1,400
13	1,020	685	15	15	450	806	1,110	1,820	1,880	1,900	1,210	1,400
14	1,020	670	15	15	450	792	1,090	1,860	1,890	1,800	1,210	1,400
15	1,020	248	15	15	540	770	1,110	1,860	1,880	1,630	1,220	1,400
16	1,020	0	15	15	628	765	507	1,880	1,880	1,460	1,220	1,200
17	425	0	15	15	700	990	15	1,880	1,880	1,270	1,240	1,120
18	0	0	15	15	753	982	531	1,880	1,880	1,200	1,250	1,080
19	0	0	15	15	753	998	1,110	1,880	1,880	1,210	1,370	1,060
20	0	0	15	15	753	998	1,150	1,900	1,880	1,220	1,320	1,060
21	0	0	15	15	726	998	1,140	1,900	1,880	1,220	1,440	1,060
22	0	0	15	15	593	998	1,180	1,900	1,880	1,230	1,420	1,060
23	0	0	15	15	593	998	1,340	1,900	1,880	1,300	1,420	850
24	0	0	15	15	593	998	1,600	1,900	1,880	1,300	1,420	610
25	0	0	15	15	593	998	2,080	1,920	1,880	1,280	1,420	605
26	0	0	15	15	596	998	2,100	1,930	1,880	1,180	1,420	605
27	0	0	15	15	583	998	2,140	1,940	1,750	1,170	1,420	605
28	0	0	15	15	568	998	2,160	1,950	1,880	1,190	1,420	605
29	0	0	15	15	.....	998	2,180	1,730	1,880	1,200	1,420	605
30	0	0	15	15	.....	990	2,210	1,950	1,880	1,200	1,440	605
31	0	.....	.....	15	.....	998	.....	1,960	.....	1,420	1,440	.....

Daily discharge, in second-feet, of Rio Grande below Elephant Butte dam, N. Mex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	605	473	2	500	2	855	965	1,820	1,830	1,880	2,030	1,480
2	605	710	3	500	3	903	950	1,760	1,840	1,880	2,000	1,470
3	605	710	2	500	2	960	950	1,760	1,860	1,880	2,020	1,460
4	605	710	3	500	3	992	950	1,760	1,860	1,880	2,080	1,640
5	605	710	2	500	2	1,020	950	1,760	1,820	1,880	2,120	1,740
6	605	851	3	613	3	1,020	1,050	1,760	1,820	1,880	2,170	679
7	605	910	2	888	2	1,010	1,100	1,760	1,820	1,900	2,080	1,710
8	605	910	3	888	3	1,010	1,230	1,760	1,820	1,900	2,040	1,700
9	605	910	2	888	2	1,010	1,280	1,770	1,820	1,900	2,040	1,700
10	202	910	3	645	3	1,010	1,460	1,780	1,820	1,900	2,000	1,700
11	2	910	2	2	2	1,100	1,700	1,780	1,920	1,900	2,030	1,700
12	3	341	3	3	3	1,080	1,700	1,800	1,960	1,900	2,040	1,740
13	2	2	2	2	117	1,090	1,630	1,800	1,960	1,900	2,040	1,740
14	3	3	3	3	200	1,090	1,500	1,810	1,960	1,900	2,040	1,730
15	2	2	2	2	547	1,090	1,500	1,810	1,960	1,900	2,040	1,720
16	3	3	3	3	720	1,090	1,500	1,810	1,960	1,910	2,040	1,710
17	2	2	2	2	720	1,090	1,510	1,810	1,960	1,920	2,040	1,710
18	3	3	3	3	720	1,090	1,630	1,820	1,960	1,930	2,040	1,700
19	2	2	2	2	720	1,090	1,690	1,820	1,960	1,930	2,040	1,760
20	3	3	3	3	720	1,090	1,690	1,920	1,960	1,980	2,040	1,920
21	2	2	2	2	720	1,090	1,690	2,000	1,960	2,030	1,800	1,920
22	3	3	3	3	720	1,090	1,690	2,000	1,980	2,030	1,560	1,940
23	2	2	2	2	720	1,090	1,690	2,000	2,000	2,030	1,560	1,940
24	3	3	3	3	720	1,090	1,780	2,000	2,000	2,030	1,560	1,920
25	2	2	2	2	720	1,090	1,840	2,000	2,000	2,030	1,560	1,920
26	3	3	3	3	810	1,090	1,840	2,000	2,000	2,030	1,210	1,940
27	2	2	2	2	855	1,090	1,840	2,000	2,000	2,030	1,090	1,940
28	3	3	333	3	855	1,090	1,840	1,900	1,900	2,030	1,210	1,940
29	2	2	500	2	855	1,060	1,880	1,820	1,900	2,030	1,210	1,940
30	3	3	500	3	.....	894	1,880	1,820	1,900	2,030	1,320	1,940
31	2	.....	500	2	.....	965	.....	1,820	.....	2,030	1,480	.....

Monthly discharge of Rio Grande below Elephant Butte dam. N. Mex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	1,080	0	547	33,600
November	1,020	0	335	19,900
December	15	15	15	922
January	15	15	15	922
February	753	15	400	22,200
March	998	568	874	53,700
April	2,210	15	1,260	75,000
May	2,320	1,730	2,020	124,000
June	2,000	1,750	1,880	112,000
July	1,900	1,170	1,540	94,700
August	1,780	1,200	1,480	91,000
September	1,450	605	1,140	67,800
The year	2,320	0	961	696,000
1919–20.				
October	605	2	184	11,300
November	910	2	303	18,000
December	500	2	61.3	3,770
January	888	2	209	12,900
February	855	2	395	22,700
March	1,090	855	1,040	64,000
April	1,880	950	1,500	89,300
May	2,000	1,760	2,170	133,000
June	2,000	1,820	1,920	114,000
July	2,030	1,880	1,950	120,000
August	2,170	1,090	1,820	112,000
September	1,940	679	1,730	103,000
The year	2,170	2	1,110	804,000

RIO GRANDE ABOVE PRESIDIO, TEX.

LOCATION.—About 2 miles above the Haciendita, 7 miles above Rio Conchos, and 10 miles west of Presidio post office. From May 22, 1900, to September 25, 1905, and from July 7, 1909, to September 30, 1913, station was maintained at the Haciendita, 9 miles above Presidio and 8 miles above mouth of Rio Conchos. From September 26, 1905, to July 6, 1909, station was 8 miles farther upstream. As no tributaries of consequence enter between the three sites, the flow is practically the same at all of them.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 22, 1900, to March 31, 1914, and September 1, 1919, to March 31, 1920.

GAGE.—Inclined staff. Relation between the gage readings at the different sites not known. W. P. Millington, observer.

DISCHARGE MEASUREMENTS.—Made from cable and car about 600 feet above gage.

CHANNEL AND CONTROL.—Channel straight for 1,000 feet above the gage. Right and left banks of medium height and steep. Bed composed of mud and sand and shifts greatly.

EXTREMES OF DISCHARGE.—September 1, 1919, to March 31, 1920; maximum discharge 18,100 second-feet, September 15 and 16; minimum discharge, 13 second-feet, January 9, 1920.

DIVERSIONS.—Considerable water diverted at Elephant Butte dam, and other points above the station, for irrigation; total amount not known. Records of the Board of Water Engineers for the State of Texas shows that about 180,000 acres were irrigated in 1920 in Texas by diversions below the station, practically all of which are in Hidalgo and Cameron counties.

REGULATION.—Flow largely regulated by storage at Elephant Butte dam, 120 miles above El Paso.

ACCURACY.—Stage-discharge relation not permanent. Daily discharge based almost entirely on frequent measurements.

COOPERATION.—Station maintained and records furnished by the United States section of the International Boundary Commission.

Discharge measurements of Rio Grande above Presidio, Tex., for the period Sept. 2, 1919, to Mar. 30, 1920.

[Made by engineers of the United States section of the International Boundary Commission.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1919.	*Feet.*	*Sec.-ft.*	1919.	*Feet.*	*Sec.-ft.*	1920.	*Feet.*	*Sec.-ft.*
Sept. 2	4.3	89	Nov. 11	4.6	119	Feb. 3	4.6	43
5	4.1	43	14	4.4	67	6	4.6	39
8	3.9	33	17	4.8	122	9	4.6	30
11	5.6	613	20	5.2	223	12	4.5	26
14	7.7	1,955	23	5.2	204	15	4.5	28
15	16.0	18,080	26	4.8	122	18	4.4	24
Oct. 3	5.7	520	29	4.7	93	22	4.3	22
6	5.8	568	Dec. 18	4.3	29	24	4.3	19
9	5.7	484	21	4.3	33	28	4.6	49
12	6.0	762	24	4.3	29	Mar. 3	4.9	86
15	5.8	544	27	4.2	20	6	4.4	46
18	5.9	696	30	4.2	18	9	4.2	28
21	5.8	552				12	4.1	23
24	5.3	374	1920.			18	4.9	92
27	5.0	252	Jan. 1	4.1	17	21	5.2	153
30	4.8	201	6	4.1	15	24	5.2	153
Nov. 2	5.2	418	9	4.1	13	27	5.1	130
5	4.9	219	12	4.2	15	30	5.0	121
8	4.7	151	15	5.6	257			

Daily discharge, in second-feet, of Rio Grande above Presidio, Tex., for the period Sept. 1, 1919, to Mar. 31, 1920.

Day.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Day.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1.....	89	520	378	93	17	43	86	16.....	18,080	544	122	29	378	24	67
2.....	89	520	418	93	17	43	86	17.....	934	596	122	29	378	24	92
3.....	89	520	418	87	17	43	86	18.....	934	596	174	29	401	24	92
4.....	56	520	380	87	17	43	46	19.....	628	596	174	33	401	24	92
5.....	43	568	219	58	15	39	46	20.....	628	552	223	33	401	22	153
6.....	43	568	219	58	15	39	46	21.....	613	552	223	33	122	22	153
7.....	40	568	200	58	15	38	28	22.....	613	552	204	29	122	22	153
8.....	33	484	151	37	14	34	28	23.....	759	374	204	29	94	20	153
9.....	550	484	151	37	13	30	28	24.....	759	374	162	29	94	19	153
10.....	578	636	119	37	14	30	28	25.....	759	300	122	28	94	19	153
11.....	613	682	119	37	15	30	23	26.....	837	250	122	24	56	28	130
12.....	784	762	119	29	15	26	23	27.....	837	252	122	20	56	36	130
13.....	1,528	762	85	29	257	26	23	28.....	624	252	104	19	56	49	130
14.....	1,955	544	67	29	257	28	23	29.....	624	201	93	18	43	49	121
15.....	18,080	544	67	29	257	28	67	30.....	520	201	93	18	43	.....	121
								31.....	.....	378	.....	18	43	.....	121

Monthly discharge of Rio Grande above Presidio, Tex., for the period Sept. 1, 1919, to Mar. 31, 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
September	18,100	33	1,760	105,000
October	762	201	492	30,300
November	418	67	179	10,700
December	93	18	39	2,400
January	401	13	121	7,440
February	49	19	31	1,780
March	153	23	86	5,290
The period	.....	.....	.....	163,000

NOTE.—Monthly discharge computed by engineers of U. S. Geol. Survey.

RIO GRANDE BELOW PRESIDIO, TEX.

LOCATION.—At west end of canyon section of Rio Grande, 7 miles below Presidio at Loma Paloma, 8 miles below mouth of Rio Conchos, and 1 mile above mouth of Alamito Creek. Discharge at this station, minus discharge at station above Presidio, is discharge of Rio Conchos, except occasionally, when some run-off enters Rio Grande from north.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 1, 1900, to July 31, 1915; September 1, 1919, to March 31, 1920.

GAGE.—Vertical staff in main channel; read by W. T. Millington. At low stages river shifts back and forth in its bed, necessitating establishment of temporary gages. Relation between this gage and previous gages not known.

DISCHARGE MEASUREMENTS.—Made in main channel from car and cable and in overflow section from boat.

