UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Water-Supply Paper 816

MAJOR TEXAS FLOODS OF 1936

BY

TATE DALRYMPLE AND OTHERS

Prepared in cooperation with the
FEDERAL EMERGENCY ADMINISTRATION
OF PUBLIC WORKS

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1937

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - - - Price 25 cents

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MAJOR TEXAS FLOODS OF 1936

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ABSTRACT

In 1936 floods occurred in parts of Texas during two periods--one about July 1 and the other in the later portion of September--which were marked by record-breaking or outstanding stages and discharges on some of the larger rivers.

Heavy rain storms occurred during the period June 30 to July 4 in a region extending across central Texas and covering about one-fourth of the area of the State, from the Neches River on the east to the Rio Grande on the west. The rainfall amounted to more than 10 inches over the areas centering at Rockland, in the Neches River Basin, at Hallettsville, near Gonzales, and near Kyle, in the Guadalupe River Basin; in the southeast corner of Kendall County, in the San Antonio River Basin; and at Eagle Pass, in the Rio Grande Basin. Extraordinary floods followed in these basins, and record-breaking floods occurred in the Guadalupe River Basin, in the central part of which a rain of over 20 inches fell, mostly on June 30 and July 1.

The rains in September occurred in several rather distinct storms over about three-fourths of the State, which led to considerable variation in the times of the resulting floods in different river basins.

In the Trinity River Basin during the period September 25-28 over 15 inches of rain fell at Kaufman, causing an unusually high flood on Cedar Creek.

From September 13 to 28 the Colorado River Basin was subjected to a series of floods, the greatest of which were in the Concho, San Saba, and Llano River Basins. The most destructive floods occurred in the Concho River Basin; the city of San Angelo suffered great damage, mostly from the flood of September 17. From September 13 to 18, in the Concho River Basin, the rainfall amounted to 24 inches near Christoval and 30 inches at Broome. During the same period, September 13 to 18, 30 inches of rain fell south of Fort McKavett, on the drainage basins of the San Saba and North Llano Rivers, causing record-breaking floods in those basins.

An enormous volume of water passed down the Colorado River during the floods. For the 20 days September 16 to October 5, the run-off of the Colorado River at Austin was over 3,200,000 acre-feet; this quantity of water is considerably more than enough to fill the Elephant Butte Reservoir on the Rio Grande, which was the largest artificial lake in the United States prior to the construction of the Boulder Dam. The average yearly run-off of the Colorado River at Austin for the 38 year period 1898-1936 is 1,960,000 acre-feet, or only about 61 percent of the run-off for the 20-day period in September-October 1936. However, the peak discharge of the Colorado River at Austin during the flood of September 1936 was 234,000 second-feet, as compared with 481,000 second-feet, or more than twice as much, during the flood of June 1935. The flood peak in 1936 was relatively much greater above Austin, and the flood wave had flattened materially at Austin.

During the floods of June-July and September 1936 drainage areas of about 20,000 square miles contributed discharges greater than ever known before from those areas, and areas of about 50,000 square miles contributed discharges that were extraordinarily high. The maximum discharge September 17, 1936, of the Concho River at Paint Rock, with a drainage area of 5,257 square miles, was 301,000 second-feet, which is greater than any known in a period beginning prior to the flood of 1882. At San Angelo on September 17, 1936, the peak discharge of the North Concho River was 184,000 second-feet from a drainage area of 1,675 square miles; no higher stage has occurred since 1853, when a higher stage may have been reached. The highest known stage in Copperas Creek, tributary to the North Llano River above Junction, occurred September 15 or 16, 1936, with a peak discharge of 98,900 second-feet from a drainage area of 118 square miles. On Red Bank Creek near San Angelo a discharge of 2,490 second-feet was measured from a drainage area of 0.76 square mile; the rate of discharge as shown by this measurement was 3,280 second-feet to the square mile.

The information in this report includes profiles of flood-crest stages on about 884 miles of rivers, results of 40 determinations of peak discharges made at miscellaneous places, records of peak stages and discharges and of mean daily discharges during flood periods at about 40 regular river-measurement stations, hydrographs of discharge at 26 river-measurement stations, records of rainfall at about 400 places, 8 isohyetal maps showing rainfall over the entire State and 4 isohyetal maps showing rainfall in more detail over smaller areas, records of past floods at all places in the State at which authentic records were available, and other data pertinent to floods in Texas.

INTRODUCTION

Unusual floods occurred in Texas in 1936 in the Trinity, Brazos, Colorado, and Guadalupe River Basins. Heavy rainfall over a small area in south-central Texas June 28 to July 4 produced floods on the lower Guadalupe River and several tributaries that were greater than had ever been known. Rains from September 14 to 30 produced floods in the Trinity, Brazos, and Colorado River Basins that exceeded all previous records on many streams, and floods in the Red, Guadalupe, and Nueces River Basins that were moderately high.

This report deals with the June-July and September storms and the resultant floods. A brief summary is also given of available information about previous floods. Figure 1 is a map of Texas showing towns and streams mentioned in the text of this report.

The rivers of Texas are subject to great and frequent floods. Some of the maximum rates of discharge have exceeded any rates recorded from areas of comparable size elsewhere in the United States. The rivers of Texas are also subject to long periods of exceedingly low flow. Few people outside the State and probably not many of the residents of the State realize the great difficulties arising from these conditions that must be overcome in controlling and utilizing the flow of Texas streams. To provide economic and safe designs of dams, reservoirs, levees, and other controlling works, long-time records of stream flow at many points are essential, together with records of the magnitude and important characteristics of flood flow.

When it became apparent that the floods of June-July and September 1936 were of unusual magnitude, the importance was recognized of obtaining more complete data than are customarily obtained of ordinary floods. It was realized also that much valuable information would be lost unless it could be obtained without delay and that it would be desirable to obtain information of discharge at many points other than the regular river-measurement stations. In order to permit a more complete analysis of the floods, special attention was given to gathering information about the rainfall that caused them.

The scope and detail of the work greatly exceeded that customarily done under the regular river-measurement program. This special report on the major Texas floods of 1936 was prepared to present and record the information so collected about these floods. The Public Works Administration, acting in accordance with the National Industrial Recovery Act of

1933, allotted to the United States Geological Survey in November 1936 $10,000 for investigation of stages and discharges of the floods and for preparing and printing reports thereon.

AUTHORIZATION

The data presented in this report 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 examinations of the geological structure, mineral resources, and produbts of the national domain.

Work under this statute was begun in 1888 in connection with special studies relating to irrigation. Since the fiscal year ending June 30, 1895, successive appropriation bills passed by Congress have carried the following item:

> 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.

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 a 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 of depth on the drainage basin, acre-feet, and millions of cubic feet. The principal terms used in this report are "second-feet", "second-feet per square mile", and "acre-feet." They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is a rate of flow of 1 cubic foot per second, or 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.

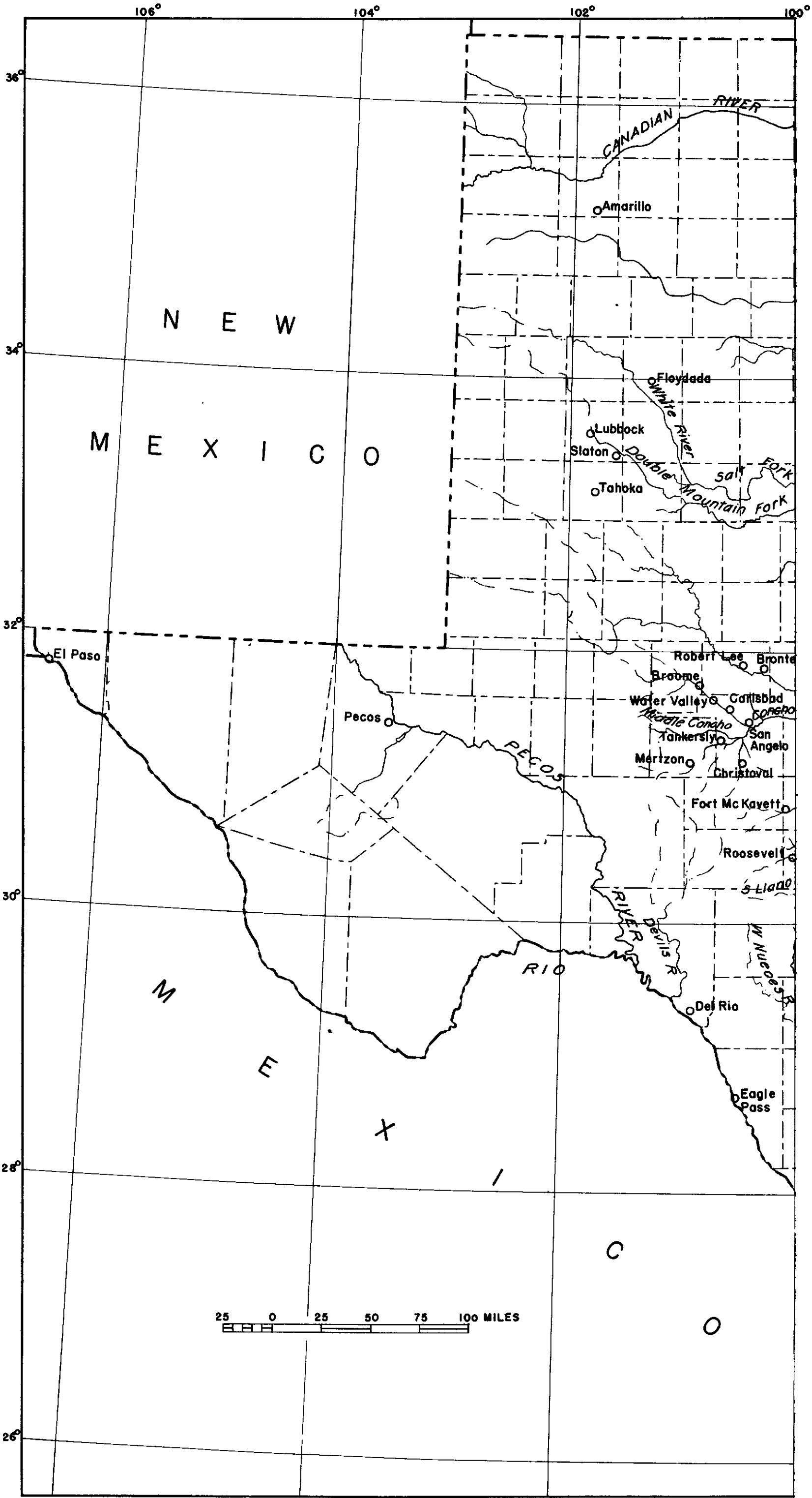
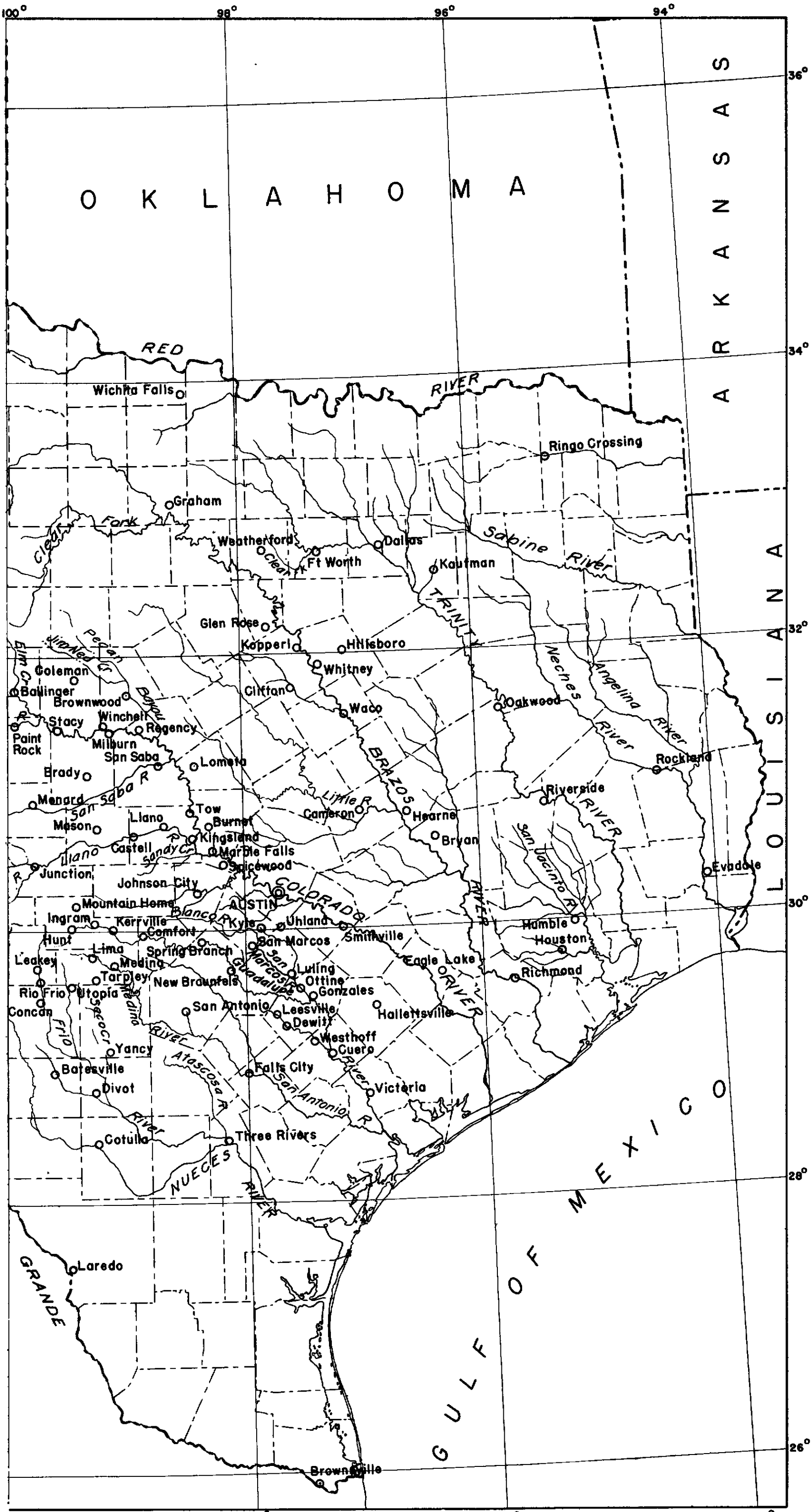


Figure 1.--Map of Texas showing principal



towns and streams mentioned in text.

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. In tables this term is abbreviated as "Ac.ft."

The following terms not in common use are here defined:

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

"Control" is a term used to designate the natural section, reach of the channel, or artificial structure below the gage, which determines the stage-discharge relation at the gage.

"Isohyetals" or "isohyetal lines" are lines joining points on the earth's surface having equal depths of rainfall in a given interval of time.

In tables 12:00 o'clock noon is designated "12N" and 12:00 o'clock midnight is designated "12M."

ADMINISTRATION AND PERSONNEL

The field and office work incident to the preparation of this report was performed by the Water Resources Branch of the Geological Survey under the general administrative direction of N. C. Grover, chief hydraulic engineer, and C. G. Paulsen, chief of the division of surface water. The field work and the collection and tabulation of the basic information with respect to stages and discharges were done by Tate Dalrymple and others, under the immediate direction of C. E. Ellsworth, district engineer. The general technical direction of the special work and assembling of the report was carried on under the division of water utilization, R. W. Davenport, chief. In carrying on this work the permanent field and office staffs were assisted by temporary employees appointed by the Secretary of the Interior under the provisions of the National Industrial Recovery Act.