CHANNEL AND CONTROL.—Shifting sand; affected by an intermittent stream, Alamito Creek, which reaches the river 1 mile below the station. This creek is subject to torrential floods which bring large quantities of boulders and gravel into the Rio Grande, forming a temporary dam which causes changes in the stage-discharge relation. The channel overflows at gage height 7 feet to an extreme width of 1,000 feet, where gravel hills are found.

EXTREMES OF DISCHARGE.—September 1, 1919, to March 31, 1920: Maximum discharge, 53,638 second-feet, September 1–3; minimum discharge 1,019 second-feet, March 30 and 31.

Below the mouth of the Rio Conchos the Rio Grande is subject to severe floods from this tributary. Since the records have been maintained, the highest flood occurred September 11, 1904, reaching a stage of 26.35 feet and a discharge of 149,200 second-feet. On the same day the discharge above Rio Conchos was only 2,600 second-feet.

ICE.—None.

DIVERSIONS.—Considerable water diverted at Elephant Butte dam and other points above the station for irrigation. Total amount not known. Records of the Board of Water Engineers for the State of Texas show that about 180,000 acres were irrigated in Texas in 1920 by diversions below the station, practically all of which are in Hidalgo and Cameron counties.

REGULATION.—Flow partly regulated by storage at Elephant Butte dam, 120 miles above El Paso.

ACCURACY.—Owing to shifting channel the determinations of daily discharge is based almost directly on frequent current-meter measurements.

COOPERATION.—Station maintained by the United States section of the International Boundary Commission, by whom the records were furnished.

Discharge measurements of Rio Grande below Presidio, Tex., for the period Sept. 3, 1919, to Mar. 31, 1920.

(Made by engineers of the United States section of the International Boundary Commission.)

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1919.	*Feet.*	*Sec.-ft.*	1919.	*Feet.*	*Sec.-ft.*	1920.	*Feet.*	*Sec.-ft.*
Sept. 3	23.0	53,638	Nov. 15	12.6	4,699	Feb. 7	12.7	2,769
6	15.0	15,566	18	12.6	5,124	10	12.6	2,514
9	14.5	10,592	21	12.5	4,795	13	12.4	2,427
12	14.4	9,877	24	12.6	4,487	16	12.4	1,949
15	16.1	18,182	27	12.4	3,979	19	12.3	1,880
Oct. 4	17.8	21,943	30	12.4	3,860	22	12.3	1,713
7	17.5	21,837	Dec. 19	12.1	2,157	25	12.3	1,504
10	17.7	21,429	22	12.1	1,952	29	12.2	1,335
13	16.3	17,568	26	12.1	1,782	Mar. 4	12.1	1,404
16	14.5	15,025	28	12.0	1,551	7	12.1	1,053
19	14.7	14,063	31	12.0	1,582	10	12.0	1,154
22	14.1	12,916				16	11.9	1,142
25	14.0	11,881	1920.			19	11.95	1,164
28	13.4	9,734	Jan. 4	12.0	1,530	22	12.0	1,188
31	15.1	15,575	7	11.9	1,451	25	12.1	1,326
Nov. 3	13.4	10,045	10	12.0	1,615	28	12.0	1,219
6	13.2	8,725	13	12.0	1,584	31	11.7	1,019
9	12.9	6,480	16	12.6	3,242			
12	12.7	5,103	Feb. 4	12.8	3,274			

Daily discharge, in second-feet, of Rio Grande below Presidio, Tex., for the period Sept. 1, 1919, to Mar. 31, 1920.

Day.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1	53,638	37,594	12,782	3,072	1,582	3,274	1,335
2	53,638	37,594	10,045	3,072	1,582	3,274	1,402
3	53,638	21,943	10,045	3,072	1,532	3,274	1,402
4	41,270	21,943	10,045	2,554	1,532	3,274	1,404
5	18,529	21,943	8,725	2,554	1,530	2,709	1,053
6	15,556	21,837	8,725	2,554	1,451	2,769	1,053
7	14,225	21,837	8,725	2,554	1,451	2,769	1,053
8	10,592	21,837	6,480	2,234	1,451	2,769	1,154
9	10,592	21,429	6,480	2,234	1,575	2,514	1,154
10	10,592	21,429	6,480	2,234	1,615	2,514	1,154
11	9,877	21,429	5,103	2,234	1,615	2,427	1,142
12	9,877	18,234	5,103	2,234	1,584	2,427	1,142
13	9,827	17,568	5,103	2,234	1,584	2,427	1,142
14	16,701	17,568	4,699	2,157	3,246	1,949	1,142
15	18,182	17,568	4,699	2,157	3,246	1,949	1,142
16	14,063	15,025	4,699	2,157	3,242	1,949	1,164
17	14,063	15,025	5,124	2,157	3,242	1,880	1,164
18	14,063	15,025	5,124	2,157	3,242	1,880	1,164
19	15,294	14,063	5,124	2,157	3,242	1,880	1,164
20	15,294	14,063	4,795	2,010	3,242	1,713	1,188
21	19,782	14,063	4,795	1,952	3,242	1,713	1,188
22	19,782	12,916	4,795	1,952	3,242	1,713	1,188
23	19,782	12,916	4,487	1,952	3,242	1,504	1,279
24	18,568	12,916	4,487	1,782	3,242	1,504	1,326
25	18,182	11,881	4,487	1,782	3,242	1,504	1,326
26	18,182	11,881	3,979	1,782	3,242	1,504	1,326
27	37,594	11,881	3,979	1,551	3,242	1,335	1,219
28	37,594	9,734	3,979	1,551	3,242	1,335	1,219
29	47,891	9,734	3,860	1,551	3,242	1,335	1,125
30	38,627	10,645	3,860	1,582	3,242	.....	1,019
31	.....	15,575	.....	1,582	3,242	.....	1,019

Monthly discharge of Rio Grande below Presidio, Tex., for the period Sept. 1, 1919, to Mar. 31, 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
September	53,600	9,830	23,200	1,380,000
October	37,600	9,730	17,700	1,090,000
November	12,800	3,860	6,030	359,000
December	3,070	1,550	2,160	133,000
January	3,250	1,450	2,530	156,000
February	3,270	1,340	2,180	125,000
March	1,400	1,020	1,190	73,200
The period	.....	.....	.....	3,320,000

NOTE.—Monthly discharge computed by engineers of U. S. Geol. Survey.

RIO GRANDE AT LANGTRY, TEX.

LOCATION.—At east end of canyon section, 1,800 feet east of Langtry and a few miles above the mouth of Pecos River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 1, 1900, to October 15, 1914; and December 1, 1919, to March 31, 1920.

GAGE.—Vertical staff. Relation between datum of this gage and previous gages not known. Read by W. H. Dodd.

DISCHARGE MEASUREMENTS.—Made from car and cable.

CHANNEL AND CONTROL.—Bed composed of mud, sand, gravel, and boulders; very shifting and subject to overflow at high stages. The overflow extends 110 feet back of the main bank.

EXTREMES OF DISCHARGE.—December 1, 1919, to March 31, 1920; Maximum discharge, 2,565 second-feet, January 21, 1920; minimum discharge, 855 second-feet March 16, 1920.

The highest stage on record occurred on September 14, 1919, when the stage was 50.5 feet (discharge not determined).

ICE.—None.

DIVERSIONS.—Considerable water is diverted at Elephant Butte dam and other points above the station for irrigation. Total amount not known. Records of the Board of Water Engineers for the State of Texas show that about 180,000 acres were irrigated in Texas, in 1920 by diversions below the station, practically all of which are in Hidalgo and Cameron counties.

REGULATION.—Flow partly regulated by storage at Elephant Butte dam, 120 miles above El Paso.

ACCURACY.—Owing to the shifting of the channel determinations of daily discharge are based almost directly on frequent current-meter measurements.

COOPERATION.—Station maintained by the United States section of the International Boundary Commission, by whom the records were furnished.

Discharge measurements of Rio Grande at Langtry, Tex., for the period Sept. 9, 1919, to Mar. 29, 1920.

[Made by engineers of the United States section of the International Boundary Commission.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge
1919.	*Feet*	*Sec.-ft.*	1920.	*Feet.*	*Sec.-ft.*	1920.	*Feet.*	*Sec.-ft.*
Sept. 9	4.5	9,370	Jan. 1	.8	1,176	Feb. 20	.8	1,286
12	4.4	8,443	7	.8	1,150	24	.9	1,349
Oct. 7	2.0	2,568	13	.8	1,196	Mar. 2	.8	1,266
26	1.4	1,725	17	.9	1,222	6	.8	1,325
Dec. 1	1.2	1,443	20	.9	1,293	13	.6	1,050
5	1.00	1,387	27	1.7	2,003	16	.5	855
11	1.0	1,396	Feb. 2	1.7	1,969	19	.4	887
17	1.0	1,280	6	1.6	1,850	23	.4	1,007
22	.9	1,271	10	1.4	1,638	29	.4	960
29	.8	1,234	16	.9	1,357			

Daily discharge, in second-feet, of Rio Grande at Langtry, Tex., for the period Dec. 1, 1919, to Mar. 31, 1920.

Day.	Dec.	Jan.	Feb.	Mar.	Day.	Dec.	Jan.	Feb.	Mar.
1	1,443	1,176	2,003	1,266	16	1,280	1,222	1,357	855
2	1,443	1,176	1,969	1,266	17	1,280	1,222	1,357	855
3	1,443	1,176	1,969	1,300	18	1,271	1,256	1,357	887
4	1,443	1,176	1,850	1,325	19	1,271	1,292	1,280	887
5	1,387	1,150	1,850	1,300	20	1,271	1,297	1,286	887
6	1,387	1,150	1,850	1,325	21	1,271	2,565	1,280	887
7	1,387	1,150	1,850	1,325	22	1,271	2,003	1,286	965
8	1,396	1,150	1,850	1,325	23	1,250	1,969	1,349	1,007
9	1,396	1,165	1,638	1,260	24	1,250	1,850	1,349	1,007
10	1,396	1,196	1,638	1,260	25	1,250	2,565	1,349	960
11	1,396	1,196	1,638	1,150	26	1,250	2,565	1,349	960
12	1,387	1,196	1,600	1,055	27	1,234	2,003	1,349	960
13	1,387	1,196	1,600	1,055	28	1,176	2,003	1,349	960
14	1,380	1,196	1,458	1,055	29	1,176	2,003	1,349	960
15	1,300	1,200	1,458	950	30	1,176	2,003	.....	960
					31	1,176	2,003	.....	960

Monthly discharge of Rio Grande at Langtry, Tex., for the period Dec. 1, 1919, to Mar. 31, 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
December	1,440	1,180	1,320	81,200
January	2,560	1,150	1,530	94,100
February	2,000	1,280	1,550	89,200
March	1,320	855	1,070	65,800
The period				330,000

NOTE.—Monthly discharge computed by engineers of U. S. Geol. Survey.

RIO GRANDE NEAR DEVILS RIVER, TEX.

LOCATION.—Near McKees Switch, 4½ miles below mouth of Devils River and town of Devils River and 3½ miles below site of former station. Several springs but no tributaries of consequence enter between the two sites.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 1, 1900, to April 30, 1915, and December 1, 1919, to March 31, 1920.

GAGE.—Inclined staff. Relation between datum of this gage and previous gages not known.

DISCHARGE MEASUREMENTS.—Made from car and cable.

CHANNEL AND CONTROL.—Shifting greatly and subject to overflow for a distance of 500 feet.

EXTREMES OF DISCHARGE.—December 1, 1919, to March 31, 1920; Maximum discharge, 9,730 second-feet, December 28, 1919; minimum discharge, 2,540 second-feet, March 21, 1920. In September, 1919, the river reached a stage of 41 feet; discharge not determined.

ICE.—None reported.

DIVERSIONS.—Considerable water diverted at Elephant Butte dam and other points above the station for irrigation. Total amount not known. Records of the Board of Water Engineers for the State of Texas show that about 180,000 acres were irrigated in Texas in 1920 by diversions below the station, practically all of which are in Hidalgo and Cameron counties.

REGULATION.—Flow partly regulated by storage at Elephant Butte dam, 120 miles above El Paso.

ACCURACY.—Owing to the shifting channel determinations of daily discharge are based almost directly on frequent current-meter measurements. Several springs discharge above this location that were not measured at the previous location of the station.

COOPERATION.—Station maintained by the United States section of the International Boundary Commission, by whom the records were furnished.

Discharge measurements of Rio Grande near Devils River, Tex., for the period Sept. 10, 1919, to Mar. 26, 1920.

[Made by engineers of the United States section of the International Boundary Commission.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Guage height.	Discharge.
1919.	*Feet.*	*Sec.-ft.*	1920.	*Feet.*	*Sec.-ft.*	1920.	*Feet.*	*Sec.-ft.*
Sept. 10	3.9	10,229	Feb. 4	2.2	3,693	Mar. 9	1.75	3.077
Dec. 9	2.1	3,629	19	2.0	3,501	15	1.60	2.710
15	2.1	3,549	23	1.9	3,588	18	1.6	2.693
19	2.2	3,838	27	1.9	3,450	22	1.5	2.546
24	2.0	3,577	Mar. 4	1.7	3,017	26	1.6	2.686

Daily discharge, in second-feet, of Rio Grande near Devils River, Tex., for the period Dec. 1, 1919, to Mar. 31, 1920.

Day.	Dec.	Jan.	Feb.	Mar.	Day.	Dec.	Jan.	Feb.	Mar.
1	3,628	3,588	7,429	3,165	16	3,549	3,450	3,693	2,710
2	3,628	3,588	6,280	3,165	17	3,549	3,450	3,693	2,710
3	3,628	3,588	6,280	3,165	18	3,838	3,577	3,501	2,693
4	3,628	3,588	5,375	3,017	19	3,838	3,577	3,501	2,693
5	3,628	3,588	5,375	3,017	20	3,838	3,577	3,501	2,693
6	3,628	3,588	5,375	3,017	21	3,750	3,577	3,588	2,540
7	3,628	3,450	5,375	3,017	22	3,650	3,577	3,588	2,546
8	3,628	3,450	5,375	3,077	23	3,600	3,577	3,588	2,546
9	3,628	3,588	4,219	3,077	24	3,577	3,450	3,450	2,546
10	3,600	3,588	4,216	3,077	25	3,577	3,450	3,450	2,546
11	3,600	3,450	3,690	3,077	26	3,501	3,840	3,450	2,686
12	3,600	3,450	3,693	3,077	27	3,501	4,578	3,450	2,686
13	3,549	3,450	3,693	2,710	28	3,501	9,726	3,450	2,686
14	3,549	3,450	3,693	2,710	29	3,558	8,536	3,436	2,686
15	3,549	3,450	3,693	2,710	30	3,558	7,429	.....	2,686
					31	3,558	7,429	.....	2,686

Monthly discharge of Rio Grande near Devils River, Tex., for the period Dec. 1, 1919, to Mar. 31, 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
December	3,840	3,500	3,610	222,000
January	9,730	3,450	4,180	257,000
February	7,430	3,440	4,240	244,000
March	3,160	2,540	2,820	173,000
The period	.....	.....	.....	896,000

NOTE.—Monthly discharge computed by engineers of U. S. Geol. Survey.

PECOS RIVER NEAR DAYTON, N. MEX.

LOCATION.—In sec. 13, T. 18 S., R. 26 E., 3 miles east of Dayton, Eddy County, half a mile above mouth of Penasco River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 24, 1905, to September 30, 1920.

GAGE.—Stevens water-stage recorder on right bank; installed August 27, 1914, at same site and datum as staff gage installed September 7, 1905. Original gage which was 100 feet below the mouth of Penasco River, and half a mile below present gage was washed out September 6, 1905.

DISCHARGE MEASUREMENTS.—Made from cable.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Shifts, especially during high stages. Right bank consists of clay, left bank of sand; both banks are overflowed at stage of about 11.5 feet; no well-defined control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 15.9 feet for 5 or 6 hours during morning of September 18 (discharge not determined; probably exceeded previous maximum of 50,300 second-feet on July 25, 1915, which was derived from discharge at Lake McMillan and included flow of Penasco River); minimum mean daily stage, 3.28 feet October 3 (discharge, 65 second-feet).

Maximum mean daily gage height during year ending September 30, 1920, 10.4 feet October 10 (discharge, 3,460 second-feet); minimum mean daily discharge, 60 second-feet, August 10.

1905–1920: Maximum stage recorded in 1919 (see above paragraph); minimum stage, 2.45 feet July 26 and 27, 1916 (discharge, 23 second-feet).

ICE.—None.

DIVERSIONS.—Considerable water is diverted above station for irrigation; quantity not known, but not in conflict with rights of Carlsbad project of the United States Reclamation Service, which serves about 20,000 acres in the vicinity of Carlsbad and stores part of the water used near Carlsbad in Lake McMillan, 10 miles below gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent, but periods of change are covered by frequent discharge measurements. Standard rating curve fairly well defined for all stages. Mean daily gage height determined from recorder graph or staff gage readings. Daily discharge ascertained by applying mean daily gage height to rating table or by shifting-control method, except March 22–25 and September 16–18, 1919, when it was determined by measurements made at Lake McMillan headgates and spillways. Records good.

COOPERATION.—Daily-discharge record and results of current-meter measurements furnished by the United States Reclamation Service.

Discharge measurements of Pecos River near Dayton, N. Mex., during the years ending Sept. 30, 1919 and 1920.

[Made by engineers of United States Reclamation Service.]

Date	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1918.	*Feet.*	*Sec.-ft.*	1919.	*Feet.*	*Sec.-ft.*	1920.	*Feet.*	*Sec.-ft.*
Nov. 4	4.42	297	Aug. 11	8.35	1,554	Mar. 11	4.74	270
20	4.00	202	17 [a]	5.79	233	24	4.27	181
Dec. 8	4.48	330	27	5.30	154	Apr. 7	4.10	157
[illegible]			Sept. 5	5.11	138	29	4.26	179
[illegible] 1919.			12	5.16	151	May 11	7.30	1,507
Jan. 1	4.30	268	29	6.50	932	31	7.36	1,113
25	4.50	346	Oct. 10	10.65	3,743	June 7	9.70	2,707
Feb. 10	4.12	225	16	7.38	1,205	17	6.40	598
Mar. 1	3.95	209	25	5.72	457	30	7.05	1,331
11	3.55	143	Nov. 6	5.42	390	July 12	7.52	1,140
June 23	7.35	1,069	14	5.20	351	30	4.30	77
26	6.72	933	Dec. 8	5.35	389	Aug. 8 [b]	4.15	61
30	8.15	1,632				23	5.70	339
July 13	7.50	1,008	1920.			Sept. 7	5.00	187
24	8.40	1,506	Jan. 4	5.20	359	15	4.54	110
29	7.10	685	19	5.90	617	23	4.38	89
Aug. 6	7.80	1,004	Feb. 18	5.10	352			

[a] Made by engineers of U. S. Geol. Survey. [b] Made by R. W. Atha.

Daily discharge, in second-feet, of Pecos River near Dayton, N. Mex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	74	311	372	263	269	209	410	1,290	1,142	1,186	790	283
2	67	310	347	287	265	203	675	1,136	1,032	1,410	1,000	212
3	65	308	325	336	276	198	850	800	1,010	1,543	900	152
4	67	302	324	402	276	198	1,120	600	911	1,623	1,186	103
5	67	284	350	450	269	189	700	464	825	1,440	1,242	116
6	67	272	350	446	263	192	550	437	700	1,458	1,092	116
7	67	260	338	407	253	176	333	570	560	1,488	785	99
8	67	240	330	373	245	157	248	760	432	1,500	625	93
9	84	236	318	344	245	153	239	900	340	1,410	750	102
10	124	224	312	317	241	150	333	1,175	306	1,302	1,175	102
11	100	224	312	287	245	147	333	1,664	370	1,290	1,230	117
12	83	216	302	267	234	143	239	1,290	464	1,320	1,092	152
13	75	212	298	276	228	147	175	875	900	1,087	850	116
14	71	212	298	298	228	143	137	725	1,902	955	700	86
15	69	214	290	385	217	135	198	600	3,780	890	402	77
16	69	252	290	432	217	136	248	525	2,412	982	299	10,000
17	69	288	280	459	223	136	230	491	1,320	1,208	263	24,200
18	73	264	272	473	219	133	222	525	1,081	2,004	316	40,000
19	88	230	278	501	219	129	214	433	1,302	2,548	500	3,620
20	90	202	290	544	219	123	198	355	1,868	2,208	625	2,616
21	665	205	327	597	219	144	160	423	1,732	1,868	525	2,106
22	4,420	207	358	520	219	4,100	137	565	1,440	1,766	299	1,630
23	4,420	194	358	455	219	21,600	160	625	1,148	1,698	351	1,290
24	1,530	188	348	415	219	26,000	267	725	860	1,583	248	1,203
25	955	190	330	377	223	10,000	675	1,272	700	1,410	198	1,218
26	650	200	316	344	226	2,242	1,410	2,446	700	1,290	175	1,260
27	600	240	300	317	221	1,470	2,106	1,772	1,065	1,092	167	983
28	750	242	272	294	209	650	3,940	1,506	1,950	928	152	775
29	182	244	252	291	.....	333	2,548	1,374	1,922	800	130	660
30	570	303	252	276	.....	239	1,576	1,290	1,500	750	116	635
31	455	.....	252	276	.....	227	.....	1,230	.....	640	109	.....
1919–20.												
1	775	491	370	381	390	263	166	200	945	710	76	232
2	900	477	340	328	395	263	167	195	885	583	76	191
3	650	455	370	328	401	253	160	195	850	579	74	176
4	640	432	459	343	401	248	159	184	896	560	73	169
5	575	446	455	353	390	265	159	165	677	395	72	194
6	491	419	410	404	419	289	158	159	867	312	72	198
7	491	432	390	468	410	293	157	162	2,115	257	70	187
8	500	432	390	560	435	289	153	165	1,975	238	66	150
9	1,470	378	370	563	419	293	153	311	1,485	220	66	136
10	3,460	390	333	451	419	285	145	316	1,208	229	66	141
11	2,106	333	340	375	401	270	139	710	988	600	60	133
12	1,773	333	333	384	413	249	142	840	796	926	70	114
13	1,350	333	326	404	404	234	142	710	591	559	83	105
14	1,093	333	306	413	375	224	142	760	533	392	220	105
15	1,087	340	293	461	359	217	142	812	812	331	324	110
16	1,314	340	378	496	359	208	142	879	812	276	392	112
17	1,059	363	370	560	348	201	142	735	663	228	438	98
18	890	370	333	587	348	201	139	587	620	194	658	85
19	790	370	299	600	335	201	139	521	468	178	644	91
20	725	370	419	489	321	192	139	451	420	160	486	78
21	675	370	500	475	307	193	139	375	426	152	437	70
22	625	390	455	475	316	184	142	375	420	144	363	71
23	600	410	419	435	314	182	164	1,485	375	178	341	83
24	590	402	410	398	309	182	187	1,112	348	187	344	94
25	550	390	432	398	296	177	179	1,050	323	152	314	94
26	510	370	433	398	291	176	203	1,380	312	133	265	74
27	491	432	402	398	285	168	233	1,415	312	112	234	68
28	477	390	378	392	282	169	222	1,310	362	98	242	70
29	464	402	370	390	270	171	203	1,175	367	88	341	85
30	491	410	340	390	.....	169	203	1,050	735	78	283	88
31	491	.....	351	390	.....	171	.....	1,000	.....	76	238	.....

Monthly discharge of Pecos River near Dayton, N. Mex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	4,420	65	540	33,200
November	311	188	242	14,400
December	372	252	311	19,100
January	597	263	378	23,200
February	276	209	236	13,100
March	26,000	123	2,260	139,000
April	3,940	137	688	40,900
May	2,450	355	930	57,200
June	3,780	306	1,190	70,800
July	2,550	640	1,380	84,800
August	1,240	109	590	36,300
September	40,000	77	3,140	187,000
The year	40,000	65	993	719,000
1919–20.				
October	3,460	464	906	55,700
November	491	333	393	23,400
December	500	293	380	23,400
January	600	328	435	26,700
February	435	270	359	20,600
March	293	168	222	13,600
April	233	139	162	9,640
May	1,480	159	670	41,200
June	2,120	312	753	44,800
July	926	76	301	18,500
August	658	60	242	14,900
September	232	68	120	7,140
The year	3,460	60	413	300,000

NOTE.—Monthly discharge computed by engineers of U. S. Geol. Survey.