ACKNOWLEDGMENTS

The river-measurement work of the United States Geological Survey in Texas is carried on in cooperation with the State Board of Water Engineers, C. S. Clark, chairman, A. H. Dunlap, and John W. Pritchett.

Acknowledgments are due to the United States Weather Bureau for many of the data on rainfall and storms.

Many miscellaneous rainfall records were obtained from the Austin office of the Bureau of Reclamation, United States Department of the

Interior, which made extensive surveys of the storm areas and collected much information on rainfall.

Information appearing in this report has been obtained from many other sources, including individuals, corporations, and city officials.

So far as practicable, acknowledgments for individual contributions of information are given at appropriate places in the report.

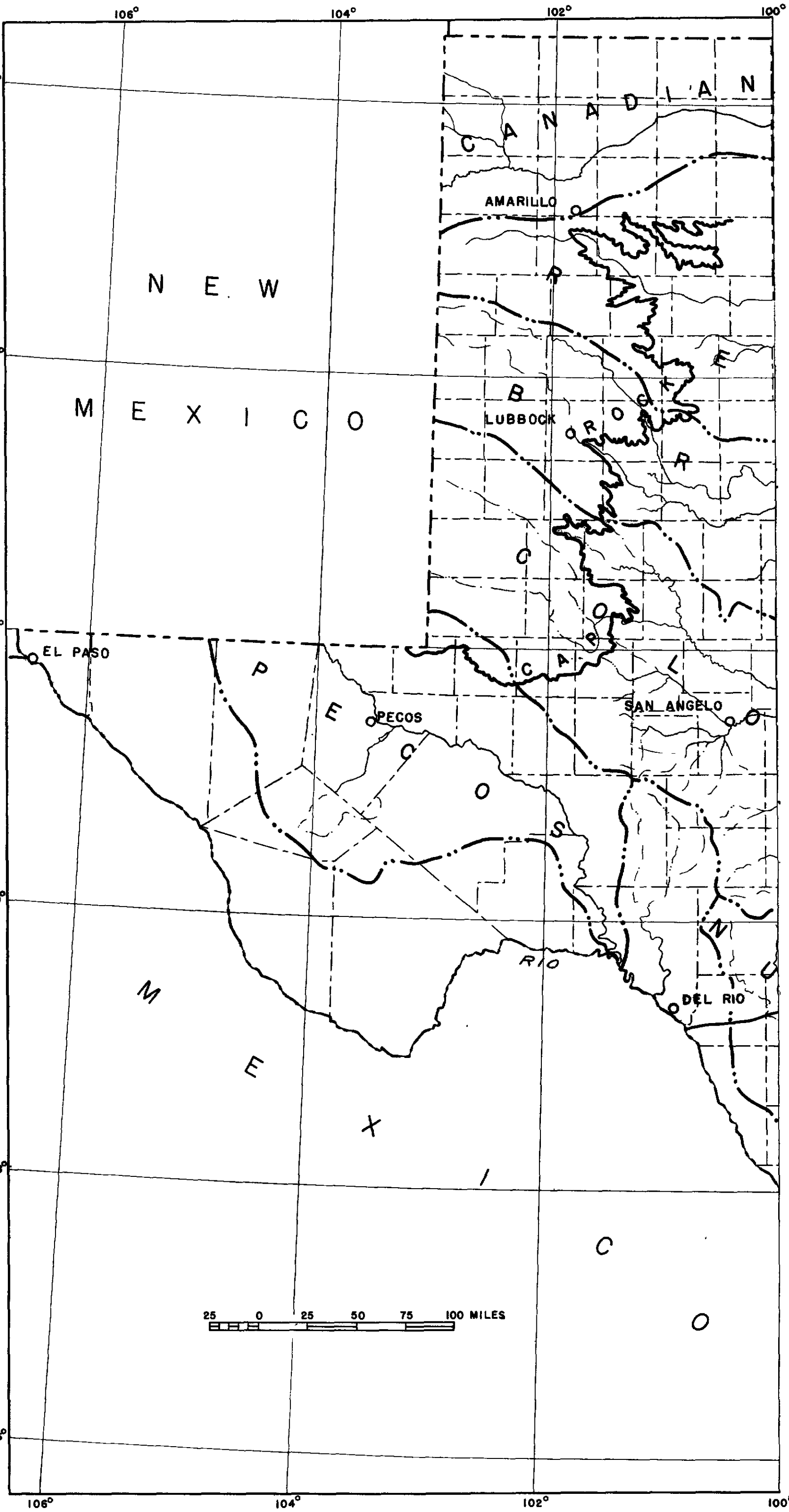
PHYSICAL FEATURES OF THE STATE

Texas may be divided topographically into three general regions--the Staked Plains, the Central Plateau, and the Coastal Plain. (See fig. 2.) The dividing lines between these sections are the Cap Rock and the Balcones fault zone, at each of which there is a pronounced change in the topographic character.

The Staked Plains extend from the Cap Rock to the northern and western boundaries of the State. This region is comparatively flat, ranges in altitude from 2,500 to 4,000 feet, has very few trees and not many streams, and receives a sparse rainfall. It contributes little if any run-off to the lower reaches of the river systems that head in it.

The Central Plateau ranges in altitude from 800 to 2,500 feet, consists mostly of low hills, is fairly well wooded, has a considerably greater rainfall than the Staked Plains, to the northwest, and the rain that falls on it feeds many streams. The southern and eastern edge of this region is along the Balcones fault zone, which forms the boundary between the Central Plateau and the Coastal Plain. This fault zone crosses the State from a point near Dallas through Waco, Austin, and San Antonio to the Rio Grande at Del Rio. The escarpment along this fault is a rather prominent topographic feature from Waco to Del Rio. The rise from the Coastal Plains to the plateau ranges from 200 or 300 feet to over 1,000 feet and is rather abrupt over much of its course. This fault area is characterized by steep slopes and shallow rocky soil, with narrow flood plains along the streams.

The Coastal Plain region, extending from the Balcones fault zone to the Gulf of Mexico, consists mostly of rolling flat hills in the inland part and of relatively flat areas along the coast. A large part of the eastern section is covered with timber. Much of the Coastal Plain is devoted to farming and is more densely populated than the other sections of the State. The streams in this region are comparatively large and have wide overflow channels.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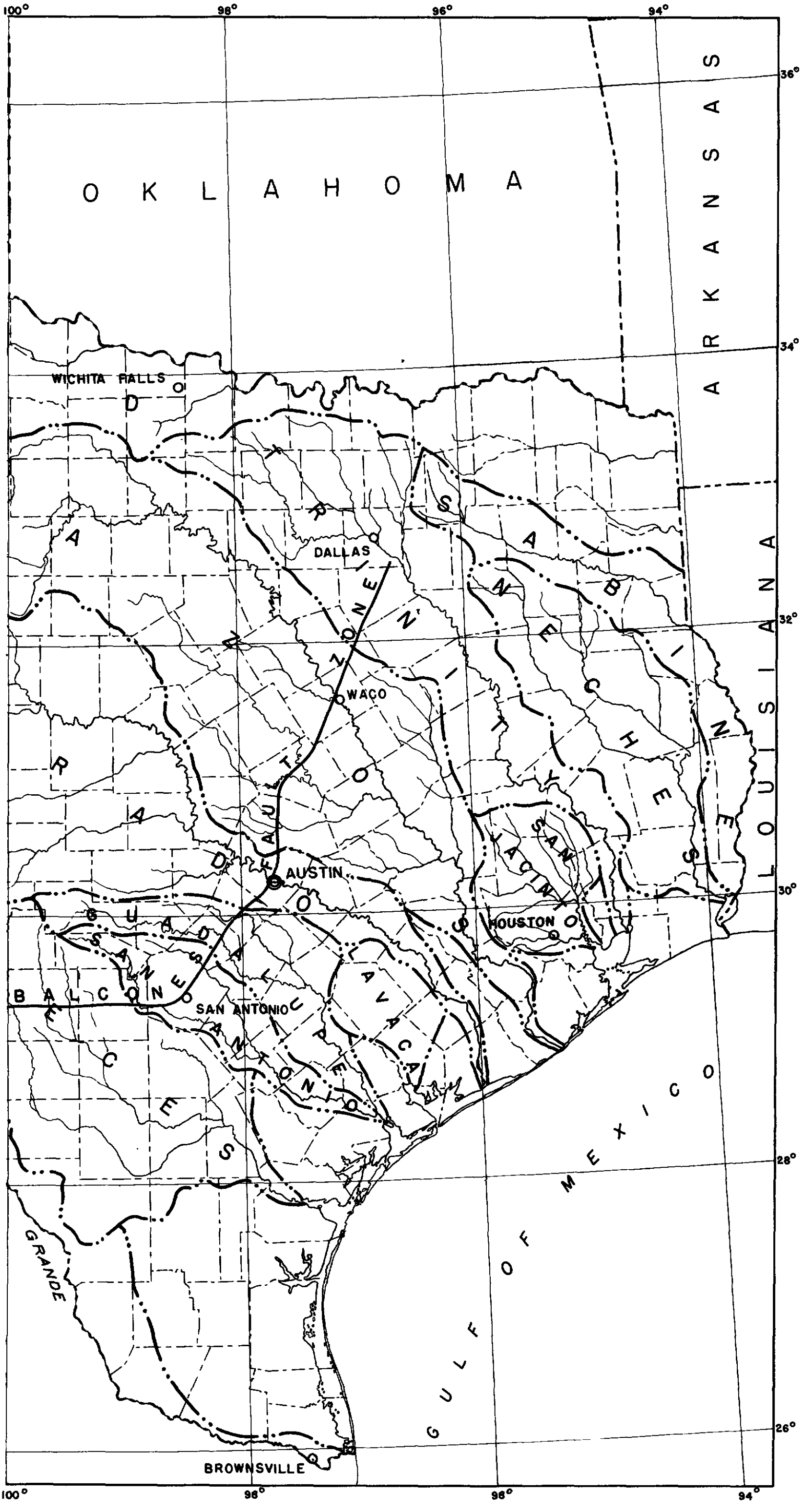
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OKLAHOMA
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LOUISIANA
WICHITA FALLS
DALLAS
WACO
AUSTIN
HOUSTON
SAN ANTONIO
BROWNSVILLE
GULF OF MEXICO
BALCONES FAULT ZONE
GRANDE
TRINITY
SABINE
NECHES
SAN JACINTO
LAVACA
GUADALUPE
SAN ANTONIO
NUECES

CAUSE OF FLOODS

Floods in Texas are caused by excessive rainfall. Snow, ice, and frozen ground have not been contributing factors, as they often are in more northern parts of the United States.

The major floods have been produced by tropical or semitropical storms that enter the State directly from the Gulf of Mexico or across the northeast corner of the Republic of Mexico.

Occasionally, though rarely, floods are caused by tropical cyclones (low-pressure areas) which cross Mexico from the Pacific Ocean. The record-breaking floods on the upper Colorado, Guadalupe, and Frio River Basins, in July 1932 were caused by a storm of this type.

Very rarely do storms from the north or west cause major floods. The storm of May 1908 that produced the highest stage on record on the Trinity River between Dallas and Riverside crossed the country from the Pacific coast.

Thunderstorms, which may or may not be parts of more general storms, often produce intense precipitation over relatively small areas. Most of the floods in the mountainous region west of the Pecos River are caused by storms of this type. These storms generally occur during the summer and early fall.

The general path of Gulf storms is up or across the major streams--a course which tends to produce smaller flood peaks than might be produced if the storms moved down the streams. However, many of the storms pass down some of the large tributaries of the main streams.

The escarpment along the Balcones fault zone tends doubtless to increase the rainfall in its vicinity to some extent, because it forces warm moist air from the Gulf to rise, then to expand and cool, thus inducing heavy rainfall. The possible effect of the escarpment may be exaggerated, because whenever intense rains occur in that area terrific floods are likely to follow, not because the rain was greater in volume or intensity than often occurs in the coastal area, but because of the steepness of the slopes, the shallowness and rocky character of the soil, and the narrow flood plains of the stream channels. The flood of July 1936 was produced by rains that fell almost entirely below the escarpment, but the September floods were caused by rains that fell in the escarpment zone.

FLOOD INVESTIGATIONS

Field work

The first consideration on the advent of a flood is to obtain current-meter measurements for as high stages as possible at the regular gaging stations. During the floods of 1936 all available personnel was occupied in obtaining measurements at such gaging stations as could be reached, and but little time could be given to special work until after the floods had receded below peak stages. Many of the wide overflow sections are not spanned by structures from which discharge measurements could be made. Under these conditions some other method of determining discharge must be used, usually the slope-area method. After the flood waters had receded sufficiently to allow travel, a reconnaissance was made of the areas most affected. Tentative sections were selected for making slope-area determinations of discharge. There are few opportunities on Texas rivers for computing flow over dams or falls or through contracted openings.

In selecting a site for a slope-area determination of discharge the following factors were considered and the best possible selection made: (1) Straightness of channel, (2) concentration of flow in deep narrow channel, (3) length of reach, (4) permanence of channel during flood, (5) absence of trees, brush, and other obstructions, (6) uniformity of cross sections and slope, (7) quality and quantity of high-water marks, (8) approach and get-away conditions, (9) debris movement, and (10) bed slope.

After the tentative selection of a site, levels were run to determine the altitude of the high-water line on both banks over the length of the reach selected. A profile of the high-water points so obtained was plotted in the field, and a study made of the uniformity of the indicated surface slopes. If a sufficiently long reach was found to have satisfactorily uniform slopes on both banks, two or more cross sections were surveyed in the reach. If the slopes were not uniform, another measuring site was selected and investigated in a like manner; this procedure was followed until a satisfactory reach was found.

Photographs were made of the reach finally selected, enough views being taken to show the pertinent characteristics of the channel.

Close attention was paid to the evidence of debris carried by the stream. In some places a considerable quantity of gravel may have been moved by the stream in flood, but in this investigation no place was found in which the quantity appeared sufficient to affect the accuracy of the measurement appreciably.

At all measuring points inquiry was made of local residents as to the heights of previous high floods. Levels were run to flood marks found by such inquiry, and the altitudes of all known flood peaks were determined and referred to a common datum.

Considerable time was spent in searching for information as to the rainfall that caused the floods. Many ranches, farms, and villages were visited, and many valuable rainfall records were obtained.

Office procedure

For each slope-area measurement profiles of the altitude of the high-water marks were plotted, and the surface slopes were determined. The cross sections were also plotted, and the characteristics of each part of the channel were described by notes. The cross-sectional area and the wetted perimeter were computed from the field notes. Computations of velocities and discharges were generally made on separate sheets and attached to the cross sections and profile sheet. All notes, computation sheets, and photographs were clipped together before placing in the permanent files.

In computing flood discharge by the slope-area method the average velocity was determined from Manning's formula:

$$V = \frac{1.486}{n} r^{2/3} s^{1/2}$$

in which V = average velocity in feet per second.

n = coefficient of roughness.

r = hydraulic radius in feet (area of cross section divided by wetted perimeter).

s = slope of energy gradient.

The selection of values of "n", the coefficient of roughness to be used in Manning's formula, has been guided by the Geological Survey's background of experience in the determination of "n" from measurements of the discharge of Texas streams, where many rating curves based on slope-area determinations of discharge have been checked later by current-meter measurements.

Cross sections of reaches of channels were divided into parts to provide for variation in the hydraulic radii and coefficients of roughness in the different parts. Where a subdivided part of a channel was bounded by dense vegetation or trees, such boundary was treated as a part of the wetted perimeter.

At many points, owing to a difference in the area of the upstream and downstream cross sections, it was necessary to consider the velocity head and to correct the surface slope to a value representing the energy grade line. Where the velocity at the downstream section was less than at the upstream section it was assumed that there was a 50 percent recovery of the theoretical kinetic energy head. Where a section was composed of two or more parts, with different "r's" and "n's", the weighted velocity head for the section was determined by an application of the method of O'Brien and Johnson* which is based upon the following formula:

$$\alpha = \frac{\Sigma V^3 \, da}{V_m^3 \, A}$$

in which α = ratio of weighted velocity head to velocity head determined from the average velocity in the entire section.

V = average velocity in any channel into which the entire section may be divided.

da = area of any channel into which the entire section may be subdivided.

$\Sigma V^3 da$ = the summation of the product of V^3 and da for the channels into which the entire section may be subdivided.

V_m = average velocity in the entire section.

A = area of the entire section.

As an example of the application of the slope-area method the computations for discharge of the Concho River near San Angelo, Tex., are given. The slope lines and cross sections are shown in figure 3. Views of the reach, taken soon after the flood, are shown in plates 1 and 2. All computations are given in table 1.

Flow through openings in a railroad embankment was computed at two places. The altitude of the high-water line was determined along the upstream side of the embankment for several hundred feet perpendicular to the flow of the stream and was generally found to be level except for a

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* O'Brien, M. P., and Johnson, J. W., Velocity head correction for hydraulic flow: Eng. News Record, Aug. 16, 1934.

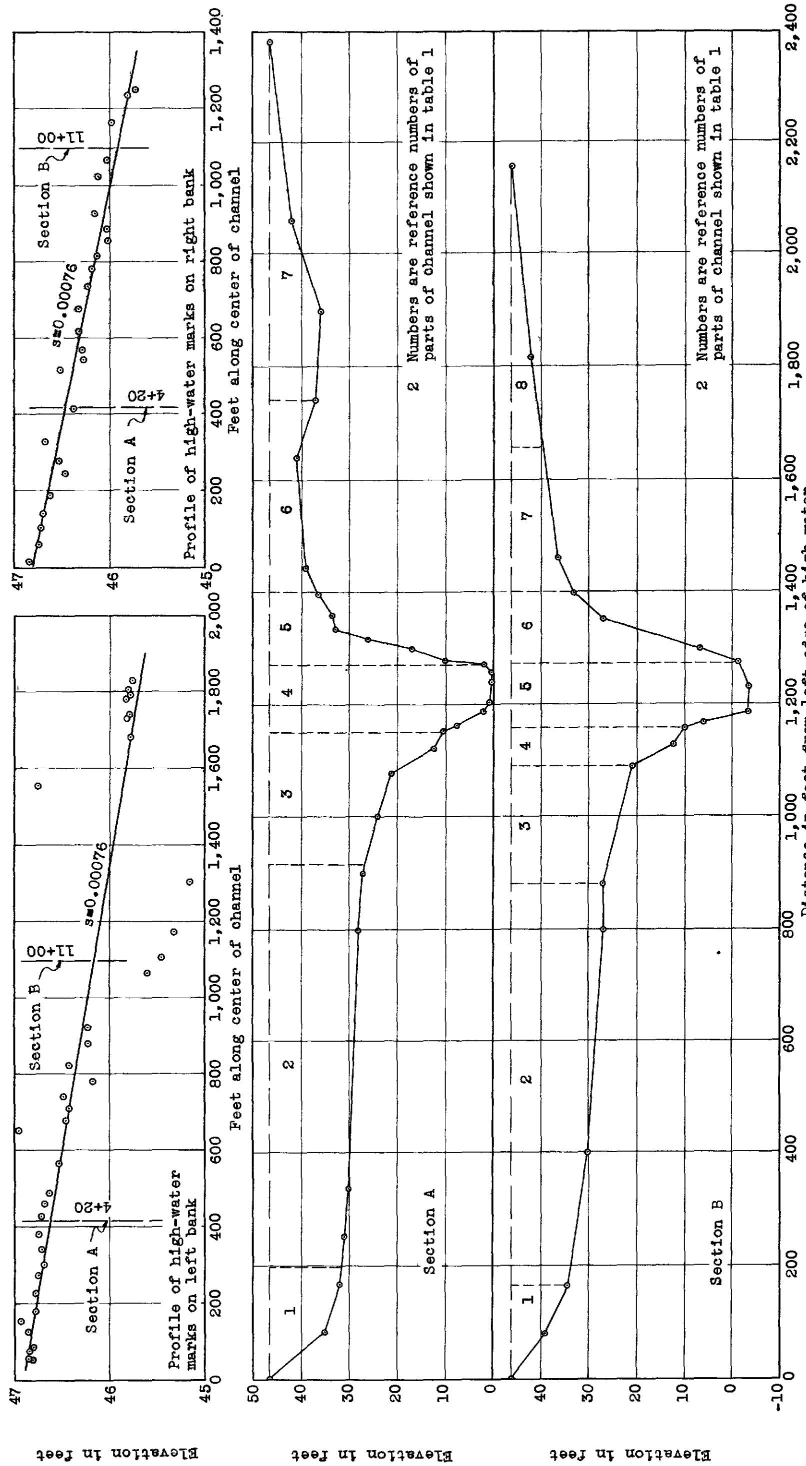


Figure 3.--Profiles of high-water marks and sections of slope-area reach on the Concho River near San Angelo.

A. LOOKING DOWN OVERFLOW SECTION ON LEFT BANK.

B. LOOKING DOWN MAIN CHANNEL.

SLOPE-AREA REACH ON CONCHO RIVER NEAR SAN ANGELO.

A. LOOKING DOWN OVERFLOW SECTION ON RIGHT BANK.

B. LOOKING DOWN OVERFLOW SECTION ON EXTREME RIGHT BANK.

SLOPE-AREA REACH ON CONCHO RIVER NEAR SAN ANGELO.

Table 1.--Discharge computations for slope-area measurement, Concho River near San Angelo, Sept. 17, 1936

Discharge at Section A

Part	A	w.p.	r	s	n	r 2/3	s 1/2	$\frac{1.486}{n}$	V	Q
1	2,354	252	9.35	0.00076	0.080	4.44	0.0276	18.58	2.27	5,350
2	12,691	735	17.3	.00076	.030	6.68	.0276	49.53	9.14	116,000
3	5,862	231	25.4	.00076	.050	8.66	.0276	29.72	7.11	41,700
4	5,385	167	32.2	.00076	.035	10.1	.0276	42.46	11.84	63,750
5	2,523	135	18.7	.00076	.100	7.05	.0276	14.86	2.89	7,300
6	2,498	350	7.14	.00076	.050	3.71	.0276	29.72	3.05	7,620
7	3,416	645	5.30	.00076	.035	3.04	.0276	42.46	3.56	12,160
Total	34,729	-	-	-	-	-	-	-	-	253,880

Discharge at Section B

Part	A	w.p.	r	s	n	r 2/3	s 1/2	$\frac{1.486}{n}$	V	Q
1	1,598	236	6.77	0.00076	0.080	3.57	0.0276	18.58	1.83	2,930
2	11,750	725	16.2	.00076	.030	6.39	.0276	49.53	8.74	102,700
3	4,750	227	20.9	.00076	.045	7.58	.0276	33.02	6.91	32,800
4	2,486	78	32.0	.00076	.055	10.09	.0276	27.02	7.54	18,740
5	4,944	153	32.4	.00076	.035	10.14	.0276	42.46	11.88	58,800
6	3,455	134	25.9	.00076	.100	8.75	.0276	14.86	3.59	12,400
7	2,270	273	8.32	.00076	.045	4.10	.0276	33.02	3.74	8,490
8	1,518	513	2.96	.00076	.035	2.06	.0276	42.46	2.41	3,660
Total	32,771	-	-	-	-	-	-	-	-	240,520
Mean discharge										247,200

for Section A (Station 4+20)

Part	V	V^3	A	AV^3	ΣAV^3	α
1	2.27	11.70	2,354	27,530		
2	9.14	764	12,691	9,690,000		
3	7.11	360	5,862	2,110,000		
4	11.84	1,660	5,385	8,940,000	21,053,830	$\alpha = \frac{21,053,830}{13,508,000} = 1.5575$
5	2.89	24.2	2,523	61,100		
6	3.05	28.4	2,498	70,900		
7	3.56	45.2	3,416	154,300		
Entire	7.30	389	34,729	-	13,508,000	

for Section B (Station 11+00)

Part	V	V^3	A	AV^3	ΣAV^3	α
1	1.83	6.12	1,598	9,780		
2	8.74	668	11,750	7,850,000		
3	6.91	330	4,750	1,567,500		
4	7.54	429	2,486	1,066,000	19,098,700	$\alpha = \frac{19,098,700}{12,950,000} = 1.4745$
5	11.88	1,680	4,944	8,305,000		
6	3.59	46.4	3,455	160,250		
7	3.74	52.4	2,270	118,900		
8	2.41	14.0	1,518	21,270		
Entire	7.34	395	32,771	-	12,950,000	

Assume discharge, 230,000 second-feet

Section	V_m	$\frac{V^2}{2g}$
A	6.62	1.066
B	7.02	1.135

Correction to S $= \frac{1.066 - 1.135}{1,100 - 420} = \frac{-.069}{680} = -.000101$

Corrected S $= 0.00076 - .000101 = 0.000659$

Corrected discharge $= \sqrt{\frac{0.000659}{0.00076}} \times 247,200 = 229,900$ second-feet

As corrected discharge checks assumed discharge, say o.k.

Correct discharge, 230,000 second-feet

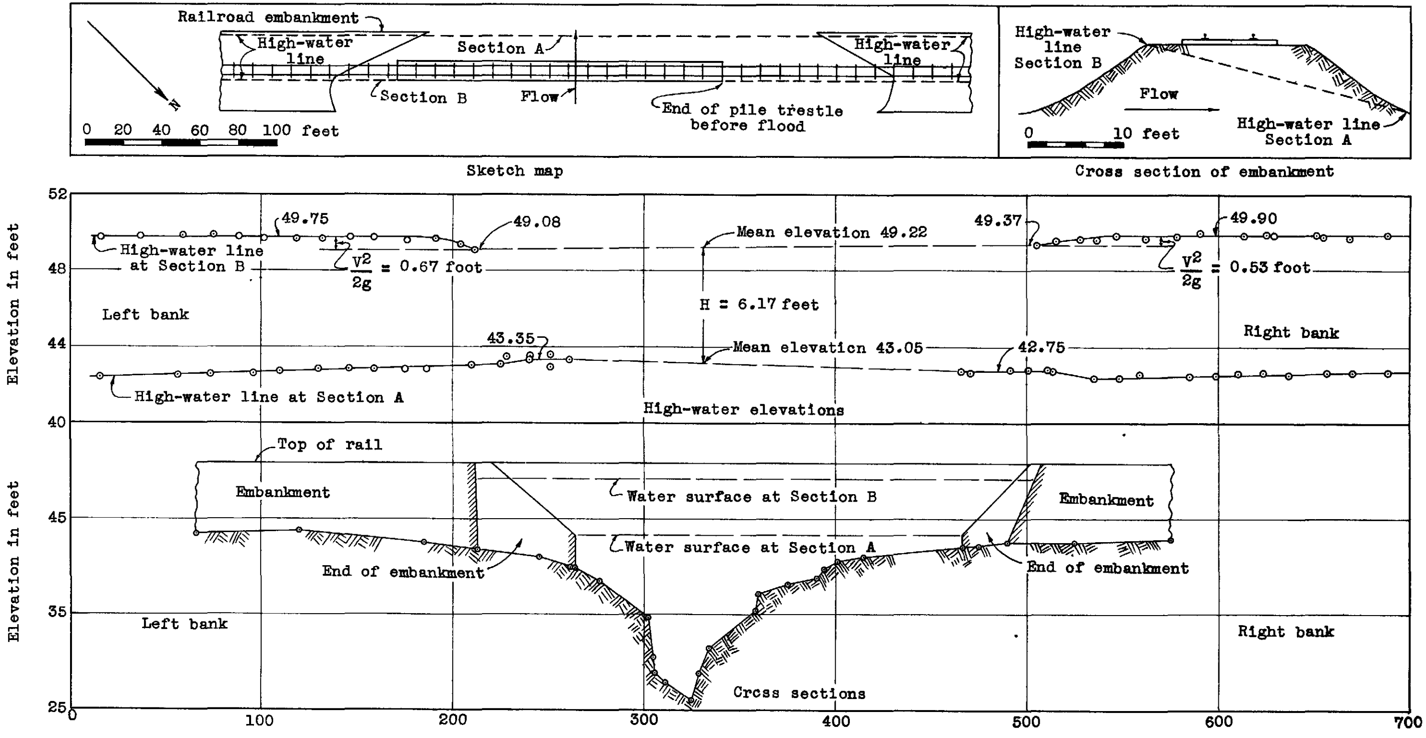
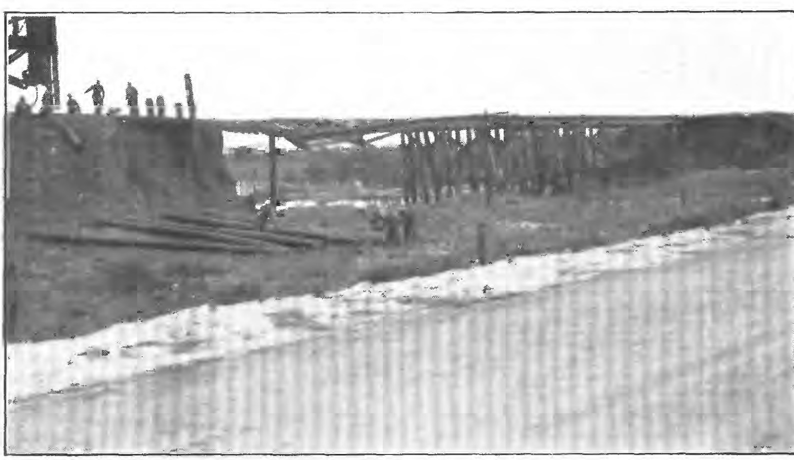


Figure 4.--Map, profiles of high-water marks, and sections for contracted-opening measurement on Dry Creek near San Angelo.

A. DRY CREEK NEAR SAN ANGELO.

Looking downstream through contracted-opening measuring section after bridge had been repaired.



B. GRAPE CREEK NEAR CARLSBAD.

Looking downstream on relief channel, contracted-opening measuring section. Section on Dry Creek was similar to this section before bridge was repaired.

A. BRAZOS RIVER NEAR HEARNE.

Looking upstream, near peak stage on October 2, 1936, showing break in levee and inundated land near Kolb Bridge. Courtesy of J. A. Norris.

B. BRAZOS RIVER NEAR BRYAN.

Showing overflowed farms and winding course of the river, October 2, 1936. Courtesy of J. A. Norris.

distance of a few feet adjacent to the opening in the embankment. The assumption was made that the level line indicated the head corresponding to zero velocity and that the difference between the altitude of this water line and the altitude of the high-water line at the mouth of the opening in the embankment was a measure of the velocity head at the mouth of the opening. The discharge was computed from the equation

$$Q = A\sqrt{2gh}$$

where Q = discharge in second-feet.

A = area, in square feet, of section at mouth of opening.

h = velocity head, in feet, at mouth of opening.

The discharges of Dry Creek and Grape Creek at the Gulf, Colorado & Santa Fe Railway bridges 8 and 12 miles respectively, northwest of San Angelo, Tex., were computed by this method. The application of the method to the determination of the discharge of Dry Creek is illustrated herewith. The slope lines and cross sections are shown in figure 4. All computations are given in table 2. Views of the section on Dry Creek and a similar section on Grape Creek, made soon after the flood are shown in plate 3.