Days of deficiency in charge of Pecos River near Dayton, N. Mex., for the years ending Sept. 30, 1906–1920.

Discharge in second-feet.	Days of deficient discharge.														
	1905–6	1906–7	1907–8	[a] 1908–9	1909–10	1910–11	1911–12	1912–13	1913–14	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20
50	.....	.....	7	80	19	.....	1	3	.....	.....	28	49	9	.....	.....
75	.....	.....	54	119	61	9	18	26	.....	4	34	69	48	13	15
100	13	12	94	154	106	37	34	83	3	22	37	100	124	22	31
125	20	40	136	171	179	91	62	151	37	34	47	129	187	34	37
150	49	75	162	200	216	120	82	184	68	37	76	156	220	47	55
175	64	84	173	225	237	165	109	218	105	42	88	178	251	56	79
200	84	120	180	230	248	193	126	234	118	56	106	186	269	70	100
250	115	148	189	263	272	248	185	262	172	85	155	221	320	120	124
300	158	175	210	285	320	282	241	295	236	116	222	282	331	160	145
350	188	208	244	318	324	303	280	320	258	157	264	317	336	191	183
400	225	243	279	339	331	311	303	333	271	226	284	329	342	202	231
450	242	262	299	342	339	317	309	340	276	263	294	338	343	213	267
500	254	282	306	346	344	325	315	344	278	275	301	345	345	221	290
550	267	307	314	347	347	329	327	346	288	283	310	349	348	228	295
600	287	318	314	347	349	336	332	347	294	292	317	355	350	234	308
650	304	328	314	347	349	337	332	349	297	299	323	356	353	242	315
700	320	339	319	347	353	339	338	349	305	306	331	359	353	249	320
800	337	347	322	350	354	341	342	350	312	317	341	360	355	262	330
900	347	351	326	352	355	347	346	352	317	327	346	362	357	271	340
1,000	351	358	334	352	355	350	357	353	326	333	347	362	360	279	344
1,200	358	359	341	354	356	357	362	356	336	343	356	363	360	296	352
1,400	358	361	343	356	357	359	365	356	344	349	360	393	361	315	357
1,700	361	363	353	356	358	360	365	358	354	354	363	363	363	335	361
2,000	362	364	358	356	358	361	365	358	357	356	363	363	363	343	363
2,500	363	364	361	356	360	362	365	362	359	361	365	364	364	350	365
3,000	364	364	363	356	360	362	365	362	362	361	365	365	364	353	365
4,000	365	365	365	366	361	362	366	362	363	362	365	.....	365	356	366
6,000	.....	.....	365	357	362	362	.....	364	363	362	365	.....	.....	359	.....
8,000	.....	.....	366	.....	363	363	.....	364	364	362	366	.....	.....	359	.....
10,000	.....	.....	.....	.....	365	364	.....	364	364	362	.....	.....	.....	359	.....
15,000	.....	.....	.....	.....	.....	365	.....	365	364	363	.....	.....	.....	361	.....
50,000	.....	.....	.....	.....	.....	.....	.....	.....	365	365	.....	.....	.....	365	.....

[a] Daily discharge for July 26 to Aug. 2, 1908, not included. Figures given for discharge above 90 second-feet are therefore subject to error.

PECOS RIVER AT CARLSBAD, N. MEX.

LOCATION.—In SE. ¼ sec. 6, T. 22 S., R. 27 E., at Green Street Bridge in Carlsbad, Eddy County, 300 feet downstream from Atchison, Topeka & Santa Fe Railway station, 1,500 feet above mouth of Dark Canyon, and 2,000 feet below Hagerman dam.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 28, 1903, to March 31, 1908; May 13, 1914, to September 30, 1920.

GAGE.—Stevens 8-day water-stage recorder attached to downstream end of middle bridge pier, installed June 1, 1920. Gage used from May 28, 1903, to October, 1904, was inclined staff gage at the present site. From October, 1904, to March 31, 1908, vertical staff gage at the same site used, and from May 18, 1914, to June 1, 1920, gage was vertical staff, attached to upstream side of middle pier of bridge.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Bed composed of gravel and rock; but considerable changes have taken place, owing to sand deposits. Banks of medium height; not subject to overflow. Position of control not known.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 12.5 feet March 25 and September 19 (discharge, 23,600 second-feet, determined from poorly defined rating curve); minimum discharge, 39 second-feet, November 24.

Maximum stage recorded during year ending September 30, 1920, 5.8 feet October 11 and 12 (discharge, 5,910 second-feet); minimum stage from water-stage recorder, 0.61 foot at 9 a. m. June 27 and 10 a. m. September 19 (discharge, 70 second-feet).

1903–1908; 1914–1920: Maximum stage recorded, about 21.0 feet August 7, 1916 (discharge, 85,700 second-feet[1]); minimum discharge, 30 second-feet September 30, 1918.

ICE.—None.

DIVERSIONS.—Large quantities of water are stored a few miles above station at Lakes McMillan and Avalon by the United States Reclamation Service for irrigating lands near Carlsbad. Water is also diverted for irrigation in valleys adjacent to river above Lake McMillan. Capacity of storage reservoirs in connection with the Carlsbad project, 58,500 acre-feet. Considerable water seeps into the river between the storage reservoirs and the gaging station, the quantity depending on the amount being used for irrigation between the two points.

REGULATION.—Flow at this point completely controlled by storage reservoirs of the Carlsbad project, except during extreme floods.

ACCURACY.—Stage-discharge relation not permanent. From October 1, 1918, to September 30, 1919, standard rating curve fairly well defined below 12,000 second-feet, except for extremely low stages. Gage read once daily to half-tenths and is only an approximate indication of the mean daily gage height, because of rapid fluctuation in stage due to operation of storage reservoirs. From October 1, 1919, to September 30, 1920, standard rating curve fairly well defined for low and high stages but poorly defined for intermediate stages. Daily discharge, October 1, 1919, to May 31, 1920, ascertained by applying to rating table daily gage reading; June 1 to September 30, 1920, by indirect method for shifting control, using mean daily gage height determined from recorder graph except on days of considerable range in stage, when it was determined by averaging results obtained by using gage heights for 2-hour periods, and except as noted in footnote to daily-discharge table. Records poor from October, 1919, to March 1920, account of daily gage reading not representing the mean for the day, because of water being released from Lake Avalon during night. Discharge probably too small. Records fair during April and May and good for June to September. Determination of daily discharge not sufficiently accurate to warrant publication prior to April 1, 1920.

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

[1] Discharge at Avalon dam; reported by engineers of United States Reclamation Service.

Discharge measurements of Pecos River at Carlsbad, N. Mex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1920.		*Feet.*	*Sec.-ft.*
Nov. 8	A. K. Gowans	1.30	82.6	Feb. 12	J. R. Yates	0.83	107
1919.				Mar. 13	do	.78	91.8
Jan. 15	do	1.46	136	Apr. 2	do	.80	96.9
Aug. 18	Ellsworth and Dudley	.97	156	May 4	do	.74	79.8
Sept. 19	United States Reclamation Service engineers.	12.5	a23,600	28	do	.87	126
				Aug. 6	do	.82	113
20	do	9.1	12,100	Sept. 3	do	.68	74.5
21	do	7.0	7,750	29	do	.74	101

a Meter broke when measurement was about half completed. Discharge in remainder of section estimated by comparison with measurements made Sept. 20 and 21.

NOTE.—Velocity observations for measurements of Sept. 19, 20, and 21, 1919, taken at 0.2 depth; coefficient of 1.00 used to reduce to mean velocity and is subject to error.

Daily discharge, in second-feet, of Pecos River at Carlsbad, N. Mex., for the period Apr. 1, 1919, to Sept. 30, 1920.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	124	112	112	105	114	86	16	112	124	112	105	102	94
2	124	112	102	105	124	86	17	112	112	329	110	100	96
3	124	112	102	105	122	82	18	112	112	436	138	100	94
4	124	112	510	105	114	86	19	112	112	311	141	98	92
5	124	112	628	107	112	84	20	124	112	112	146	98	98
6	124	112	478	105	102	90	21	112	124	110	119	100	96
7	124	112	234	105	98	86	22	112	124	102	114	94	96
8	138	112	2,120	114	96	90	23	112	124	107	110	94	96
9	138	112	2,320	110	96	88	24	112	124	105	106	92	98
10	138	112	164	102	98	90	25	112	124	100	102	92	96
11	124	112	221	102	98	94	26	112	112	94	102	92	96
12	124	112	494	107	98	92	27	112	112	96	107	96	102
13	124	112	161	100	100	98	28	124	124	119	112	98	102
14	124	124	778	105	100	96	29	112	124	110	107	96	100
15	112	124	256	105	100	94	30	112	124	110	102	96	100
							31	.....	124	.....	112	90	.....

NOTE.—Gage heights partly estimated June 8-10, 1920. Discharge interpolated July 1–3, 22–24, and Aug. 11–14, 1920. Daily discharge Oct. 1, 1919, to March 31, 1920, not sufficiently accurate for publication.

Monthly discharge of Pecos River at Carlsbad, N. Mex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	92	51	68.3	4,200
November	94	39	62.5	3,720
December	129	52	90.8	5,580
January	249	75	138	8,480
February	383	57	188	10,400
March	23,600	85	2,420	149,000
April	6,250	79	1,640	97,600
May	5,240	79	995	61,200
June	5,740	100	886	52,700
July	3,820	100	1,000	61,500
August	297	136	201	12,400
September	23,600	126	4,380	261,000
The year	23,600	39	1,000	728,000
1919-20.				
October	5,910	152	1,310	80,600
November	335	124	200	11,900
December	1,130	124	244	15,000
January	930	124	252	15,500
February	3,520	124	517	29,700
March	.....	.....	a147	9,040
April	138	112	120	7,140
May	124	112	117	7,190
June	2,320	94	368	21,900
July	146	100	110	6,760
August	124	90	100	6,150
September	102	82	93.3	5,550
The year	5,910	82	300	216,000

a Partly estimated. See footnote to daily-discharge table.

PECOS RIVER NEAR MALAGA, N. MEX.

LOCATION.—In sec. 18 or 19, T. 24 S., R. 29 E., 3½ miles southeast of Malaga, Eddy County, and 4½ miles below mouth of Black River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 1 to September 30, 1920.

GAGE.—Friez water-stage recorder, installed on right bank with staff gage attached to stilling well; inspected by W. F. Gerlach.

DISCHARGE MEASUREMENTS.—Made from cable.

CHANNEL AND CONTROL.—Bed composed of solid rock covered with sand; shifts. Right bank solid rock and steep. Left bank sand and high. Control is a rock ledge overlain with sand, 500 feet below gage. Shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage during period of record from water-stage recorder, 8.2 feet at 3 a. m. June 9 (discharge, 2,340 second-feet, determined from extension of rating curve); minimum stage, 3.63 feet at 8 p. m. September 1 (discharge, 63 second-feet, determined from extension of rating curve), caused by storage at Public Utilities power dam.

In September, 1919, the river reached a stage of 26.4 feet (discharge not determined.)

ICE.—None.

DIVERSIONS.—The Carlsbad project of the United States Reclamation Service, with reservoirs of a capacity of 58,500 acre-feet, diverts a large part of the natural run-off above Carlsbad, N. Mex. During the season of irrigation, considerable water is returned to the stream by seepage from lands in the vicinity of Carlsbad. In addition to the water used by the Carlsbad project, some diversions are made for irrigation in the basin above the storage reservoirs of the Carlsbad project.