Table 2.--Discharge computations for contracted opening measurement, Dry Creek near San Angelo, Sept. 17, 1936 *

Discharge computed by formula: $Q = k A\sqrt{2g\left(H + \frac{V^2}{2g} - h_f\right)}$

Where Q = discharge in second-feet

k = coefficient of contraction, to be applied if water moves around a sharp corner in entering contracted section

A = area, in square feet, of most contracted section

H = surface drop, in feet, at entrance to contracted section

V = velocity of approach, in feet per second

h_f = head loss, in feet, due to friction.

Then, $Q = 1.00 \times 1{,}210 \sqrt{64.32\ (6.17 + 0.60 - 2.86)}$

$= 1{,}210 \times 8.02 \sqrt{3.91}$

$= 19{,}185$ second-feet.

To check assumed h_f:

Cross section	A	V	$\frac{V^2}{2g}$	Elevation of energy gradient
1	1,210	15.856	3.91	Elev. = 43.05 + 3.91 = 46.96
2	3,100	6.189	.60	Elev. = 49.22 + .60 = 49.82

h_f = 49.82 - 46.96 = 2.86 feet = assumed value in original computation.

* Houk, I. E., Calculation of discharge from measurements at contracted openings: Miami Conservancy Dist. Techn. Rept., pt. 4, p. 262, 1918: Calculation of flow in open channels.

At two places the discharge over dams was computed. Each dam had an ogee section topped by taintor gates. The following formulas were used:

Ogee section, $Q = CLH^{1.5}$

Taintor gate, $Q = 3.34\ LH^{1.47}$

where Q = discharge in second-feet.

L = length, in feet, of crest.

H = static head, in feet, on crest. Velocity of approach was small and was neglected.

C = a coefficient depending on the shape of the cross sections of the crest and the ratio of the head on the crest to the head for which the crest section was designed. This coefficient ranges from 3.15 at a ratio of 1:4 to 4.13 at a ratio of 5:4.

COMPUTATION OF DISCHARGE AT GAGING STATIONS

The mean daily discharge and the volume of run-off were computed at all gaging stations in the flood areas. The discharge is treated as a function of the stage, or gage height. The discharge for an appropriate interval of time was found by taking the mean gage height for that interval and applying it to the rating curve. Rating curves were developed from discharge measurements at the station by plotting discharges as abscissas and gage heights as ordinates. Efforts were made to obtain sufficient data to determine the stages satisfactorily and to define the rating curve throughout the range of stages observed.

At several gaging stations the peak stage occurred at an altitude considerably above that of the stage-recorder instrument, which was protected by a submergence cover. At each of those stations, the graph record was a horizontal line during the comparatively short time the water was above the instrument shelf, and a direct graph record of the peak was not obtained. For this short interval the gage-height graph was interpolated from the direction of the graph preceding and following the horizontal line and from the peak gage height as determined or deduced from readings of the staff gage outside the recorder structure, or from neighboring high-water marks.

The stilling wells at several recorder stations were destroyed and all the chart records for the flood lost. At these stations careful inquiry was made of local residents as to the time of flood stages observed by them, and the altitudes in relation to the gage were determined

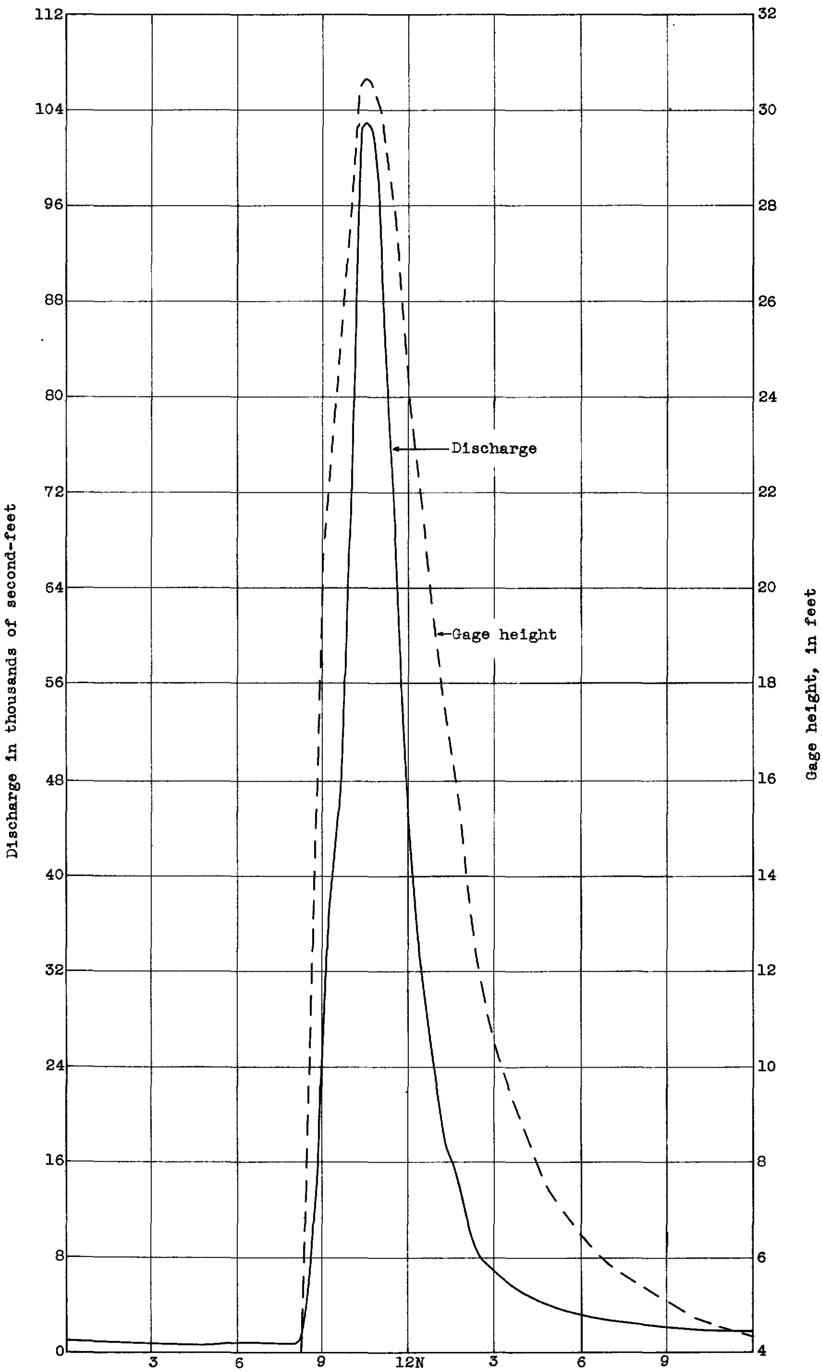


Figure 5.--Stage and discharge hydrographs of the Frio River at Concan, September 16, 1936.

by levels. Generally such stations were visited by an engineer within a day or two after being destroyed, while the details of the flood were still fresh in the minds of local residents. The gage-height records obtained in this manner are subject to possible error but are the best obtainable under the circumstances. The records of discharge computed at such stations were carefully compared with records at other stations on the same or adjacent streams in order to avoid large errors.

In the plateau region of Texas current-meter measurements of maximum flood discharges can be obtained only very rarely, because of the flashy character of the discharge. Stages and discharges of the Frio River at Concan on September 16, 1936, present an example of such flashiness:

Time	Gage height	Discharge
8:00 a.m.	2.84 feet	746 second-feet
10:30 a.m.	30.65 feet	103,000 second-feet
12M	4.35 feet	1,760 second-feet

Both gage height and discharge hydrographs for this flood peak are shown in figure 5, as plotted from data given in table 3.

Table 3.--Gage height, in feet, and discharge in second-feet, of Frio River at Concan, Sept. 16, 1936

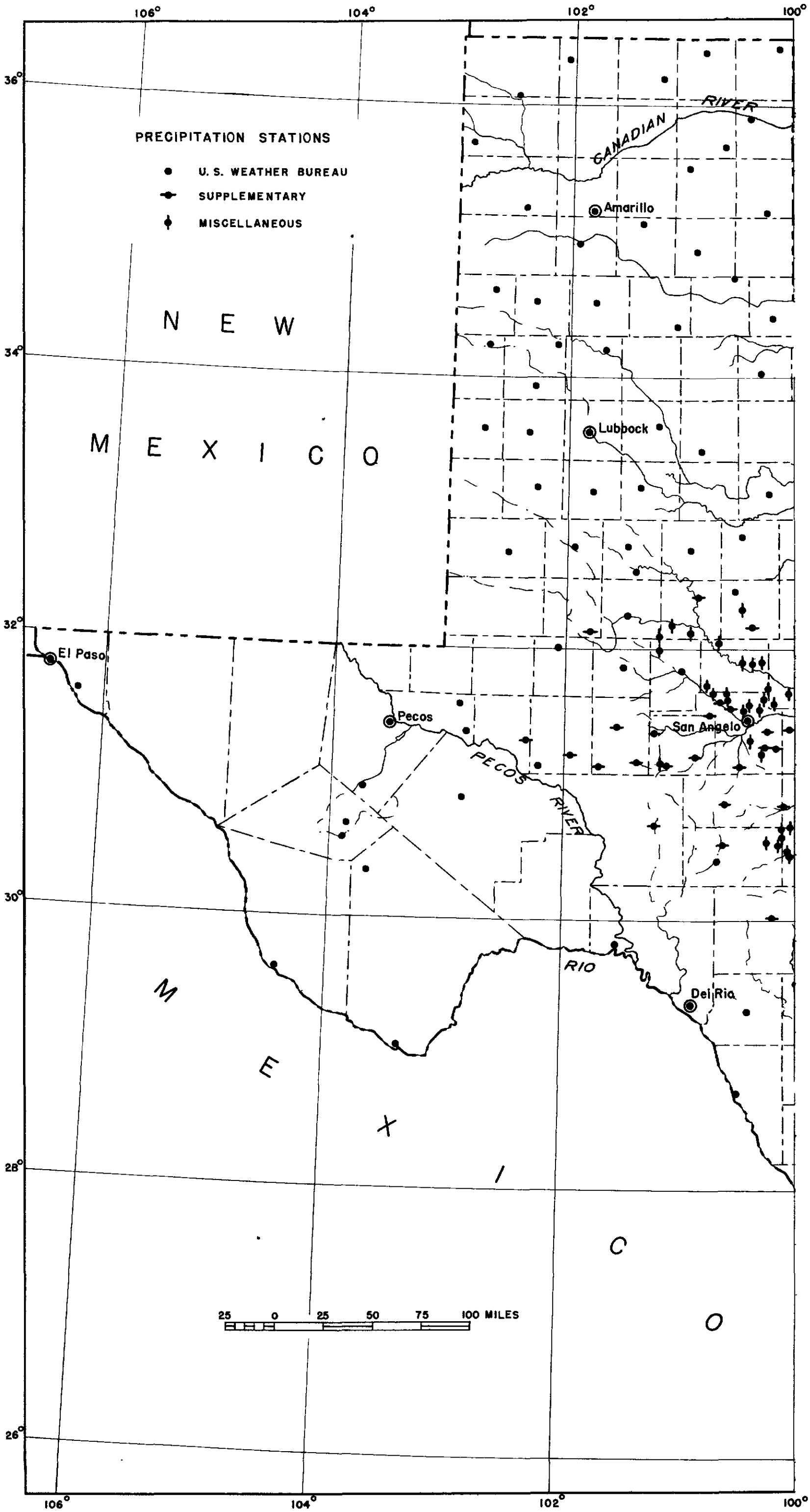
Time	Gage height	Discharge	Time	Gage height	Discharge	Time	Gage height	Discharge
1:00am	3.03	870	10:45am	30.47	102,000	2:45pm	11.03	7,300
4:00	2.76	694	11:00	30.00	95,000	3:00	10.50	6,750
5:00	2.73	674	11:15	29.00	81,500	3:30	9.57	5,840
6:00	2.91	792	11:30	27.90	69,600	4:00	8.77	5,120
7:00	2.90	785	11:45	26.02	54,000	4:30	7.98	4,400
8:00	2.84	746	12N	24.14	43,000	5:00	7.36	3,870
8:15	4.80	2,020	12:15pm	22.86	37,000	5:30	6.90	3,480
8:30	10.10	6,310	12:30	21.55	31,400	6:00	6.50	3,200
8:45	15.40	13,900	12:45	20.00	25,500	7:00	5.87	2,780
9:00	20.70	28,000	1:00	18.70	21,600	8:00	5.44	2,430
9:15	22.55	37,700	1:15	17.53	18,200	9:00	5.13	2,220
9:30	24.40	44,700	1:30	16.55	16,200	10:00	4.77	2,020
9:45	26.25	55,500	1:45	15.54	14,000	11:00	4.55	1,890
10:00	28.10	71,600	2:00	14.00	11,400	12M	4.35	1,760
10:15	30.25	97,800	2:15	12.73	9,410			
10:30	30.65	103,000	2:30	11.90	8,380			

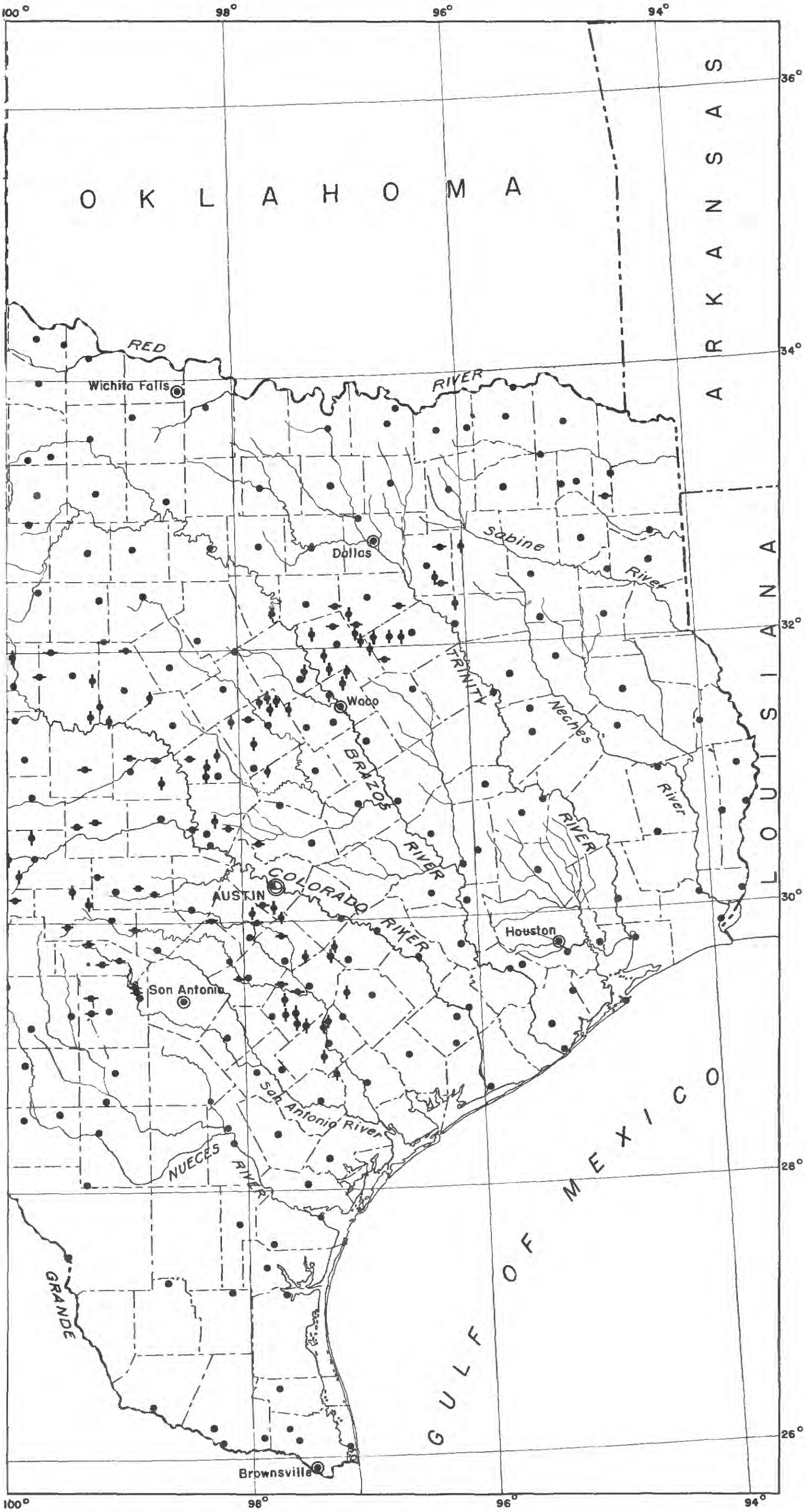
In constructing a rating curve, from which the discharge is computed, the curve must often be extended beyond the point defined by current-meter measurements to the point defined by the determination of peak discharge by some less reliable method. In the present investigation former measurements by the slope-area method were carefully examined and were frequently recomputed on the basis of more recent knowledge and experience or were discarded because of lack of sufficient data for a satisfactory recomputation. The logarithmic plotting of stage and discharge has been found helpful in drawing a rating curve. This method is especially helpful in interpolating or extrapolating a rating curve for any considerable range in stage. The graph of the relation thus developed usually tends to be a very flat curve or nearly a straight line, provided certain adjustments are made to the observed gage heights to make them conform to the physical conditions of the site. This adjustment consists of the addition or subtraction of some constant amount, which is determined by a study of such conditions. For example, at a river-measurement station with a riffle control of uniform altitude across the channel the gage height of zero flow should be subtracted from each observed gage reading. The straight line or flat curve usually produced may be extended without great error provided no marked changes take place in the cross section within the range of stage of such extension. In the logarithmic plotting the measurement of peak discharge may not be consistent with the lower measurements. In such circumstances after a study of the control the direction of the rating curve was usually changed at or near the gage height corresponding to the stage at which the characteristics of the control changed. After the logarithmic rating curve was drawn it was transferred to rectangular coordinates.