REGULATION.—The operation of a water-power plant of 300 horsepower capacity above station, just below Carlsbad, N. Mex., owned and operated by Carlsbad Electric Light & Power Co., does not materially regulate flow at gage. The flow is, however, regulated to a large extent by waters stored in the reservoirs of the Carlsbad project. In the season of irrigation the effect of the regulation is decreased by return seepage waters, but during the winter the flow depends on water released at the reservoirs.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used May 1 to July 20 well defined between 140 and 680 second-feet, and extended above; parallel curve used from July 21 to September 30. Operation of water-stage recorder satisfactory except as indicated in footnote to daily-discharge table. Mean daily gage heights determined from recorder graph by inspection, or by use of planimeter. Daily discharge ascertained by applying mean daily gage height to rating table, by shifting-control method, or for days of considerable fluctuation by applying gage heights for fractional parts of a day to rating table. Records good.

COOPERATION.—Base data furnished by the United States Reclamation Service.

Discharge measurements of Pecos River near Malaga, N. Mex., during the year ending Sept. 30, 1920.

[Made by J. R. Yates.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 1	3.97	151	June 19	5.25	678	Sept. 4	4.08	215
8	4.05	160	26	4.00	142	18	4.08	214
29	4.21	227	July 24	4.12	206			

Daily discharge, in second-feet, of Pecos River near Malaga, N. Mex., for the year ending Sept. 30, 1920.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1	126	252	188	164	86	16	169	521	180	213	194
2	126	236	162	150	186	17	150	348	188	293	213
3	123	188	140	172	225	18	140	709	196	459	198
4	130	249	176	168	190	19	123	680	265	309	175
5	140	1,080	184	198	154	20	105	424	315	340	213
6	151	622	154	164	164	21	105	268	548	357	245
7	162	672	136	147	186	22	190	260	265	428	233
8	169	568	133	158	179	23	123	236	213	321	213
9	180	2,120	143	217	168	24	117	216	209	293	205
10	173	789	244	154	168	25	260	200	257	273	194
11	130	376	216	150	201	26	284	154	249	245	186
12	105	716	208	183	209	27	264	150	249	229	205
13	107	454	188	161	198	28	180	192	217	233	198
14	216	649	192	161	213	29	212	216	198	229	213
15	341	844	180	161	213	30	240	212	194	221	205
						31	268	.....	190	168	.....

NOTE.—Indirect method for shifting control used May 1–4, and Aug. 18 to Sept. 28. Discharge interpolated May 5–7. Gage height partly estimated May 4 and 8. Discharge obtained by averaging discharge for fractional parts of days: May 14, 15, 22, June 4–10, 12–16, 18, 20, July 19–21, and Aug. 18 and 20

Monthly discharge of Pecos River near Malaga, N. Mex., for the year ending Sept. 30, 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May	341	105	171	10,500
June	2,120	150	487	29,000
July	548	133	212	13,000
August	459	147	230	14,100
September	245	86	194	11,500
The period	.....	.....	.....	78,100

PECOS RIVER NEAR ANGELES, TEX.

LOCATION.—In T. 26 S., R. 29 E., just below Pecos Valley Railroad bridge crossing Delaware Creek at its mouth, 2 miles north of New Mexico-Texas State line, 2½ miles southeast of Red Bluff, Eddy County, N. Mex., and 8½ miles northwest of Angeles, Reeves County, Tex.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 27, 1914, to September 30, 1920.

GAGE—Stevens continuous water-stage recorder, at first outcropping of rock on the right bank about 600 feet below railroad bridge and mouth of Delaware Creek inspected by T. A. Ezell, R. T. Ezell, B. B. Dickson, and H. N. White.

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

CHANNEL AND CONTROL.—Bed and banks composed of sand, gravel, and rock; banks not subject to overflow. Control formed by a series of rapids 200 feet below gage; shifts.

EXTREMES OF DISCHARGE.—Maximum stage from water-stage recorder, during year ending September 30, 1919, 10.1 feet at 5 a. m. September 20 (discharge, 22,400 second-feet); minimum stage, 0.30 foot at 8 p. m. February 27 (discharge, 80 second-feet).

Maximum stage from water-stage recorder during year ending September 30, 1920, 4.47 feet at 3.30 a. m. October 13 (discharge, 5,490 second-feet); minimum stage not determined as it occurred during period when recorder was not working properly.

1914–1920: Maximum stage 21.5 feet at 10 a. m. August 8, 1916, measured by leveling from flood marks (discharge not determined); minimum discharge, February 27, 1919 (see above).

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

DIVERSIONS.—The Carlsbad project of the United States Reclamation Service, with reservoirs of a capacity of 58,500 acre-feet, diverts a large part of the natural run-off above Carlsbad, N. Mex. During the season of irrigation, considerable water is returned to the stream by seepage from lands in the vicinity of Carlsbad. In addition to the water used by the Carlsbad project, some diversions are made for irrigation in the basin above the storage reservoir of the Carlsbad project.

REGULATION.—The operation of a water-power plant of 300 horsepower capacity above station, just below Carlsbad, N. Mex., owned and operated by Carlsbad Electric Light & Power Co., does not materially regulate flow at gage. The flow is, however, regulated to a large extent by water stored in the reservoirs of the Carlsbad project. In the season of irrigation the effect of the regulation is decreased by return seepage water, but during the winter the flow depends on water released at the reservoirs.

ACCURACY.—Stage-discharge relation assumed to have changed during flood beginning March 23, 1919, and changed slightly in 1920. Rating curves well defined for all stages. Operation of water-stage recorder not satisfactory considerable of the time owing principally to silt in float well, as indicated in footnote to daily-discharge table. From October 1, 1918, to September 30, 1919, daily discharge ascertained by applying to rating table mean daily gage heights determined from gage-height graph by inspection, or by planimeter; and from October 1, 1919, to September 30, 1920, by discharge integrator, except as noted in footnote to daily-discharge table. Records good, except when recorder was not operating properly

Discharge measurements of Pecos River near Angeles, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Nov. 7	A. K. Gowans	0.47	133	Sept. 20	C. E. Ellsworth	8.66	[a]16,700
				21	do	6.25	9,560
1919.				Nov. 27	D. A. Dudley	.40	214
Jan. 14	do	.55	182				
Mar. 20	R. J. Hank	.58	189	1920.			
June 12	do	1.20	745	Feb. 24	do	.46	244
Aug. 16	Ellsworth and Dudley	.52	231	Mar. 18	do	.40	220
19	do	.50	232	Apr. 15	do	.30	157
Sept. 18	C. E. Ellsworth	3.85	4,110	May 19	do	.25	153
19	do	6.48	[a]10,200	June 23	do	.38	215
19	do	7.20	[a]12,800	July 24	do	.39	216
20	do	9.28	[a]19,600	Sept. 24	do	.36	200
20	do	9.02	[a]18,400				

[a] Surface velocity observed and coefficient of 0.85 used to reduce to mean velocity.

Daily discharge, in second-feet, of Pecos River near Angeles, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	147	151	225	147	244	110	1,530	2,080	990	900	314	258
2	135	147	218	147	257	114	2,780	2,060	1,550		245	258
3	126	151	225	143	257	139	3,670	1,710	990	562	262	266
4	135	143	200	156	251	162	1,960	1,910	1,280	2,640	245	262
5	135	139	173	151	264	183	1,610	1,190		745	910	245
6	135	135	131	147	270	189	1,510	632		314	396	245
7	147	139	135	147	285	194	930	476		436	1,220	249
8	135	147	135	151	285	225	880	363	1,300	3,370	1,400	294
9	156	151	110	151	300	205	1,100	330		2,490	1,370	309
10	156	151	118	143	308	189	2,660	990		1,390	597	274
11	147	173	126	151	285	200	1,470	1,270		1,040	698	253
12	143	162	156	162	238	200	2,360	802		304	320	258
13	147	167	167	178	285	183	1,700	1,470	1,420	294	356	258
14	143	167	173	189	212	126	476	3,750	2,730	641	309	245
15	143	167	178	183	293	114	1,330	1,090	4,280	299	274	270
16	156	156	183	167	194	131	764	1,420	1,530	632	270	3,420
17	151	162	178	178	183	156	330	940	2,740	314	320	12,100
18	139	162	183	194	173	194	330	2,570	1,580	1,090	245	4,820
19	151	162	218	205	162	231	330	1,210	2,680	502	249	10,900
20	151	151	231	212	151	200	330	562	1,300	3,500	299	15,500
21	167	156	257	231	143	194	330	396	2,670	4,060	245	10,100
22	173	162	270	251	135	1,160	330	363		3,020	241	6,530
23	194	162	270	264	126	6,160	337	1,960		1,630	237	4,560
24	178	189	264	270	118	12,300	343	2,150		493	241	4,880
25	162	231	264	427	110	21,000	330	650		1,430	270	4,530
26	162	183	257	489	104	13,300	325	562	1,900	1,310	270	2,880
27	167	183	257	386	101	6,200	1,910	1,190		1,190	258	707
28	151	156	231	251	110	3,400	3,870	3,770		1,160	258	900
29	135	147	173	218	.....	2,020	3,270	990		1,280	258	970
30	143	315	151	212	.....	1,660	4,330	840		890	253	1,060
31	143	.....	151	225	.....	1,550	.....	840		890	245	.....

Daily discharge, in second-feet, of Pecos River near Angeles, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919-20.												
1	1,380	1,340	435	1,100	352	223	173	181			221	207
2	524	338	370	614	664	194	172	172			215	173
3	290	244	360	350	390	628	174	180			210	220
4	267	229	370	333	1,280	302	175	184			215	255
5	761	275	369	967	399	421	177	190	410		218	246
6	978	312	357	292	1,300	310	178	195			222	234
7	1,400	314	270	223	388	224	180	194			212	234
8	585	723	227	225	297	450	182	216			197	255
9	335	300	242	220	911	350	183	225	2,310		211	249
10	805	240	278	220	359	548	185	225	1,600		222	272
11	1,050	220	320	514	539	335	186	207	494		197	265
12	4,190	245	304	864	981	229	188	195	550	250	220	215
13	4,540	254	351	372	867	415	198	190	852		205	217
14	2,410	295	356	1,280	588	319	193	214	535		200	215
15	1,400	277	352	787	322	211	177	317	1,030		195	212
16	1,040	364	358	327	226	194	177	309	601		219	225
17	1,430	535	358	319	586	566	179	218	311		278	221
18	1,140	292	362	317	278	244	184	188	413		314	219
19	354	322	366	313	184	231	195		623		403	215
20	1,030	390	363	765	630	395	214		536		274	218
21	342	318	360	848	315	333	193		280		365	263
22	1,090	369	348	1,000	215	229	197		234		340	286
23	322	345	348	378	754	213	209		228		369	240
24	1,110	284	348	1,210	281	204	194	200	217	223	303	205
25	713	260	288	391	588	182	191		200	252	282	193
26	1,070	292	247	1,040	334	181	200		198	258	267	196
27	317	258	1,040	420	236	180	200		207	238	245	196
28	1,100	228	334	318	578	178	205		233	242	240	646
29	321	224	238	892	284	177	188		686	239	236	400
30	254	441	211	401	.....	176	186		300	230	237	300
31	1,610	.....	236	588	.....	174	.....	.....	.....	232	240	.....

NOTE.—On account of unsatisfactory operation of the recorder, mean daily gage heights were estimated Dec. 13–15, 1918; and Jan. 12–13, Feb. 17–26, Apr. 14, May 4–13, 15, 19–31, June 1–4, July 12–19, 24–31, Aug. 1, and 12–16, 1919. Discharge estimated or interpolated: June 6–12, June 22–30, and July 1–2, 1919; Mar. 26–31, Apr. 1, 3–11, May 19 to June 8, July 1–23, Sept. 10, 11, 29, and 30, 1920, by comparison with records on Pecos River at Malaga, N. Mex., and from incomplete gage graph. Braced figures show estimated mean discharge for period included.