PRECIPITATION

In Texas it is necessary to obtain rainfall data from miscellaneous sources, as the official United States Weather Bureau stations are widely separated, especially in that section of the State where many of the intense rainstorms occur. There are areas in Texas larger than the State of Massachusetts in which there is not a single official rain gage. Consequently it is difficult or impossible to make reliable comparisons between rainfall and run-off for individual storms or flood periods. Immediately after the storm of June 30 to July 3, 1932, an extensive search was made in the field for information regarding rainfall in areas remote from official gages. This search produced much reliable information that the maximum rainfall was about 35 inches instead of 20.3 inches, the maximum measured by an official gage. From official records only, the average rainfall over the Guadalupe River Basin above Kerrville for that storm was about 8 inches, although the actual rainfall was nearly if not quite 20 inches. The more adequate coverage of this region by representative rainfall stations has been prevented by limitation of funds.

As a result of years of effort and experience in obtaining additional rainfall information many persons become known who regularly maintain rain


PRECIPITATION STATIONS
U. S. WEATHER BUREAU
SUPPLEMENTARY
MISCELLANEOUS
NEW MEXICO
MEXICO
CANADIAN RIVER
PECOS RIVER
RIO
Amarillo
Lubbock
El Paso
Pecos
San Angelo
Del Rio
106°
104°
102°
100°
36°
34°
32°
30°
28°
26°
25 0 25 50 75 100 MILES



at which data were obtained for flood periods in 1936.

Table 4.--Rainfall, in inches, for periods shown, 1936

Station	Lat.	Long.	June			July				June 28 to		September											
			28	29	30	1	2	3	4	July 1	July 4	13	14	15	16	17	18	13-18	19-24	25	26	27	28	25-28
U.S. Weather Bureau																								
Canadian River Basin:																								
Amarillo	35°13'	101°50'	0.08	0.29	-	-	-	-	-	0.37	0.37	-	-	-	T	0.02	-	0.02	1.01	T	0.01	0.67	-	0.68
Canadian	35 55	100 23	-	.31	-	-	-	-	-	.31	.31	-	-	0.60	-	-	-	.60	.80	.30	-	-	0.48	.78
Dalhart	36 5	102 30	.50	-	T	T	-	-	-	.50	.50	-	-	-	-	T	-	-	.03	T	T	.13	.35	.48
Follett	36 25	100 8	-	.06	0.09	-	-	-	-	.15	.15	-	-	-	-	-	-	-	.92	-	.21	.40	.07	.68
Miami	35 41	100 38	T	-	.46	-	-	-	-	.46	.46	0.02	-	-	0.52	.24	T	.78	.89	-	.30	.08	.50	.88
Pampa	35 32	100 57	-	.55	-	-	-	-	-	.55	.55	-	-	-	.27	-	T	.27	.43	-	.12	.80	-	.92
Perryton	36 24	100 49	-	2.00	-	-	-	-	-	2.00	2.00	-	-	.01	-	-	-	.01	.50	-	-	.69	-	.69
Spearman	36 11	101 10	-	-	1.25	-	-	-	-	1.25	1.25	-	-	-	-	-	-	-	-	-	-	1.10	.20	1.30
Stratford	36 20	102 3	-	.07	-	-	-	-	-	.07	.07	-	-	-	-	.02	-	.02	.44	T	-	.80	-	.80
Vega	35 15	102 26	.03	-	.08	-	-	-	-	.11	.11	-	-	-	-	-	-	-	1.08	-	-	.12	.13	.25
Red River Basin:																								
Arthur City	33 53	95 30	-	-	-	0.02	2.06	0.03	-	.02	2.11	-	-	.03	-	.02	0.03	.08	.93	-	.06	6.28	1.19	7.53
Bonham	33 34	96 11	-	-	-	.35	-	-	-	.35	.35	-	-	-	.34	.34	.14	.82	1.25	-	.46	3.85	1.15	5.46
Canyon	34 59	101 56	-	-	-	-	-	-	-	-	-	-	-	-	-	.05	-	.05	1.30	-	-	.25	-	.25
Childress	34 25	100 12	-	-	-	-	-	-	-	-	-	-	-	-	1.35	1.50	.38	3.23	4.25	-	.12	.70	.35	1.17
Chillicothe	34 16	99 30	-	-	-	T	-	-	-	-	-	-	-	T	.54	1.10	1.20	2.84	8.60	T	2.05	.55	.30	2.90
Clarendon	34 56	100 52	-	-	.10	-	-	-	-	.10	.10	.70	-	-	.40	1.05	T	2.15	2.10	-	.20	-	.75	.95
Clarksville	33 36	95 2								-	-	-	-	-	-	-	1.38	1.38	-	-	-	3.10	-	3.10
Claude	35 7	101 22	-	.32	-	-	-	-	-	.32	.32	-	-	-	.22	-	.12	.34	1.31	-	-	.65	-	.65
Crowell	33 59	99 42								-	-	-	-	1.97	2.00	.85	.75	5.57	3.25	.48	1.10	1.20	-	2.78
Denison	33 45	96 32	-	-	-	-	-	-	-	-	-	-	-	T	.60	.40	-	1.00	3.60	-	.45	4.50	2.40	7.35
Dimmitt (near)	34 32	102 18	-	-	-	-	-	-	-	-	-	.02	0.28	.72	-	-	-	1.02	1.04	-	-	.27	-	.27
Dundee (near)	33 44	98 53	-	-	-	-	-	-	-	-	-	-	-	1.75	4.39	.85	.53	7.52	1.15	.86	.42	1.37	-	2.65
Friona (near)	34 38	102 40	.02	.04	-	T	T	-	-	.06	.06	-	.23	-	-	-	-	.23	1.49	.02	.02	.10	-	.14
Gilmer (near)	32 45	94 57	-	-	-	.25	2.95	.05	0.20	.25	3.45	-	-	-	.77	-	-	.77	-	-	-	-	.36	.36
Henrietta	33 47	98 12	-	-	-	-	.10	-	-	-	.10	-	-	T	.13	4.50	1.04	5.67	.53	.10	.83	1.10	.74	2.77
Honey Grove	33 35	95 55	-	-	-	.46	-	-	.10	.46	.56	-	-	.80	.05	.38	T	1.23	2.36	.15	3.46	1.85	-	5.46
Jefferson	32 45	94 21	-	-	-	-	1.02	.26	-	-	1.28	-	-	.18	-	-	-	.18	-	-	-	-	.37	.37
Memphis	34 43	100 32	-	-	-	-	-	-	-	-	-	-	-	-	.40	1.60	.03	2.03	1.94	-	.40	.12	.68	1.20
Mount Pleasant	33 9	94 58	-	-	-	.08	2.71	.11	-	.08	2.90	-	-	.33	-	-	-	.33	.47	-	-	3.70	.27	3.97
Naples	33 12	94 40	-	-	-	-	2.00	.20	-	-	2.20	-	-	-	-	-	-	-	.72	-	.30	1.70	.18	2.18
Paducah	34 1	100 19	-	-	.83	-	-	-	-	.83	.83	-	-	1.30	1.30	1.18	1.80	5.58	1.13	.75	.82	.18	-	1.75
Paris	33 39	95 35	-	-	-	.04	2.03	.06	-	.04	2.13	-	-	.04	.08	-	.25	.37	1.07	.08	-	4.95	1.50	6.53
Quanah	34 18	99 44	-	-	-	.95	-	-	-	.95	.95	-	-	.02	.55	1.56	.53	2.66	3.96	1.82	1.10	.28	-	3.20
Quitaque	34 22	101 1	-	-	-	-	-	-	-	-	-	-	-	-	1.23	.07	.17	1.47	3.18	.03	.22	.53	-	.78
Ringo Crossing	33 22	95 17	-	-	-	.14	1.90	.08	-	.14	2.12	-	-	-	.22	-	-	.22	.47	-	.10	4.00	.57	4.67
Shamrock	35 13	100 15	-	.09	-	-	-	-	-	.09	.09	-	-	-	1.19	-	T	1.19	1.31	-	1.02	.64	-	1.66
Sherman	33 38	96 37	-	-	-	-	.06	-	-	-	.06	-	-	.09	T	1.21	1.59	2.89	.37	-	.82	5.13	2.72	8.67

Sulphur Springs	33 8	95 37	-	-	.05	3.98	-	-	-	4.03	4.03	-	.40	.28	-	-	-	.68	-	-	4.74	.68	-	5.42
Tulia (near)	34 32	101 46	-	-	-	-	-	-	-	-	-	-	-	-	-	.75	-	.75	1.76	-	-	.16	.40	.56
Vernon	34 9	99 16	-	-	-	-	-	-	-	-	-	-	.07	.32	1.60	.77	3.23	5.99	.94	.35	.38	.59	T	1.32
Wichita Falls	33 55	98 30	-	-	-	T	-	-	-	-	-	-	-	.42	2.20	2.17	.05	4.84	1.85	-	1.51	1.43	T	2.94
Winfield (near)	33 8	95 7	-	-	.15	3.80	-	-	1.50	3.95	5.45	-	-	-	-	T	.10	.10	-	T	6.00	.70	-	6.70
Sabine River Basin:																								
Bon Wier	30 44	93 40	-	-	-	.13	3.31	1.30	1.15	.13	5.89	-	-	-	-	-	-	-	-	-	-	.55	1.05	1.60
Greenville	33 8	96 7	-	-	-	.52	1.56	-	-	.52	2.08	-	-	-	.07	-	-	.07	.67	.01	.23	6.95	.68	7.87
Kirbyville (near)	30 39	93 53	.07	-	-	.95	3.45	.07	-	1.02	4.54	.60	.40	.08	-	.09	-	1.17	.56	T	.36	-	.31	.67
Lindale (near)	32 30	95 25	-	-	T	1.67	.54	T	.47	1.67	2.68	T	.08	1.61	.14	.03	-	1.86	.03	-	.84	.18	.23	1.25
Longview	32 30	94 45	-	-	-	-	3.09	1.27	-	-	4.36	-	-	.05	-	-	-	.05	.47	-	.05	-	.04	.09
Marshall	32 33	94 24	-	-	-	.20	.45	.44	.29	.20	1.38	.12	-	-	-	-	-	.12	.24	-	.05	T	.29	.34
Wiergate	31 1	93 45				.48	6.20	-	-	.48	6.68	-	.32	-	-	-	-	.32	-	-	1.28	-	-	1.28
Neches River Basin:																								
Beaumont	30 5	94 6	.22	-	-	-	.46	.80	.26	.22	1.74	T	2.08	.41	.23	.02	-	2.74	-	-	1.25	.05	.63	1.93
Bronson	31 20	94 1	-	-	-	-	4.40	.04	1.20	-	5.64	.03	.08	.02	.02	-	-	.15	-	1.35	.05	-	T	1.40
Dialville	31 52	95 15	-	-	.25	-	.60	.47	2.63	.25	3.95	.08	.03	.80	T	-	-	.91	-	.36	.30	.15	-	.81
Flint	32 11	95 22	-	-	T	1.30	.90	-	1.83	1.30	4.03	-	T	.32	-	-	-	.32	.51	-	.12	.23	-	.35
Henderson	32 10	94 48	-	-	T	1.12	.70	-	.55	1.12	2.37	.02	.10	.62	-	-	-	.74	.06	-	.10	.35	-	.45
Hyatt (near)	30 33	94 26	-	-	.03	.53	2.01	.09	.44	.56	3.10	.02	.22	.33	.01	-	-	.58	-	.12	T	-	.67	.79
Lufkin	31 20	94 44	-	-	-	-	-	-	2.06	-	2.06	-	.36	.03	-	-	-	.39	-	.32	.01	.03	.05	.41
Nacogdoches	31 36	94 40	-	-	-	-	1.80	-	.70	-	2.50	-	.04	.09	T	-	-	.13	-	T	.40	.32	.07	.79
Rockland	31 1	94 25	-	-	-	1.14	3.80	1.40	3.98	1.14	10.32	.20	-	.16	-	-	-	.36	-	-	.10	.20	-	.30
Trinity River Basin:																								
Bridgeport	33 12	97 46	-	-	-	-	T	-	-	-	-	-	-	.05	.59	1.61	.10	2.35	.01	-	.33	2.64	1.93	4.90
Carrollton	32 57	96 55	-	-	-	.44	-	-	-	.44	.44	-	-	.15	.65	.70	.08	1.58	.09	-	.63	5.16	1.41	7.20
Corsicana	32 6	96 28	-	-	-	1.52	.06	-	-	1.52	1.58	-	.15	.43	.27	.81	-	1.66	-	.93	.40	3.70	1.97	7.00
Crockett	31 20	95 28	-	-	1.65	1.11	-	1.03	1.01	2.76	4.80	-	.51	.20	-	-	-	.71	-	.30	.10	.20	-	.60
Dallas	32 47	96 47	-	-	T	.39	-	-	T	.39	.39	T	.70	.20	1.24	.29	T	2.43	-	.51	3.77	3.30	-	7.58
Denton	33 12	97 7	-	-	-	.03	T	-	-	.03	.03	-	.09	.31	.92	1.21	.79	3.32	.25	-	3.35	2.83	-	6.18
Fort Worth	32 44	97 19	-	-	T	.26	-	-	.02	.26	.28	.02	.03	1.01	.86	.13	-	2.05	.02	.85	1.40	2.98	T	5.23
Gainesville	33 37	97 8	-	-	-	T	-	-	.06	-	.06	-	-	.17	-	4.91	T	5.08	.60	-	2.85	2.83	-	5.68
Grapeland	31 30	95 28								-	-	-	.50	.20	-	-	-	.70	.05	.89	-	.25	-	1.14
Huntsville	30 44	95 35	.27	.62	.22	4.55	1.30	1.04	.16	5.66	8.16	-	T	.38	T	T	-	.38	.11	-	.26	.29	.32	.87
Kaufman	32 35	96 20	-	-	-	1.55	1.68	.04	-	1.55	3.27	-	-	.21	.13	.20	-	.54	.15	-	.21	13.90	1.04	15.15
Liberty	30 4	94 49	-	.09	-	1.05	1.68	.15	-	1.14	2.97	.22	.25	.05	-	-	-	.52	.46	.15	-	.52	.13	.80
Long Lake	31 38	95 46	-	-	-	.90	3.13	-	-	.90	4.03	-	-	-	.25	.04	-	.29	-	-	.26	1.01	.53	1.80
Madisonville	30 57	95 54	.16	-	.05	3.32	.25	-	.45	3.53	4.23	-	.09	.37	.34	-	-	.80	.16	1.43	.60	.32	-	2.35
McKinney	33 12	96 37	-	-	-					-	-	-	-	-	-	3.75	-	3.75	-	2.65	1.35	1.40	-	5.40
Palestine	31 46	95 39	-	-	.90	3.13	.04	.16	.56	4.03	4.79	.08	.07	.53	-	-	-	.68	.03	.48	.17	.58	-	1.23
Riverside	30 51	95 25	-	-	.02	-	4.44	.44	1.08	.02	5.98	.12	.28	.77	-	.36	-	1.53	.36	-	.32	.43	.36	1.11
Trinidad	32 9	96 6	-	-	-	2.40	1.78	-	-	2.40	4.18	-	.75	.31	.32	-	-	1.38	-	.78	-	1.10	.32	2.20
Waxahachie	32 23	96 52	-	-	-	.45	.25	-	-	.45	.70	-	.12	.15	.11	.28	-	.66	.20	-	.73	8.50	1.02	10.25

Table 4.--Rainfall, in inches, for periods shown, 1936--Continued

Station	Lat.	Long.	June 28	June 29	June 30	July 1	July 2	July 3	July 4	June 28 to July 1	June 28 to July 4	Sept. 13	Sept. 14	Sept. 15	Sept. 16	Sept. 17	Sept. 18	Sept. 13-18	Sept. 19-24	Sept. 25	Sept. 26	Sept. 27	Sept. 28	Sept. 25-28
U.S. Weather Bureau--Continued																								
San Jacinto River Basin:																								
Conroe	30°18	95°28'	-	-	0.17	0.81	3.51	1.05	0.97	0.98	6.51	0.16	0.64	0.30	0.63	-	-	1.73	0.46	0.66	0.72	-	-	1.38
Houston	29 46	95 21	T	-	.10	.63	1.24	.60	.11	.73	2.68	.57	.28	1.48	.04	0.03	-	2.40	.05	.11	.01	0.19	0.06	.37
Houston Airport	29 41	95 17	-	-	.01	.90	2.13	.33	.14	.91	3.51	.72	.16	1.63	.02	.16	-	2.69	.22	.12	T	.27	T	.39
Brazos River Basin:																								
Abilene	32 27	99 43	-	-	-	-	-	-	.72	-	.72	T	.03	1.54	1.83	1.77	0.08	5.25	.20	T	.97	.90	-	1.87
Albany	32 43	99 18	-	-	-	-	-	-	-	-	-	-	-	.15	2.30	2.00	.68	5.13	.11	-	.35	1.50	.45	2.30
Anderson	30 28	95 59	0.39	-	.40	4.50	-	.70	.60	5.29	6.59	.08	-	-	-	-	-	.08	.70	.25	.17	.77	-	1.19
Aspermont	33 9	100 13	-	-	-	-	-	-	-	-	-	-	-	-	-	3.25	-	3.25	4.63	-	-	1.56	-	1.56
Breckenridge	32 45	98 54	-	-	-	-	-	-	-	-	-	-	.33	2.20	2.30	.80	.42	6.05	.03	.63	1.60	1.30	-	3.53
Brenham	30 10	96 24	-	-	.42	2.85	1.40	.29	.26	3.27	5.22	.01	.47	.43	.78	.27	-	1.96	.59	-	.20	.12	.69	1.01
Cameron	30 51	96 59	-	0.75	2.35	.80	-	-	2.26	3.90	6.16	.14	.20	.32	.16	-	-	.82	.15	.07	.33	.55	-	.95
Cleburne	32 19	97 23	-	-	.29	.83	-	-	-	1.12	1.12	-	T	1.12	-	1.80	-	2.92	.30	-	1.10	6.16	-	7.26
Clifton	31 47	97 27	-	T	.01	.51	-	-	.45	.52	.97	.02	.70	.44	3.19	.12	T	4.47	.03	.60	2.72	9.31	-	12.63
College Station	30 37	96 23	-	.35	6.00	3.49	-	.03	.72	9.84	10.59	.44	.37	.52	.89	-	-	2.22	-	.46	.81	1.18	-	2.45
Comanche	31 54	98 36	-	-	.03	T	-	-	-	.03	.03	-	.10	1.22	3.79	2.73	.04	7.88	.04	.10	1.45	3.14	-	4.69
Copperas Cove	31 7	97 54	-	-	.42	.20	-	.98	.38	.62	1.98	-	.48	3.10	.92	-	-	4.50	-	1.45	.95	6.60	-	9.00
Crosbyton	33 38	101 6	-	-	-	.44	-	-	-	.44	.44	.19	-	.03	.25	.80	.77	2.04	6.10	.03	.30	.32	.06	.71
Dublin	32 5	98 20	-	-	.02	T	T	-	-	.02	.02	-	.24	.66	1.42	3.24	1.85	7.41	.07	-	.27	3.30	1.00	4.57
Eastland	32 24	98 48	-	-	T	T	T	-	-	-	-	-	-	2.50	3.00	2.50	1.51	9.51	.34	T	.38	2.75	.44	3.57
Freeport	28 59	95 20	-	-	-	.54	.91	.15	-	.54	1.60	1.04	-	1.30	.42	-	.10	2.86	.57	1.79	.13	.29	-	2.21
Gatesville	31 26	97 45	-	.25	.13	2.13	-	-	.57	2.51	3.08	-	.45	1.25	1.82	.14	-	3.66	.23	.58	1.71	4.77	-	7.06
Graham	33 6	98 35	-	-	-	-	-	-	-	-	-	-	1.52	.91	4.82	1.30	-	8.55	.20	.65	.81	1.50	-	2.96
Hamilton	31 43	98 7				-	-	-	1.25	-	1.25	2.00	1.50	.75	-	1.05	-	5.30	-	-	-	7.00	-	7.00
Haskell	33 9	99 43	-	-	-	-	-	-	-	-	-	-	-	.27	.95	1.78	1.20	4.20	1.15	.03	1.30	1.50	-	2.83
Hempstead	30 6	96 5	-	-	-	2.36	1.78	.12	1.01	2.36	5.27	.25	.55	.33	.34	.31	-	1.78	1.02	-	.87	.33	1.67	2.87
Hewitt	31 27	97 10	-	.09	.13	.42	-	T	1.02	.64	1.68	.02	.05	.20	.72	-	-	.99	-	.25	1.02	6.77	-	8.04
Hico	31 59	98 1	-	-	T	.12	-	-	T	.12	.12	.06	.12	.72	.84	.06	.05	1.85	-	.62	.84	4.92	-	6.38
Hillsboro	32 1	97 7	-	-	-	.19	.20	-	-	.19	.39	-	-	.22	.98	.14	-	1.34	.10	.30	2.35	11.30	1.50	15.45
Jarrell	30 51	97 40	-	.35	1.92	.06	-	T	.58	2.33	2.91	-	.73	2.13	1.21	.12	-	4.19	1.03	.95	.74	1.62	-	3.31
Knox City	33 25	99 48	-	-	-	-	-	-	-	-	-	-	-	.12	4.03	2.10	1.35	7.60	1.75	.04	.75	1.12	.27	2.18
Lampasas	31 4	98 10	.01	-	.16	.18	-	-	-	.35	.35	-	.21	3.50	3.07	1.14	.15	8.07	-	.78	.04	4.33	1.50	6.65
Levelland	33 36	102 22	-	-	-	.20	-	-	-	.20	.20	-	-	-	.10	.02	.61	.73	2.86	.07	.09	.13	-	.29
Littlefield	33 55	102 20	-	-	-	.21	-	-	-	.21	.21	.12	-	-	.08	-	-	.20	3.04	-	.08	.40	-	.48
Lubbock	33 35	101 51	-	-	-	-	-	-	-	-	-	T	-	T	.09	.02	2.53	2.64	8.32	.15	.18	.13	-	.46
Marlin	31 18	96 54	-	.33	.07	2.49	-	-	2.05	2.89	4.94	.46	.34	.30	.20	-	-	1.30	-	T	.25	1.38	-	1.63
McGregor	31 25	97 24	-	.39	.06	.18	-	1.60	-	.63	2.23	-	1.03	2.10	1.56	.24	-	4.93	-	2.10	1.52	6.20	-	9.82
Mexia	31 40	96 30	-	-	T	4.10	1.76	-	-	4.10	5.86	-	.51	.31	.45	.42	-	1.69	-	-	.74	.85	.43	2.02

Mineral Wells (near)	32 45	98 13	-	-	-	-	-	-	-	-	-	-	-	.55	2.53	1.90	.10	5.08	-	-	.37	2.00	1.35	3.72
Morton	33 36	102 46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.72	.72	1.52	.20	-	-	-	.20
Muleshoe	34 13	102 43	-	-	.15	-	.11	-	-	.15	.26	-	-	-	-	-	-	-	1.40	-	-	.29	-	.29
Munday	33 26	99 37	-	-	-	T	-	-	-	-	-	-	.06	.28	3.50	2.26	.72	6.82	2.23	.24	.71	2.61	-	3.56
Navasota	30 23	96 6	.60	-	-	1.80	2.05	-	1.20	2.40	5.65	-	.20	.45	.13	.06	-	.84	.04	-	.05	.10	1.40	1.55
Olton	34 14	102 10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.18	.34	-	-	.34
Plainview	34 12	101 41	-	-	-	-	-	-	-	-	-	.40	-	-	.54	-	.10	1.04	3.91	.25	-	.05	-	.30
Post	33 12	101 21	-	-	-	-	-	-	-	-	-	-	-	.05	.30	.85	1.15	2.35	7.03	.07	.91	.61	-	1.59
Putnam	32 23	99 12	-	-	-	-	-	-	-	-	-	-	.12	.54	4.07	1.25	-	5.98	-	-	1.53	1.88	-	3.41
Rainbow	32 15	97 41	-	-	T	.33	.03	-	-	.33	.36	-	.01	.55	2.44	1.92	.71	5.63	T	-	1.10	3.47	1.14	5.71
Richmond	29 35	95 45	T	-	-	.35	.89	1.12	.49	.35	2.85	T	.98	.40	.26	.10	T	1.74	.27	T	T	.49	.32	.81
Roscoe	32 27	100 31	-	-	-	-	-	-	-	-	-	-	T	.84	.75	1.51	.85	3.95	.10	.06	2.54	.45	-	3.05
Rotan	32 50	100 28	-	-	-	.12	-	-	-	.12	.12	-	-	.95	.87	1.36	-	3.18	1.80	.51	1.22	1.73	-	3.46
Sealy	29 47	96 10	.05	-	.48	3.58	.08	.21	1.08	4.11	5.48	.40	.04	.03	.05	.10	-	.62	.08	-	.31	1.81	-	2.12
Seymour	33 35	99 15	-	-	-	-	-	-	-	-	-	-	-	.13	.65	3.66	.50	4.94	3.45	-	1.15	1.18	.28	2.61
Spur	33 28	100 51	-	-	-	.03	-	-	-	.03	.03	-	-	.21	.61	.56	1.76	3.14	4.58	.21	1.07	.30	-	1.58
Stamford	32 57	99 48				-	-	-	-	-	-	-	.25	2.24	-	2.10	1.26	5.85	.43	-	3.19	2.42	-	5.61
Tahoka	33 10	101 47	-	-	-	-	-	-	-	-	-	-	-	-	.14	.70	1.04	1.88	9.39	.62	.32	.01	-	.95
Taylor	30 33	97 25	.04	-	1.40	1.52	1.27	-	-	2.96	4.23	-	.11	.48	.13	1.18	.10	2.00	.14	-	1.58	.50	.91	2.99
Temple	31 5	97 22	-	-	.09	1.00	.22	.02	-	1.09	1.33	-	.37	.10	2.00	1.18	-	3.65	-	.03	.53	1.63	1.96	4.15
Throckmorton	33 10	99 13	-	-	-	-	-	-	-	-	-	-	.36	.46	1.68	1.62	.21	4.33	2.11	.56	.80	1.36	-	2.72
Valley Junction	30 50	96 40	-	-	.17	4.83	2.15	-	-	5.00	7.15	-	.53	.71	.79	.94	-	2.97	-	-	-	.23	.59	.82
Waco	31 33	97 8	-	-	.02	.57	.08	-	-	.59	.67	T	.08	.03	.17	.74	-	1.02	-	-	.97	6.03	2.25	9.25
Weatherford	32 46	97 48	-	-	-	.01	-	-	-	.01	.01	-	-	.68	1.84	1.78	.08	4.38	7.65	-	-	-	-	-
Colorado River Basin:																								
Austin	30 16	97 44	T	.19	3.03	.49	1.26	.13	.01	3.71	5.11	.33	.87	.99	.35	.04	-	2.58	-	.35	.85	1.38	-	2.58
Ballinger	31 44	99 56	-	-	-	-	-	-	-	-	-	-	T	1.25	1.63	6.25	1.80	10.93	-	-	.48	2.30	.22	3.00
Brownfield	33 11	102 16	-	-	-	-	-	-	-	-	-	-	-	-	-	.25	1.00	1.25	7.85	.25	.35	.12	-	.72
Brownwood	31 43	98 59	-	-	.05	-	-	-	.08	.05	.13	-	-	.27	4.10	1.60	.72	6.69	.16	.08	.07	3.20	.35	3.70
Coleman	31 50	99 25	-	-	-	-	-	-	-	-	-	-	.97	1.93	4.03	2.70	1.20	10.83	T	.10	1.61	2.13	-	3.84
Columbus	29 42	96 33	-	-	.76	2.85	1.15	1.22	.28	3.61	6.26	.03	1.30	.09	.27	1.91	T	3.60	.56	-	1.19	.23	.97	2.39
Eden	31 13	99 51	-	-	-	.33	-	-	-	.33	.33	-	.25	4.00	1.27	2.50	1.10	9.12	-	-	2.75	1.15	-	3.90
Fairland	30 39	98 17	.62	.03	2.25	.01	T	.10	.03	2.91	3.04	.43	3.75	3.00	.01	.62	-	7.81	.42	.19	-	9.80	-	9.99
Gail	32 45	101 27	-	-	-	-	-	-	-	-	-	-	-	-	.36	.17	.28	.81	4.31	1.40	.12	-	-	1.52
Garden City	31 52	101 29	-	-	-	-	-	-	-	-	-	-	-	-	-	1.25	1.35	2.60	4.75	.50	1.50	.50	-	2.50
Goldthwaite	31 27	98 34	-	-	.26	T	-	-	2.00	.26	2.26	T	1.10	1.70	2.89	1.00	.40	7.09	.40	.58	1.17	2.67	-	4.42
Junction	30 29	99 45	-	.43	.06	-	-	-	.02	.49	.51	-	.69	5.22	1.39	.23	-	7.53	.33	.09	.05	2.43	-	2.57
Knapp (near)	32 34	101 23	-	-	-	-	-	-	-	-	-	-	-	-	.97	-	-	.97	4.08	.10	.60	.53	-	1.23
Lagrange	29 55	96 52	-	.02	1.34	8.25	.39	.22	.06	9.61	10.28	.57	.05	-	.13	-	.07	.82	.32	.06	.67	1.57	-	2.30
Lamesa	32 44	101 56	-	-	T	-	T	-	-	-	-	1.32	-	-	-	.20	.80	2.32	3.60	.25	.94	.17	T	1.36
Llano	30 45	98 40	-	.03	.18	1.91	-	-	-	2.12	2.12	-	.17	3.47	5.59	.54	.70	10.47	.01	-	.44	3.25	.25	3.94
Marble Falls	30 34	98 17	-	2.55	-	.35	-	-	.66	2.90	3.56	-	.07	2.30	3.00	1.52	1.15	8.04	-	-	.09	5.00	1.40	6.49
Menard	30 55	99 47	-	.04	-		-	-		.04	.04	-	.18	1.60	6.03	1.14	.31	9.26	.64	.72	.19	1.35	-	2.26
Midland	32 0	102 5	-	-	-	-	-	-	-	-	-	-	-	-	.43	1.45	1.10	2.98	2.02	1.26	.14	-	-	1.40