Monthly discharge of Pecos River near Angeles, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	194	126	150	9,220
November	315	135	166	9,880
December	270	110	194	11,900
January	489	143	211	13,000
February	308	101	209	11,600
March	21,000	110	2,340	144,000
April	4,330	325	1,450	86,300
May	3,770	330	1,310	80,600
June	.....	990	1,770	105,000
July	4,060	294	1,280	78,700
August	1,400	237	422	25,900
September	15,500	245	2,930	174,000
The year	21,000	101	1,040	750,000

Monthly discharge of Pecos River near Angeles, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1919–20.				
October	4,540	254	1,100	67,600
November	1,340	220	351	20,900
December	1,040	211	347	21,300
January	1,280	220	577	35,500
February	1,300	184	522	30,000
March	628	174	291	17,900
April	214	172	188	11,200
May	.....	.....	206	12,700
June	2,310	.....	531	31,600
July	.....	.....	247	15,200
August	403	195	251	15,400
September	646	173	250	14,900
The year	4,540	.....	405	294,000

PECOS RIVER ABOVE BARSTOW, TEX.

LOCATION.—Three-quarters of a mile below headgate of Biggs irrigation project, 1 mile east of Patrole siding on Pecos Valley Railway, 1¼ miles above headgate of Barstow Irrigation Co., 14 miles northwest of Barstow, Reeves County, and 10 miles northwest of Pecos.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—February 1, 1916, to September 30, 1920.

GAGE.—Stevens water-stage recorder on right bank, inspected by W. G. Paddock and C. E. Armstrong.

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

CHANNEL AND CONTROL.—Channel straight 100 feet above and 300 feet below station. Bed composed of gravel, clay, and sand; not permanent. Right bank is clay, clean, and fairly permanent; left bank loose and covered with salt cedar; banks are overflowed at gage height about 10 feet. Shoal 250 feet below gage serves as control; shifts during high water.

EXTREMES OF DISCHARGE.—Maximum stage during year ending September 30, 1919, occurred during the period, September 20–23, for which no reliable record is available. Flood marks indicate a maximum of about 12 feet. Minimum stage from water-stage recorder 1.20 feet October 2 (discharge, 63 second-feet).

Maximum stage from water-stage recorder during year ending September 30, 1920, 10.65 feet at 10 p. m. October 14 (discharge, 4,000 second-feet); minimum stage occurred during period of missing record.

1915–1920: Maximum stage from water-stage recorder 12.1 feet at 6 a. m. August 10, 1916 (discharge not measurable above a stage of about 11 feet because of water overflowing banks); minimum discharge 22 second-feet, June 24, 1917.

ICE.—None reported.

DIVERSIONS.—In addition to water used in New Mexico by the Carlsbad and other projects, several large diversions are made above the station in Texas. The principal projects in Texas which divert above the station are the Arno, Porterville, Farmers Independent, and Biggs. According to the records of the Board of Water Engineers for the State of Texas, these projects have declared a total of about 7,500 acres irrigated. The principal projects below the station are the Barstow, Grandfalls, Imperial, and Zimmerman which have declared a total irrigated area of about 30,000 acres.

REGULATION.—Storage in connection with the Carlsbad project controls the run-off during parts of the year. The operation of a water-power plant of 300 horsepower capacity, below Carlsbad, does not affect the flow at this point.

ACCURACY.—Stage-discharge relation not permanent. Standard rating curve well defined below 500 second-feet, and fairly well defined to 4,000 second-feet. Operation of water-stage recorder not satisfactory, principally because of silt in float well, and insufficient attendance. Mean daily gage heights determined by inspecting recorder graph, or by planimeter. Daily discharge, October 1, 1918, to September 27, 1919, ascertained by applying mean daily gage height to rating table and from September 28, 1919, to September 30, 1920, by indirect method for shifting control except as otherwise indicated in footnote to daily-discharge table. Records April 1 to September 30, 1919, poor; fair for other periods.

Discharge measurements of Pecos River above Barstow, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1920.		*Feet.*	*Sec.-ft.*
Nov. 9	A. K. Gowans	1.49	85.4	Jan. 9	D. A. Dudley	2.80	277
1919.				Feb. 23	do	3.05	293
Jan. 12	do	2.08	136	Mar. 17	do	2.16	178
Mar. 20	R. J. Hank	1.90	119	Apr. 14	do	1.21	89.2
30	do	8.48	2,500	May 18	do	1.84	166
June 12	do	6.10	1,400	June 22	do	2.56	267
Aug. 15	C. E. Ellsworth	3.05	271	July 22	do	.87	72.6
20	D. A. Dudley	2.33	170	Sept. 22	do	1.07	94.9
Nov. 26	do	2.71	275				

Daily discharge, in second-feet, of Pecos River above Barstow, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	64			138			1,570	3,450				114
2	63			129			912	2,350				112
3	66			128			2,470	2,380	1,730			114
4	74			136			3,520	2,170				114
5	71			140			1,450	1,740				129
6	69	89		141			589	1,400				131
7	70			138			1,420					120
8	71			136			924					117
9	74	82		127			520					116
10		82		133			1,040					146
11		84		139			2,500					151
12		90		138			1,840	1,380	1,280			124
13		100		150			2,680	765	1,230			129
14		108		156			1,790	1,330	1,630			124
15		122		163				3,140	2,900		265	124
16		120						1,430	3,440		251	443
17		114						1,580	2,000		238	3,020
18		108						1,040	2,720		249	4,190
19		94						2,490	2,050		189	4,190
20		90			168	121		1,600	2,840		167	
21		80				143			1,730		164	
22						144	203		2,720		157	
23						1,400	193		1,430		151	
24						3,820	193	1,730	1,940		148	4,269
25						4,260	190	1,480	1,940		147	4,120
26						4,560	190		1,480		140	4,000
27						4,550	193		1,430		134	3,260
28			176			4,090	1,380	1,230			129	1,570
29						3,440	3,250	3,080			124	1,320
30			164			2,640	3,120	1,280	360		119	1,320
31			146			1,620		1,000			114	

Daily discharge, in second-feet, of Pecos River above Barstow, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	1,370	1,570	310			414					117	166
2	2,200	1,370	462								117	166
3	1,420	574	426								110	
4	723	410	403								103	
5	514	345	403			392					101	
6	793	335	403								110	
7	1,170	366	392								113	
8	1,620	377	339								116	
9	872	670	310	291							110	
10	559	433	300	291							104	
11	832		329	291							107	
12	1,170		350	339							163	
13	3,550		350	900							265	
14	3,670		370	505							173	
15	3,070		370	1,110			93				120	
16	1,820		360	880				98			124	
17	1,570		350			185		335			137	
18	1,670	514	350			257		164			155	
19	1,520	388	339			370		117			221	
20	723	315	339			236					252	
21	1,320	410	339			222					284	
22	1,370	356	291	1,040		339			282	82	215	98
23	1,130	335	339	980	282	241				156	265	95
24	574	377			565	193				111	260	98
25	1,130	339		1,020	414						279	91
26	872	291			426						230	89
27	1,220	291			426						228	87
28	589	310									193	87
29	1,130	274									175	
30	688	255							310	136	167	
31	723									122	167	

NOTE.—No gage-height record for days for which discharge is not given. Discharge partly estimated on following dates. Oct. 17–23, Nov. 6, 22–24, 26, 1919; Jan. 9, 22, 23, 25, Feb. 23–27, Mar. 1, 5, 17, May 16 July 22, July 30 to Aug. 19, and Sept. 22, 1920. Discharge from staff gage reading on following dates: Dec. 18, 1918, Feb. 20, June 30, 1919, Nov. 25, Apr. 14, and June 22, 1920.

Monthly discharge of Pecos River above Barstow, Tex., for the year ending Sept. 30, 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	3,670	514	1,340	82,400
August	284	101	170	10,500

NOTE.—Records too fragmentary to permit computation of discharge for other months.

PECOS RIVER NEAR GRANDFALLS, TEX.

LOCATION.—At site of old highway bridge where Grandfalls–Fort Stockton road formerly crossed Pecos River, 1½ miles upstream from present Grandfalls–Fort Stockton road crossing at Iron Bridge, 2 miles below diversion dam for silt-line canal of Imperial Irrigation Co., 3 miles south of Grandfalls, Ward County, 4½ miles above diversion dam of Zimmerman project, and 21 miles south of Monahans.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 6, 1915, to September 30, 1920. Records were taken at Iron Bridge, 1½ miles downstream, from November 6, 1915, to August 3, 1917. Discharge at both points believed to be the same.

GAGE.—Stevens water-stage recorder, installed August 9, 1917, on downstream side of old bridge pier near left water's edge; inspected by A. J. Adcock. Prior to August 3, 1917, a Stevens water-stage recorder at Iron Bridge. Backwater from Zimmerman dam compelled the relocation of the station.

DISCHARGE MEASUREMENTS.—Made by wading near gage, from cable 50 feet above gage, or during extremely high stages, at Iron Bridge.

CHANNEL AND CONTROL.—Bed of stream clean, smooth, solid rock, and permanent, except small deposits of sand and gravel. Channel straight for 100 feet above and below station. One channel below gage height of 8 feet; above this stage, both banks, which are dirt and wooded, subject to overflow. Rock ledge extending diagonally across stream just below gage serves as low-water control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, from water-stage recorder 9.6 feet from 2 to 6 a. m. September 25 (discharge, 13,000 second-feet); minimum discharge, approximately 3 second-feet from March 16–21.

Maximum stage from water-stage recorder during year ending September 30, 1920, 5.7 feet October 16 (discharge, 2,580 second-feet). Minimum stage during year from water-stage recorder, 0.52 foot from 1 to 6 p. m. July 23 discharge, 13 second-feet). A lower stage may have been reached during periods of missing records.

1915–1920: Maximum stage in 1919 (see above); minimum discharge less than 0.7 second-foot April 17, 1916.

ICE.—None.

DIVERSIONS.—Station is 2 miles below diversion of silt-line canal of the Imperial Irrigation Co., 15½ miles below diversion for Grandfalls project, 18½ miles below diversion for the Imperial reservoir (17,000 acre-feet capacity), and 4½ miles above diversion for Zimmerman project. Available data show that tracts aggregating approximately 143,000 acres are irrigable between station and lower limits of Carlsbad project of United States Reclamation Service. Records of Board of Water Engineers for the State of Texas show that about 58,000 acres are declared irrigated in Texas above station. The effect of diversions is somewhat counterbalanced by water returned to stream by seepage. The only diversion of importance below the station is that for the Zimmerman project which has declared an irrigated area of 2,005 acres.

REGULATION.—Slight effect caused by operation of storage reservoirs on Carlsbad project.

ACCURACY.—Stage-discharge relation appears to be practically permanent for high stages, but measurements indicate that the low-stage control shifts considerably. Standard rating curve well defined for all stages. Operation of water-stage recorder unsatisfactory. Mean daily gage heights obtained by inspecting gage-height graph, or for days of considerable fluctuation by use of planimeter. Daily discharge ascertained by applying mean daily gage height to rating table, March 19 to September 30, 1919, and January 1 to February 8, 1920; by shifting-control method the remainder of period except as indicated in footnote to daily-discharge table. Records excellent when water-stage recorder was operating satisfactorily and poor for other periods.

Discharge measurements of Pecos River near Grandfalls, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1918.		*Feet.*	*Sec.-ft.*	1919.		*Feet.*	*Sec.-ft.*
Nov. 5	A. K. Gowan	0.65	11.5	Oct. 6	A. J. Adcock	2.33	667
				Nov. 24	Dudley and Adcock	2.20	541
1919.				1920.			
Jan. 11	do	.48	9.8	Jan. 8	D. A. Dudley	2.30	627
Mar. 19	R. J. Hank	.39	3.0	Feb. 21	do	1.61	279
29	do	9.30	[a] 12,600	Mar. 16	do	1.32	178
30	do	8.20	[b] 6,390	Apr. 13	do	.60	16.4
31	do	6.55	[c] 3,270	May 17	do	.69	31.2
June 11	do	2.84	954	June 21	do	.69	34.1
Aug. 14	Ellsworth and Dudley	1.58	253	July 21	do	.62	24.0
21	do	.97	75	Sept. 21	do	.97	80.8
Sept. 24	C. E. Ellsworth	8.55	[d] 7,110				
25	do	9.60	[d] 11,800				

[a] Surface velocity observed; coefficient of 0.87 used to reduce to mean velocity.
[b] Surface velocity observed; coefficient of 0.85 used to reduce to mean velocity.
[c] Surface velocity observed; coefficient of 0.88 used to reduce to mean velocity.
[d] Surface velocity observed; coefficient of 1.05 used to reduce to mean velocity.

Daily discharge, in second-feet, of Pecos River near Grandfalls, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918–19.												
1	14	13	16	9		22	1,500	1,790	570	224		
2	13	12	16	9		18	1,320	1,980		576	450	
3	14	12	16	9		13	1,010	1,930		1,330		
4	14	12	16	9		9	1,490	1,580		1,060	221	
5	13	12	17	9	30	4	2,180	1,330	1,500	718	151	
6	13	14	18	9		4	2,170	1,380		1,470	104	
7	13	12	19	9		4	960	1,190	1,010	812	175	
8	13	9	19	9	88	4	1,140	680		400	257	
9	15	8	19	9	85	4	933	524	1,000	405	410	70
10	16	10	15	9	82	4	894	368		1,720	796	
11	18	10	11	10	79	4	1,010	212	928	1,610	834	
12	22	9	8	10	76	4	1,550	265	559	1,180	365	
13	18	9	6	10	72	4	1,470	365	691	894	365	
14	19	9	6	10	69	4	1,710	360	790	520		
15	17	9	6	10	66	4	1,680	559	1,020	325		
16	16	10	6	9	65	3	757	1,060	1,050	350	150	
17	16	10	6	9	64	3	900	1,200	1,900	440		1,000
18	16	10	6	9	62	3	818	1,080	1,800	265		2,140
19	17	10	6	9	60	3	415	916	1,620	345		2,350
20	19	10	7	9	58	3	280	735	1,630	375		
21	16	11	7	9	56	3	254	480	1,710	702	76	2,750
22	16	12	7	9	54	4	242	295	1,380	1,610		3,390
23	16	12	7	9	52	20	227	265	1,630	1,820		3,920
24	16	12	8	9	50	365	202	305		1,870		6,980
25	15	13	8	9	45	1,660	187	305		1,340		12,300
26	16	14	8	9	40	2,000	187	310	1,500		80	8,250
27	15	14	9	9	36	2,630	187					5,360
28	17	15	9	9	31	3,790	175			850		4,420
29	17	15	9	9	.....	10,500	669	800				3,230
30	16	15	9	9	.....	6,740	1,540		365			1,550
31	15	.....	9	9	.....	3,080	.....		.....			.....

Daily discharge, in second-feet, of Pecos River near Grandfalls, Tex., for the years ending Sept. 30, 1919 and 1920—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919-20.												
1	1,450	988	.....	390	669	125	13	19	52	169	.....	136
2	1,480	1,540	.....	335	500	175	14	18	45	178	.....	.....
3	1,770	1,510	.....	553	576	157	15	18	45	187	.....	.....
4	1,480	988	.....	834	465	117	15	18	52	190	.....	.....
5	906	751	.....	598	598	112	16	19	56	193	.....	.....
6	664	614	.....	515	801	227	16	19	68	193	18	.....
7	1,040	543	.....	834	691	160	18	18	83	196	18	.....
8	.....	537	.....	658	971	172	17	17	145	199	17	.....
9	.....	548	.....	490	.....	184	18	18	184	193	17	.....
10	.....	691	.....	420	.....	142	18	19	181	193	.....	.....
11	.....	686	.....	455	.....	181	17	20	.....	193	.....	93
12	.....	520	.....	475	.....	202	16	18	.....	.....	.....	.....
13	.....	430	.....	460	.....	270	16	16	.....	.....	.....	.....
14	.....	380	.....	856	.....	218	28	16	.....	.....	.....	.....
15	.....	380	.....	762	.....	166	70	25	.....	.....	.....	.....
16	2,580	380	.....	982	.....	181	70	25	.....	.....	.....	.....
17	2,280	390	.....	1,060	.....	175	66	32	.....	.....	.....	.....
18	1,580	410	455	696	.....	91	58	37	.....	.....	.....	.....
19	1,490	485	475	542	.....	56	60	39	.....	.....	.....	.....
20	1,320	570	470	490	.....	139	58	43	.....	20	.....	.....
21	928	475	465	475	275	106	58	41	35	23	.....	78
22	1,100	537	460	542	280	68	60	50	106	50	.....	.....
23	856	576	455	933	450	86	58	58	122	15	.....	.....
24	1,100	554	455	960	235	96	58	52	125	18	.....	.....
25	867	614	450	686	250	32	56	43	131	18	.....	.....
26	1,070	610	455	906	320	22	58	41	136	.....	.....	63
27	960	548	435	716	187	18	43	50	139	.....	.....	63
28	1,400	470	405	790	246	16	25	39	148	.....	.....	60
29	1,060	455	641	716	166	16	19	37	157	.....	.....	58
30	1,500	450	625	537	.....	16	19	43	163	.....	.....	169
31	1,200	.....	465	592	.....	13	.....	52	.....	.....	.....	.....

NOTE.—Discharge interpolated: Jan. 17–21, 23–30, Feb. 9–14, 16–23, 25–28, Mar. 1–4, 6–10, 12–18, May 9 and 10, 1919. Discharge estimated: Feb. 1–7, May 27–30, June 2–6, 8–10, 24–29, July 26–31, Aug. 1–3, 14–20, 22–31, Sept. 1–16, 17 and 18, 1919; estimated discharge obtained by comparison with records of flow at other stations and are probably fairly accurate. Gage-height record estimated wholly, or in part, for following periods: Nov. 18 to Dec. 28, 1918; May 23–26, 1919, and July 8–11, 1920. Discharge for following days determined from readings of staff gage: Jan. 22, 31, Feb. 8, 15, 24, Mar. 5, 11, June 1, 7, Aug. 21, 1919; Sept. 1, 11, and 21, 1920. Braced figures show mean discharge for periods included.

Monthly discharge of Pecos River near Grandfalls, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918-19.				
October	22	13	15.8	972
November	15	8.0	11.4	678
December	19	6.0	10.6	652
January	10	9.0	9.16	563
February	.....	.....	53.5	2,970
March	10,500	3.0	997	61,300
April	2,180	175	935	55,600
May	.....	212	821	50,500
June	.....	365	1,270	75,600
July	1,870	224	886	54,500
August	834	.....	221	13,600
September	12,300	.....	1,990	118,000
The year	12,300	3.0	601	435,000
1919-20.				
November	1,540	380	621	37,000
December	641	405	479	13,300
January	1,060	335	653	40,200
March	270	13	121	7,440
April	70	13	35.8	2,130
May	58	16	31.0	1,910

PECOS RIVER NEAR COMSTOCK, TEX.[8]

LOCATION.—At Pecos High Bridge of Galveston, Harrisburg & San Antonio Railway Co., 11 miles west of Comstock, Valverde County, 18 miles east of Langtry, 14 miles by stream above confluence with Rio Grande, and below all tributaries.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 1, 1900, to September 30, 1920. (Also gage heights for 1898.)

GAGE.—Vertical staff attached to downstream side of bridge pier on left bank; read by W. A. Clare.

DISCHARGE MEASUREMENTS.—Made from cable, 1,000 feet above bridge.

CHANNEL AND CONTROL.—Banks and stream bed composed of rock and gravel; water flows through a series of rapids and pools in a canyon approximately 300 feet deep; banks not subject to overflow. Stage-discharge relation at low stages changes slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1919, 30.00 feet at 10 a. m. September 16 (discharge, not determined); minimum stage, −0.02 foot October 6–9 (discharge, 126 second-feet).

Maximum stage recorded during year ending September 30, 1920, 5.8 feet at 5 p. m. October 4 (discharge, 5,220 second-feet); minimum stage, 0.40 foot on several days during July and August (discharge, 288 second-feet).

1900–1920: Maximum stage recorded, 35.75 feet April 6, 1900 (discharge not determined); minimum discharge recorded, 106 second-feet July 29 to August 1, 1918 (gage-height, −0.12 foot). Gage heights for low stages not comparable owing to shifting control.

ICE.—None.

DIVERSIONS.—Considerable water is diverted and stored above the station for irrigation. Lakes McMillan and Avalon of the Carlsbad project of the United States Reclamation Service, with a combined capacity of 58,500 acre-feet, are located on Pecos River a few miles above Carlsbad, N. Mex. In addition to the water stored in New Mexico, water from Pecos River is used to irrigate large areas of land in the vicinity of Barstow and Grandfalls, Tex. There are no diversions below the station. Return waters tend to equalize effects of diversions in lower part of drainage basin.

REGULATION.—Flow partly controlled by storage and diversions for irrigation above station. No water-power plants of any consequence operated in the drainage basin, except a public utility plant of about 300 horsepower, near Carlsbad, N. Mex.

ACCURACY.—Stage-discharge relation changed during period, October 10–24, 1918. Two curves used: One applicable from October 1–9, 1918, well defined for all stages, the other, applicable from October 25, 1918, to September 30, 1920, well defined from 260 to 13,000 second-feet, and fairly well defined to 40,000 second-feet. Gage read to hundredths twice daily from October 1, 1918, to September 30, 1919, and to half-tenths October 1, 1919, to September 30, 1920. Daily discharge ascertained by applying mean daily gage height to rating table except from October 10–24, 1918, when indirect method for shifting control was used. Records good.

Discharge measurements of Pecos River near Comstock, Tex., during the years ending Sept. 30, 1919 and 1920.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1919.		*Feet.*	*Sec.-ft.*	1920.		*Feet.*	*Sec.-ft.*
Jan. 16	W. H. Dodd	0.30	261	May 14	D A. Dudley	.73	400
May 10	do	2.40	1,460	14	do	.66	363
Aug. 23	Ellsworth and Dudley	1.17	579				
Sept. 22	D. A. Dudley	17.85	[a] 38,200				
23	do	7.78	[a] 8,910				

[a] Surface velocity observed and coefficient of 1.02 used to reduce to mean velocity.

[8] Records published in reports prior to 1915 under heading "Pecos River near Moorehead, Tex."