Table 4.--Rainfall, in inches, for periods shown, 1936--Continued

Station	Lat.	Long.	June			July				June 28 to		September												
			28	29	30	1	2	3	4	July 1	July 4	13	14	15	16	17	18	13-18	19-24	25	26	27	28	25-28
U.S. Weather Bureau--Continued																								
Colorado River Basin--Contd.																								
Morris Ranch	30°13'	99° 4'	0.17	1.77	1.26	0.14	-	-	T	3.34	3.34	0.04	4.00	5.80	0.55	0.45	-	10.84	0.98	0.24	1.17	3.59	-	5.00
Paint Rock	31 30	99 55	-	-	-	-	-	-	0.27	-	.27	-	-	6.74	5.66	.65	-	13.05	.25	-	2.76	.99	-	3.75
Pierce	29 14	96 12	.73	-	.05	1.30	0.95	0.85	.55	2.08	4.43	.24	.91	.10	.42	.06	-	1.73	.67	-	.40	.06	0.97	1.43
San Angelo	31 28	100 26	-	-	-	-	T	-	-	-	-	-	T	11.75	1.16	4.64	7.64	25.19	.25	.08	1.11	.88	T	2.07
Seminole	32 42	102 31	-	-	T	.50	-	-	-	.50	.50	-	-	-	-	.06	.30	.36	6.35	.28	.23	.08	-	.59
Sloan	31 7	98 57	-	-	.46	-	-	-	-	.46	.46	-	.38	2.25	2.80	1.67	-	7.10	.07	.83	.44	3.39	-	4.66
Smithville	30 1	97 10	-	.58	1.55	6.00	1.30	1.65	.18	8.13	11.26	T	.70	.07	.44	T	.14	1.35	-	.17	.52	1.10	-	1.79
Snyder	32 44	100 55	-	-	-	-	-	-	-	-	-	-	-	T	.42	1.38	.05	1.85	4.34	.25	.88	1.53	.02	2.68
Sterling City	31 51	100 59	-	-	-					-	-	-	-	.85	.10	5.50	2.65	9.10	1.50	.80	2.30	1.00	-	4.10
Wharton	29 19	96 7	.33	-	-	.93	1.00	2.27	1.14	1.26	5.67	.03	.70	-	.24	.42	-	1.39	.06	.22	.31	.28	1.14	1.95
Lavaca River Basin:																								
Edna	28 59	96 38	-	.40	-	3.78	.33	-	-	4.18	4.51	2.40	-	.19	.48	.27	-	3.34	1.54	-	-	1.63	-	1.63
Hallettsville	29 26	96 56	T	T	2.30	11.30	.70	1.10	1.00	13.60	16.40	T	1.45	.05	.06	1.50	-	3.06	1.15	T	.80	.80	-	1.60
Yoakum	29 17	97 11	-	2.50	7.30	2.81	.28	.93	.75	12.61	14.57	1.23	.19	.84	1.40	.44	-	4.10	.47	.17	1.06	.40	-	1.63
Guadalupe River Basin:																								
Blanco	30 5	98 25	-	.23	4.87	2.85	1.57	-	.22	7.95	9.74	-	.57	1.45	1.95	.56	1.12	5.65	.38	-	.96	1.10	1.55	3.61
Cuero	29 4	97 17	1.53	T	3.00	3.15	2.50	.28	.23	7.68	10.69	.17	.63	.83	.16	.46	.02	2.27	.60	-	.04	1.78	.17	1.99
Flatonia	29 41	97 7	-	.09	2.03	5.34	.77	2.10	.45	7.46	10.78	.04	1.84	.28	.41	.38	-	2.95	.08	.12	.47	1.28	-	1.87
Gonzales	29 30	97 27	.89	-	1.34	9.01	3.14	1.98	3.69	11.24	20.05	-	.34	.83	T	.04	.20	1.41	.89	-	.30	.28	2.31	2.89
Kerrville	30 1	99 7	.05	1.11	2.92	1.02	.15	-	.01	5.10	5.26	-	.56	6.42	5.95	.95	T	13.88	1.16	T	.12	4.58	.04	4.74
Luling	29 41	97 39	.36	T	.62	7.75	.84	-	.06	8.73	9.63	.08	.54	1.00	.28	1.55	.23	3.68	.04	-	.46	.40	1.05	1.91
New Braunfels	29 42	98 7	.06	.02	3.13	.13	.25	.05	.07	3.34	3.71	.13	.93	.05	1.42	.53	-	3.06	.05	.04	.09	.89	-	1.02
Nixon	29 17	97 46	T	T	1.56	7.78	.16	.40	.22	9.34	10.12	.84	.52	.22	.07	.41	-	2.06	.64	-	.08	1.75	-	1.83
San Marcos	29 53	97 58	.25	-	.68	3.10	1.32	T	.25	4.03	5.60	-	.75	.60	.05	.12	T	1.52	.32	-	.60	.30	.25	1.15
Seguin	29 34	97 58	.67	.07	8.07	.65	.06	1.02	-	9.46	10.54	.05	1.23	.25	.02	.35	-	1.90	-	.27	.21	.57	-	1.05
Victoria	28 47	97 0	-	.86	2.13	2.13	.68	-	-	5.12	5.80	1.04	.04	.03	.01	.01	.18	1.31	.24	.03	.36	1.61	-	2.00
San Antonio River Basin:																								
Boerne	29 47	98 44	.86	2.10	6.07	-	.90	.02	.08	9.03	10.03	.10	2.60	3.40	.43	.11	-	6.64	.45	.19	.11	3.63	-	3.93
Floresville	29 8	98 9	-	.19	4.90	.50	-	.85	-	5.59	6.44													
Goliad	28 40	97 23	-	.11	1.89	3.07	.70	.31	.62	5.07	6.70	.65	.66	-	-	-	-	1.31	1.79	-	.82	.55	.05	1.42
Karnes City	28 52	97 54	-	1.97	.40	1.55	.90	-	.32	3.92	5.14	.45	1.30	-	-	.55	.33	2.63	1.40	-	-	1.20	-	1.20
Riomedina	29 26	98 52	.40	5.00	4.87	-	-	.32	.32	10.27	10.91	.60	.40	-	-	-	-	1.00	-	.15	.98	-	-	1.13
Runge	28 54	97 43	-	.27	1.24	2.12	.23	-	-	3.63	3.86	.16	.95	-	-	.04	.05	1.20	.52	T	.05	1.01	-	1.06
San Antonio	29 25	98 31	.52	2.33	1.55	.03	.02	-	T	4.43	4.45	.15	.31	.41	.04	1.57	-	2.48	.20	.09	T	1.24	-	1.33
Nueces River Basin:																								
Big Wells	28 34	99 34	1.33	.17	-	-	-	-	-	1.50	1.50	-	2.00	-	-	.10	.18	2.28	.75	-	.20	2.00	-	2.20

Carrizo Springs	28 32	99 51	4.40	.11	-	-	-	-	.88	4.51	5.39	-	3.85	.23	-	.13	.63	4.84	.23	.08	-	2.58	-	2.66
Cotulla	28 26	99 14	.37	2.10	-	-	-	-	-	2.47	2.47	-	1.20	-	-	-	.05	1.25	-	-	.29	-	-	.29
Dilley	28 40	99 10	2.29	1.09	1.38	-	-	-	.57	4.76	5.33	-	.48	.01	-	.36	.08	.93	.18	.01	.20	.20	T	.41
Encinal	28 3	99 20	.27	.60	3.70	-	-	-	.63	4.57	5.20	-	2.89	-	-	-	-	2.89	.52	.62	.38	.13	-	1.13
George West	28 20	98 7	.10	-	.71	-	.45	-	-	.81	1.26	.67	-	-	2.10	.28	-	3.05	2.24	.04	-	-	-	.04
Hondo	29 20	99 8	1.63	1.37	3.10	.29	.84	1.02	-	6.39	8.25	.51	2.42	.14	.05	.31	-	3.43	.63	.36	T	1.00	-	1.36
Montell	29 32	100 1	.06	6.64	T	-	.19	-	.03	6.70	6.92	.37	1.88	.07	1.89	1.20	-	5.41	.19	.07	.06	2.83	-	2.96
Pearsall	28 53	99 6	1.73	4.12	-	-	-	-	-	5.85	5.85	.65	-	-	-	1.80	-	2.45	.32	.30	-	.47	-	.77
Sabinal	29 19	99 28	.34	1.88	.74	-	-	-	.40	2.96	3.36	.10	1.80	.28	.04	.18	-	2.40	.11	.47	-	2.50	-	2.97
Three Rivers	28 28	98 11	5.33	-	1.61	.67	-	.28	.02	7.61	7.91	.03	.30	.03	-	1.00	.15	1.51	.61	.01	-	-	.60	.61
Uvalde	29 13	99 48	-	-	-	-	.41	T	.80	-	1.21	-	3.25	T	T	.40	-	3.65	-	.05	-	3.05	-	3.10
Whitsett	28 40	98 18	.43	3.75	-	-	-	-	-	4.18	4.18	-	-	-	-	.87	-	.87	1.03	-	-	.64	-	.64
Pecos River Basin:																								
Alpine	30 21	103 40	-	-	-	.04	-	-	-	.04	.04	.14	-	-	-	.13	-	.27	3.04	.05	.51	.08	-	.64
Balmorhea	30 58	103 43	-	-	-	-	-	-	-	-	-	-	-	-	-	.45	.12	.57	1.69	.57	.08	.21	-	.86
Fort Davis	30 35	103 53	-	-	-	.33	-	-	-	.33	.33	-	.20	-	.17	-	-	.37	3.42	.62	-	-	-	.62
Fort Stockton	30 54	102 52	-	-	-	.80	-	-	-	.80	.80	-	-	-	-	.56	-	.56	1.25	.50	.50	T	-	1.00
McCamey	31 7	102 13	-	-	-	-	T	-	-	-	-	-	-	-	-	.09	.10	.19	.26	.60	3.35	.35	T	4.30
Monahans	31 34	102 51	-	-	-	1.26	-	-	-	1.26	1.26	-	-	-	-	.31	.04	.35	1.41	1.00	-	.10	-	1.10
Mount Locke	30 41	103 53	-	-	-	-	.12	-	-	-	.12	.08	T	-	-	.37	.04	.49	3.07	.17	.34	.09	-	.60
Pecos	31 25	103 30	-	-	.10	.29	-	-	-	.39	.39	-	-	-	-	.50	-	.50	1.45	.23	-	-	-	.23
Rio Grande Basin:																								
Brackettville	29 18	100 25	.09	2.96	1.48	-	.76	.24	-	4.53	5.53	-	.21	.01	1.73	.03	.19	2.17	.01	.09	.01	.80	-	.90
Brownsville	25 54	97 30	T	-	T	-	.02	-	.04	-	.06	2.99	1.02	-	-	.25	-	4.26	.46	.11	.19	1.48	.26	2.04
Clint	31 35	106 14	T	T	-	-	T	T	-	-	-	-	-	-	-	-	-	-	1.88	.90	-	.40	T	1.30
Del Rio	29 22	100 53	.44	3.20	T	-	.23	.68	.02	3.64	4.57	.09	.18	-	.16	.57	.69	1.69	-	.01	.08	.92	-	1.01
Eagle Pass	28 43	100 30	.67	15.60	.05	-	.43	-	.31	16.32	17.06	-	.88	.07	-	.58	-	1.53	.09	.02	-	1.17	-	1.19
El Paso	31 47	106 29	-	T	T	T	-	-	-	-	-	-	-	-	.01	-	-	.01	1.85	.13	T	.78	-	.91
Harlingen	26 11	97 42	-	-	.05	-	.45	.35	-	.05	.85	.95	.15	.08	.35	.70	T	2.23	2.57	-	.70	.25	1.20	2.15
Hidalgo	26 6	98 15	-	-	-	-	-	.07	.01	-	.08	.45	.22	-	-	-	-	.67	1.68	.17	.02	-	.36	.55
Johnson Ranch	29 2	103 22	-	T	-	.16	-	-	-	.16	.16	-	-	-	T	-	.20	.20	.04	2.30	-	-	-	2.30
Langtry	29 48	101 33	-	7.00	2.00	-	-	-	-	9.00	9.00	-	-	-	-	-	-	-	-	-	.52	-	-	.52
Laredo	27 30	99 30	T	-	2.16	-	-	-	.05	2.16	2.21	-	3.33	-	-	1.06	.05	4.44	.26	.24	T	T	-	.24
Mercedes	26 9	97 54	-	-	T	-	.33	.17	T	-	.50	.91	.16	-	.01	.42	.45	1.95	2.66	.02	.04	1.83	.03	1.92
Mission	26 13	98 21	-	-	-	-	-	.36	.17	-	.53	.72	.05	T	-	.20	T	.97	1.99	.05	.05	-	.23	.33
Presidio	29 36	104 27	-	-	-	.15	-	-	-	.15	.15	.05	.07	-	.58	-	-	.70	1.72	.04	-	-	-	.04
Rio Grande	26 22	98 49	-	-	-	-	-	1.96	.33	-	2.29	-	.53	-	-	.73	.41	1.67	.53	T	-	T	-	-
San Benito	26 8	97 38	-	-	-	-	-	.08	.54	-	.62	.95	.39	T	-	1.00	.05	2.39	1.96	1.42	.37	-	3.64	5.43
Substation No. 14	30 26	100 41	-	.61	-	-	.08	-	-	.61	.69	-	.60	2.98	2.13	2.08	.03	7.82	.11	.27	.20	.92	-	1.39
Coastal Basins:																								
Alice	27 45	98 4	.08	-	.56	-	-	.22	-	.64	.86	.51	.53	-	-	.53	.13	1.70	.62	.26	-	-	.69	.95
Anahuac	29 46	94 41	-	-	-	.71	2.12	.68	-	.71	3.51	.53	.20	-	-	-	-	.73	.46	2.00	.05	.03	.63	2.71
Angleton	29 10	95 25	-	.15	.04	.88	4.65	1.18	.09	1.07	6.99	.77	.69	.68	1.60	.07	-	3.81	1.24	.58	.03	.12	.08	.81