Daily discharge, in second-feet, of Pecos River near Comstock, Tex., for the years ending Sept. 30, 1919 and 1920.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1918-19.												
1	130	257	262	257	243	250	2,370	1,080	570	1,630	1,080	350
2	130	255	262	257	250	250	2,270	560	611	1,000	970	347
3	130	250	262	257	250	250	2,820	1,290	1,290	900	935	341
4	130	250	262	252	250	250	3,400	1,320	595	802	900	316
5	130	238	260	250	250	250	2,780	1,350	580	682	802	316
6	126	233	257	250	250	250	1,740	1,360	570	802	710	316
7	126	238	257	250	250	250	1,320	1,350	570	1,270	710	310
8	126	550	257	250	255	255	2,050	2,740	585	1,430	682	305
9	126	262	262	250	255	250	2,200	2,180	580	1,110	628	288
10	332	302	262	252	250	250	2,160	1,750	580	1,310	528	291
11	570	262	257	250	250	250	1,290	1,290	835	970	505	288
12	1,400	257	257	250	255	250	1,300	2,220	580	770	460	291
13	229	257	262	250	255	250	1,270	1,300	575	655	460	288
14	194	250	257	252	250	250	1,270	1,250	570	1,550	600	288
15	190	250	257	257	255	250	1,280	575	575	1,470	770	322
16	192	250	257	262	255	255	1,330	580	1,890	1,150	740	51,800
17	188	250	257	260	257	255	1,330	580	835	868	528	16,300
18	190	248	257	257	255	255	1,340	580	585	802	550	3,780
19	194	250	257	257	255	250	1,300	1,300	1,210	682	505	3,220
20	202	250	260	257	257	238	1,260	1,330	1,330	655	505	1,810
21	1,550	250	257	278	250	233	1,270	1,300	1,960	655	505	24,400
22	816	250	262	262	255	238	1,250	1,300	1,330	600	469	35,200
23	776	250	260	257	243	238	1,240	1,290	1,330	550	616	7,980
24	397	250	257	250	250	257	570	1,330	1,330	600	469	3,780
25	310	252	257	250	250	2,270	565	1,290	1,330	770	460	3,640
26	283	262	257	250	250	1,050	565	590	2,500	1,510	400	3,840
27	288	272	257	250	250	580	560	580	1,610	1,790	381	3,840
28	285	267	257	250	255	460	555	565	1,320	1,710	400	4,170
29	283	262	257	250	.....	740	550	565	1,330	6,000	378	5,080
30	267	283	257	243	.....	1,330	550	585	1,290	2,000	374	4,240
31	262	.....	257	250	.....	2,220	.....	575	.....	1,390	350	.....
1919-20.												
1	4,660	1,590	935	600	835	740	401	332	364	381	316	460
2	4,940	1,590	835	710	710	740	440	332	347	381	316	460
3	4,940	1,590	770	710	710	710	401	332	347	347	288	460
4	5,220	1,590	803	710	710	628	401	332	347	347	288	460
5	3,330	1,590	710	710	770	575	401	332	381	347	288	460
6	2,980	1,910	710	600	710	528	381	332	381	347	302	440
7	3,210	1,750	710	600	770	528	401	332	483	347	302	460
8	2,360	1,590	835	835	710	628	381	332	381	332	316	440
9	1,670	1,350	835	835	710	528	401	332	381	347	316	420
10	1,590	1,270	710	740	770	440	381	332	347	332	316	420
11	2,180	1,110	710	835	835	440	401	316	347	420	288	420
12	1,830	1,080	710	900	970	401	364	332	347	420	288	420
13	1,750	1,000	710	710	970	401	364	332	347	347	316	420
14	1,670	1,040	710	683	770	460	364	381	1,150	347	381	381
15	1,590	1,110	710	655	710	483	381	347	835	347	401	381
16	1,910	970	710	710	803	483	364	347	935	347	440	381
17	2,180	970	710	655	803	505	381	347	740	316	440	381
18	2,560	835	710	770	900	528	364	347	655	302	440	381
19	2,980	835	710	835	970	575	381	332	628	288	440	381
20	3,090	803	710	970	1,000	505	364	316	550	302	420	381
21	2,560	803	710	1,110	1,000	483	364	347	483	288	420	381
22	2,270	835	710	970	835	483	364	347	483	294	4,660	401
23	2,180	970	710	803	710	483	364	575	505	288	1,110	347
24	1,910	970	710	710	710	460	364	347	505	288	710	347
25	1,750	970	710	683	710	440	364	420	460	288	600	347
26	1,750	935	710	628	600	483	347	401	440	288	575	347
27	1,590	970	710	970	600	440	332	381	381	302	528	364
28	1,590	970	710	970	710	440	332	347	381	302	483	364
29	1,590	970	710	835	600	440	332	347	381	347	460	1,350
30	1,590	970	600	970	.....	460	347	347	381	347	460	505
31	1,590	.....	600	835	.....	483	.....	364	.....	332	460	.....

Monthly discharge of Pecos River near Comstock, Tex., for the years ending Sept. 30, 1919 and 1920.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
1918–19.				
October	1,550	126	340	20,900
November	550	233	265	15,800
December	260	257	259	15,900
January	278	243	254	15,600
February	257	243	252	14,000
March	2,270	233	472	29,000
April	3,400	550	1,460	86,900
May	2,740	560	1,160	71,300
June	2,500	570	1,030	61,300
July	6,000	550	1,230	75,600
August	1,080	350	593	36,500
September	51,800	288	5,920	352,000
The year	51,800	126	1,100	795,000
1919–20.				
October	5,220	1,590	2,480	152,000
November	1,910	803	1,160	69,000
December	935	600	727	44,700
January	1,110	600	782	48,100
February	1,000	600	780	44,900
March	740	401	514	31,600
April	440	332	374	22,300
May	575	316	353	21,700
June	1,150	347	490	29,200
July	420	288	333	20,500
August	4,660	288	560	34,400
September	1,350	347	439	26,100
The year	5,220	288	751	544,000

Days of deficiency in discharge of Pecos River near Comstock, Tex., for the years ending Sept. 30, 1901–1920.

Discharge in second-feet.	Days of deficient discharge.									
	1900–1	1901–2	1902–3	1903–4	1904–5	1905–6	1906–7	1907–8	1908–9	1909–10
100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
150	.....	.....	.....	45	.....	.....	.....	.....	.....	.....
200	19	.....	5	130	.....	.....	3	.....	19	78
250	29	20	59	256	.....	.....	33	12	82	123
300	73	57	109	291	.....	.....	81	17	157	238
350	88	81	125	305	.....	.....	83	63	212	309
400	114	108	150	306	.....	.....	115	101	293	345
450	143	127	232	306	.....	16	175	128	334	350
500	185	165	269	309	.....	39	200	158	338	352
600	251	208	333	317	18	98	316	186	344	353
700	280	256	339	326	47	188	329	222	348	354
800	299	273	345	334	107	255	361	258	350	357
900	306	290	348	344	162	320	365	293	352	358
1,000	313	307	350	344	176	325	.....	313	354	358
1,200	330	326	350	346	211	336	.....	330	353	359
1,500	345	338	352	352	247	354	.....	350	362	363
1,800	352	345	352	354	290	356	.....	355	365	364
2,200	360	353	365	357	315	359	.....	355	.....	364
2,600	363	360	.....	357	328	359	.....	359	.....	364
3,000	363	364	.....	358	338	359	.....	364	.....	364
3,500	363	364	.....	361	342	359	.....	364	.....	364
4,000	363	364	.....	361	345	359	.....	364	.....	364
5,000	364	364	.....	362	355	361	.....	364	.....	364
7,000	364	364	.....	362	362	361	.....	364	.....	364
10,000	365	364	.....	362	364	362	.....	365	.....	364
15,000	.....	364	.....	365	365	362	.....	366	.....	364
20,000	.....	364	.....	366	.....	363	.....	.....	.....	364
25,000	.....	365	.....	.....	.....	363	.....	.....	.....	364
30,000	.....	.....	.....	.....	.....	364	.....	.....	.....	365
35,000	.....	.....	.....	.....	.....	364	.....	.....	.....	.....
37,000	.....	.....	.....	.....	.....	365	.....	.....	.....	.....

Days of deficiency in discharge of Pecos River near Comstock, Tex., for the years ending Sept. 30, 1901–1920—Continued.

Discharge in second-feet.	Days of deficient discharge.									
	1910–11	1911–12	1912–13	1913–14	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20
100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
150	.....	54	10	.....	.....	.....	28	50	9	.....
200	21	129	63	.....	.....	.....	123	260	15	.....
250	128	187	150	18	.....	65	185	347	28	.....
300	217	325	214	91	.....	121	220	355	171	12
350	264	363	255	130	.....	181	237	356	182	81
400	295	365	283	151	28	211	261	357	189	123
450	310	365	299	193	57	243	299	359	190	159
500	321	365	305	216	76	273	342	359	196	183
600	331	365	316	239	141	287	355	360	238	198
700	336	365	325	272	193	300	359	360	250	216
800	340	365	331	285	240	320	362	360	258	269
900	343	365	335	297	281	337	362	360	266	291
1,000	345	365	339	310	290	342	363	360	271	313
1,200	347	366	346	322	303	344	365	360	277	323
1,500	353	.....	352	331	321	353	.....	361	323	326
1,800	356	.....	353	339	331	359	.....	362	332	345
2,200	358	.....	357	347	333	362	.....	363	339	352
2,600	363	.....	359	352	337	364	.....	363	346	356
3,000	363	.....	359	353	344	364	.....	363	349	358
3,500	363	.....	359	355	346	364	.....	363	351	361
4,000	364	.....	360	356	350	364	.....	364	356	361
5,000	364	.....	361	360	354	364	.....	364	358	365
7,000	364	.....	362	361	361	364	.....	365	360	366
10,000	364	.....	362	365	362	365	.....	.....	361	.....
15,000	365	.....	362	.....	363	365	.....	.....	361	.....
20,000	.....	.....	365	.....	363	.....	.....	.....	362	.....
25,000	.....	.....	.....	.....	363	.....	.....	.....	363	.....
30,000	.....	.....	.....	.....	364	.....	.....	.....	363	.....
35,000	.....	.....	.....	.....	364	.....	.....	.....	363	.....
37,000	.....	.....	.....	.....	365	.....	.....	.....	364	.....
52,000	.....	.....	.....	.....	.....	.....	.....	.....	365	.....

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MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements in Texas during the years ending Sept. 30, 1919 and 1920.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1920.				*Feet.*	*Sec.-ft.*
Aug. 21	West Fork of Trinity River.	Trinity River.....	Fort Worth, Tex., below Clear Fork.	1.73	219
30	.....do.....	.....do.....	.....do.....	3.60	1,740
30	Trinity River.....	Trinity Bay.....	Dallas, Tex.....	25.70	6,700
31	.....do.....	.....do.....	.....do.....	27.17	7,630
Sept. 1	.....do.....	.....do.....	.....do.....	28.39	8,770
2	.....do.....	.....do.....	.....do.....	30.79	10,400
3	.....do.....	.....do.....	.....do.....	30.39	9,960
4	.....do.....	.....do.....	.....do.....	20.17	3,860
5	.....do.....	.....do.....	.....do.....	17.41	3,250
Aug. 30	Elm Fork of Trinity River.	Trinity River.....	Record crossing near Dallas, Tex.	10.63	6,200
31	.....do.....	.....do.....	.....do.....	11.75	6,560
Sept. 1	.....do.....	.....do.....	.....do.....	13.96	8,530
4	.....do.....	.....do.....	.....do.....	4.84	1,070
July 12	San Saba River.....	Colorado River....	Dam site near Doran ranch, 20 miles above San Saba, Tex.	.....	135
Mar. 6	Clear Creek.....	San Saba River...	Near Menard, Tex.....	.....	17.9
1919.					
Jan. 9	Noyes canal.....	.....do.....	.....do.....	.....	2.2
1920.					
Mar. 6	.....do.....	.....do.....	.....do.....	.....	17.2
26	.....do.....	.....do.....	.....do.....	.....	17.9
June 1	.....do.....	.....do.....	.....do.....	.....	8.4
July 10	.....do.....	.....do.....	.....do.....	.....	18.7
1918.					
Oct. 30	Guadalupe River.....	Gulf of Mexico....	½ mile south of Seguin, Tex..	.....	328
31	.....do.....	.....do.....	1 mile south of Belmont, Tex.	.....	313
1919.					
Feb. 9	San Marcos River.....	Guadalupe River .	Martindale, Tex.....	.....	205
9	.....do.....	.....do.....	Fentress, Tex.....	.....	226
1918.					
Nov. 2	.....do.....	.....do.....	1 mile west of Fentress, Tex.	.....	65.6
2	.....do.....	.....do.....	Highway bridge, 2 miles west of Luling, Tex.	.....	76.4
1919.					
Feb. 9	Blanco River.....	San Marcos River.	San Marcos-Luling crossing..	.....	96.8
8	Plum Creek.....	.....do.....	Gonzales-Luling crossing....	.....	10.8
May 8	Salado Creek.....	San Antonio River	Just above Government well, Camp Travis, near San Antonio, Tex...	.....	3.0
8	.....do.....	.....do.....	Below Government well and above Farmers well, Camp Travis, near San Antonio, Tex.	.....	14.9
8	.....do.....	.....do.....	Just below Farmers well, Camp Travis, near San Antonio, Tex.	.....	24.0
8	.....do.....	.....do.....	300 feet above confluence with San Antonio River, near San Antonio, Tex.	.....	41.6
8	Government well.....	Salado Creek.....	Penstock outlet below turbine, Camp Travis, near San Antonio, Tex.	.....	9.6
Aug. 23	Devils River.....	Rio Grande.....	Near Del Rio, Tex.....	.....	381
20	San Solomon Spring.....	Pecos River.....	Near Balmorhea, Tex.....	.....	34.7
20	Griffin Spring.....	.....do.....	.....do.....	.....	3.9
20	Saragosa Spring.....	.....do.....	.....do.....	.....	4.8
21	Fort Stockton Springs.....	.....do.....	Near Fort Stockton, Tex....	.....	44.5
1920.					
July 26	Leon Springs and wells....	Pecos River.....	.....do.....	.....	26.9
1919.					
Dec. 1	.....do.....	.....do.....	Near Fort Stockton, Tex., above well known as "Honey well."	.....	20

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