Table 4.--Rainfall, in inches, for periods shown, 1936--Continued

Station	Lat.	Long.	June 28	June 29	June 30	July 1	July 2	July 3	July 4	June 28 to July 1	June 28 to July 4	September 13	14	15	16	17	18	13-18	19-24	25	26	27	28	25-28
U.S. Weather Bureau--Continued																								
Coastal Basins--Continued:																								
Austwell	28°22'	96°51'	-	0.52	-	2.50	2.09	0.18	-	3.02	5.29	0.95	0.10	0.25	0.53	0.53	0.28	2.64	0.75	0.18	-	1.30	0.05	1.53
Beeville	28 24	97 44	-	.22	0.87	.09	.25	-	0.48	1.18	1.91	.92	.58	-	.34	.27	.01	2.12	.84	.10	0.02	.36	-	.48
Bishop	27 35	97 48	-	-	.56	-	.05	.85	.03	.56	1.49	1.84	.05	-	2.36	.38	-	4.63	.58	.02	-	.12	-	.14
Corpus Christi	27 47	97 24	0.01	.24	.24	.28	T	.91	.01	.77	1.69	1.39	.03	.05	T	.57	.23	2.27	.47	.18	.58	.23	T	.99
Danevang	29 3	96 14	.05	T	.17	2.74	1.13	.05	.09	2.96	4.23	1.34	.10	.30	.50	T	-	2.24	.66	.67	.05	.96	.10	1.78
Falfurrias	27 13	98 9	-	-	1.24	-	.04	T	-	1.24	1.28	.80	.59	T	-	.29	.62	2.30	.53	.33	.14	.02	.75	1.24
Galveston	29 18	94 48	-	T	T	.28	2.45	.18	.04	.28	2.95	.89	.72	T	.43	T	.20	2.24	.03	.77	T	.42	.21	1.40
Goose Creek	29 45	94 59	-	.15	T	1.22	2.27	.05	-	1.37	3.69	1.08	.21	1.10	.02	-	-	2.41	.23	1.38	.03	.42	-	1.83
Hebbronville	27 18	98 40	-	-	1.01	-	-	-	.16	1.01	1.17	6.39	-	-	-	.82	-	7.21	.36	-	-	-	-	-
La Parra	27 12	97 42	-	-	1.10	.35	.30	1.98	T	1.46	3.73	1.60	.19	.50	T	.70	T	2.99	1.45	.20	-	.04	.23	.47
Matagorda	28 42	95 58	-	-	T	1.18	.70	1.12	-	1.18	3.00	1.50	T	.44	.48	-	T	2.42	-	1.65	T	T	.60	2.25
Port Arthur	29 52	93 56	T	-	T	.16	1.16	.17	.31	.16	1.80	1.39	2.03	.06	.15	-	-	3.63	.74	1.23	.03	.02	.62	1.90
Port Isabel	26 4	97 13	-	-	-	-	.07	-	-	-	.07	4.17	.50	.18	.01	-	-	4.86	.59	-	.59	-	.56	1.15
Raymondville	26 30	97 47	.42	-	-	-	-	.10	.42	.42	.94	1.86	.20	-	-	.24	.31	2.61	1.50	.53	.04	-	.40	.97
Sinton	28 2	97 31	-	.04	.05	.61	T	-	.68	.70	1.38	4.80	.09	-	-	.85	.32	6.06	.85	.23	.05	.21	-	.49
Sugarland	29 36	95 40	-	.01	.16	.88	2.09	.19	.04	1.05	3.37	1.04	.10	.06	.50	.03	.05	1.78	.41	.10	.12	.18	-	.40
Woodsboro	28 13	97 20	-	.16	.30	.60	.90	.46	.55	1.06	2.97	3.08	-	.12	-	.52	-	3.72	.98	.16	2.34	1.01	-	3.51
Supplementary																								
Red River Basin:																								
Daingerfield	33 2	94 42										-	-	-	-	.09	-	.09	.33	-	-	.91	-	.91
Trinity River Basin:																								
Dawson	31 54	96 42																		.25	4.16	1.20	-	5.61
Ennis	32 19	96 38																		-	2.20	12.50	-	14.70
Grandview	32 16	97 11										-	-	-	-	-	-	-	.15	1.75	4.20	4.00	-	9.95
Italy	32 11	96 53																		.70	6.25	3.60	-	10.55
Kemp	32 27	96 12																		-	-	10.0	-	10.0
Terrell	32 44	96 16																		-	-	11.0	-	11.0
Brasos River Basin:																								
Bertram	30 44	98 3										-	-	6.5	-	1.0	-	7.5	-	-	-	5.0	-	5.0
Itasca	32 11	97 9										-	-	-	-	-	-	-	-	-	2.03	7.20	.90	10.13
Leander	30 34	97 51										.55	3.76	4.49	.42	.30	-	9.52	-	1.03	.82	1.0	-	2.85
Levita	31 33	97 53										-	-	-	-	-	-	-	-	-	-	5.6	-	5.6
Colorado River Basin:																								
Arden (9 mi. N.)	31 29	100 44										-	-	2.0	-	5.0	-	7.0	1.0	-	2.5	-	-	2.5
Barnhart	31 8	101 10										-	-	-	4.7	-	-	4.7	-	2.2	4.0	-	-	6.2

Bar-S Ranch	31 25	101 15										-	-	-	-	-	-	-	5.0	-	2.2	8.5	-	10.7
Big Lake	31 10	101 27										-	-	-	-	-	.5	.5	1.7	4.0	6.0	-	-	10.0
Blackwell	32 5	100 23										-	1.9	.5	4.9	1.2	-	8.5	-	.1	4.0	.4	-	4.5
Brady	31 8	99 20										-	.1	.7	4.3	.2	1.0	6.3	-	.7	.1	3.8	-	4.6
Buchanan Dam	30 45	98 22										-	1.5	5.0	.1	.5	-	7.1	-	-	.1	-	6.0	6.1
Buda	30 5	97 51	-	-	*	5.69	-	-	-	5.69	5.69													
Carlsbad	31 36	100 38										-	1.0	3.2	3.0	6.0	.1	13.3	1.1	.3	1.7	.2	-	2.2
Christoval	31 13	100 30										-	-	-	18.0	6.0	-	24.0	.2	-	-	5.0	-	5.0
Colorado	32 24	100 51										-	-	-	-	-	4.7	4.7	-	2.4	-	1.8	-	4.2
Cross Cut	32 2	99 8										-	-	1.7	4.0	2.8	-	8.5	-	-	1.7	2.3	-	4.0
Eldorado	30 52	100 36										-	-	-	14.2	-	-	14.2	1.4	2.4	1.9	-	-	4.3
Eola	31 23	100 5										-	-	8.0	1.0	5.0	2.5	16.5	-	-	3.9	2.1	-	6.0
Fort McKavett	30 50	100 06										-	-	4.0	3.5	2.5	-	10.0	-	1.0	1.0	-	-	2.0
Fredericksburg	30 15	98 53										1.6	-	5.5	1.7	.1	-	8.9	.4	.8	.4	2.6	-	3.8
Harper	30 17	99 15										-	2.0	2.5	3.2	1.0	-	8.7	.7	-	6.0	-	-	6.0
Lometa	31 13	98 23										-	0.60	2.1	2.0	0.9	-	5.6	0.2	0.5	6.0	-	-	6.5
Mason	30 45	99 14										-	.7	3.0	3.3	.3	-	7.3	1.3	.2	-	4.4	-	4.6
May (6 mi. N.W.)	31 59	98 55										-	.2	.5	4.3	1.0	-	6.0	.2	-	.7	2.2	-	2.9
Mertzon	31 13	100 49										-	-	.3	-	1.1	.2	1.6	.5	-	2.2	-	-	2.2
Novice	31 59	99 37										-	-	-	6.2	-	-	6.2	-	-	-	4.2	-	4.2
Richland Springs	31 17	98 57										-	1.5	-	4.5	1.0	1.0	8.0	-	5.25	-	-	-	5.25
Rock Springs (30 mi. E.)	30 6	99 50										-	1.1	3.6	3.3	.4	-	8.4	-	-	-	1.8	-	1.8
San Angelo (11 mi. N.W.) (a)	31 34	100 34										-	-	5.2	-	8.5	2.0	15.7	-	1.5	1.9	.3	-	3.7
San Saba	31 12	98 43										-	-	-	-	4.6	-	4.6	-	1.0	.6	1.9	-	3.5
Sonora (22 mi. S.E.)	30 20	100 25										-	-	4.7	4.0	2.5	-	11.2	-	-	.5	.5	-	1.0
Stanton	32 7	101 48										-	-	-	-	-	2.7	2.7	5.1	-	1.6	.2	-	1.8
Stiles	31 25	101 33										-	-	-	1.2	2.2	.8	4.2	4.2	4.2	1.5	-	-	5.7
Stonewall	30 13	98 39										-					13.0	13.0	-	-	.5	5.0	-	5.5
Streater	30 43	99 24										-	.6	6.5	.8	.8	-	8.7	.2	2.7	-	3.1	-	5.8
Talpa	31 46	99 42										.4	-	2.0	-	4.5	.5	7.4	-	-	2.7	.9	-	3.6
Texon	31 11	101 41										-	-	-	-	.3	.6	.9	2.0	.6	5.0	.4	-	6.0
Veribest (a)	31 29	100 17										-	-	10.1	1.0	5.7	-	16.8	.1	-	2.5	.6	-	3.1
Wall (a)	31 22	100 19										-	-	7.5	.8	4.1	2.4	14.8	-	.2	2.6	1.2	-	4.0
Wall (4 mi. E.) (a)	31 20	100 15										-	-	9.0	1.5	5.0	-	15.5	-	3.2	1.8	-	-	5.0
Guadalupe River Basin:																								
Bandera	29 43	99 3										-	3.3	5.5	1.0	.2	-	10.0	-	.9	-	3.7	-	4.6
Comfort	29 59	98 54										1.2	10.4	.4	1.0	-	-	13.0	1.3	.5	3.0	-	-	3.5
Fischer Store	29 59	98 14										.50	1.38	1.46	.44	.45	-	4.23	.15	.90	.33	1.04	-	2.27
Gonzales (near) (b)	29 30	97 34	-	.32	2.62	10.60	1.44	.71	.05	13.54	15.74													
Gonzales (near) (b)	29 32	97 42	.15	.27	6.00	7.30	.47	.15	.45	13.72	14.79													

* Precipitation included in next following figure.
a Record furnished by U. S. Soil Conservation Service.
b Record furnished by Fargo Engineering Company.

Table 4.—Rainfall, in inches, for periods shown, 1936—Continued

Station	Lat.	Long.	June			July				June 28 to		September												
			28	29	30	1	2	3	4	July 1	July 4	13	14	15	16	17	18	13-18	19-24	25	26	27	28	25-28
Supplementary-Continued																								
Guadalupe River Basin-Contd.																								
Kyle	29°59'	97°52'	-	0.74	13.27	-	-	*	0.12	14.01	14.13	-	-	-	-	1.23	-	1.23	-	-	-	1.12	-	1.12
Lima	29 50	99 22										-	2.32	5.42	2.60	-	1.10	11.44	-	-	-	5.70	-	5.70
Lockhart	29 53	97 41	-	-	8.45	-	0.45	0.35	.22	8.45	9.47													
Medina Dam	29 31	98 56										-	2.48	-	-	-	-	2.48	0.27	1.05	0.66	1.55	-	3.26
Medina Diversion Dam	29 29	98 50										-	1.75	-	-	-	-	1.75	-	-	-	-	2.50	2.50
McQueeney (b)	29 34	98 2	T	.14	2.67	0.38	T	1.27	.10	3.19	4.56													
Nueces River Basin:																								
D'Hanis	29 19	99 16										-	-	1.9	-	.6	-	2.5	1.4	1.2	2.1	-	-	3.3
D'Hanis (10 mi. N.)	29 24	99 16										-	1.5	.1	.1	1.5	-	3.2	.8	.7	-	1.9	-	2.6
Kerrville (near)	29 50	99 33										-	-	-	-	9.0	-	9.0	-	-	-	-	-	-
Rock Springs	30 1	100 12										-	2.0	1.3	2.8	-	-	6.1	-	-	1.0	-	-	1.0
Tarpley	29 38	99 16										-	.9	3.0	.7	-	.2	4.8	.9	.7	-	3.2	-	3.9
Rio Grande Basin:																								
Crane (near)	31 19	102 22										-	-	-	.2	.3	.2	.7	1.2	.5	.1	-	-	.6
Ozona	30 43	101 13										-	-	.55	-	.18	-	.73	-	2.3	-	.4	-	2.7
Rankin	31 13	101 57										-	-	-	-	1.0	2.2	3.2	1.2	-	1.6	-	-	1.6
Sonora	30 34	100 38										-	.4	5.3	2.4	1.8	-	9.9	1.0	.2	.7	.9	-	1.8
Miscellaneous																								
Trinity River Basin:																								
Barry	32 6	96 38																		-	-	6.5	-	6.5
Blooming Grove	32 6	96 43																						8.0
Frost	32 5	96 48																						12.0
Irene	31 59	96 52																		-				9.0
Jiba	32 30	96 16																		-	-	11.0	-	11.0
Mabank	32 23	96 7																		-				5.0
Maypearl	32 18	97 1																	-	-				8.0
Mertens	32 3	96 53																						14.0
Milford	32 8	96 57																		-	-	10.8	-	10.8
Wills Point	32 42	96 1																		-	-	12.0	-	12.0
Brazos River Basin:																								
Ames	31 34	97 48																	-	-				10.75
Aquilla	31 50	97 13																	-	-				10.0
Arnett	31 23	97 50																	-	-				6.0
Blum	32 9	97 24																	-	-	-	5.75	-	5.75
China Springs	31 39	97 18																	-	-	3.0	6.75	-	9.75
Clifton (1 mi. N.)	31 47	97 34																	-	-	-	10.1	-	10.1

Evant	31 28	98 10																	-					6.0
Gholson	31 42	97 11																	-	-	1.1	6.9	-	8.0
Killeen	31 7	97 44										-	-	-	-	-	-	-	-	-	4.0	1.75	-	5.75
Lampasas (4 mi. W.)	31 4	98 16										-	-	-	-	-	-	-	-	-	-	7.5	-	7.5
Lampasas (10 mi. N.)	31 12	98 12																-	-	-	-	6.25	-	6.25
Mosheim	31 37	97 35																	-	-	-	11.0	-	11.0
Pancake	31 38	97 48																	-	-	-	6.0	-	6.0
Turnersville	31 37	97 43																	-	-	-	12.0	-	12.0
West	31 48	97 5																	-					9.0
White Hall	31 34	97 48																	-					10.0
Whitney	31 55	97 19																	-					11.0
Whitney (4 mi. E.)	31 56	97 16																	-					11.0
Colorado River Basin:																								
Barnhart (near)	31 17	101 10										-	-	-	-	2.0	-	2.0	5.5	-	4.5	-	-	4.5
Big Springs (16 mi. S.E.)	32 6	101 22										-	-	-	-	-	-	-	10.2	2.5	1.5	-	-	4.0
Bradshaw (c)	32 6	99 54										-						*	10.0					
Bronte	31 53	100 17										-	-					18.5	-	3.25	-	-	-	3.25
Broome	31 45	100 50										-	-					30.0	-					11.0
Burnet	30 45	98 15															-	10.6	-				-	10.0
Carlsbad (2½ mi. E.)	31 36	100 36																28.0	-					2.5
Carlsbad (3½ mi. N.E.)	31 38	100 36																30.0	-					5.0
Cherokee	30 59	98 42										-						6.5	-					6.5
Cistern	29 49	97 13			*	6.0				6.0	14.0													
Cleo	30 35	99 51																8.0						
Creedmore	30 5	97 44			*	4.5				4.5	4.5													
Fort McKavett (near)	30 40	100 7										-	1.0	13.0	8.0	1.75	-	23.75	-	-	-	-	-	-
Fort McKavett (near)	30 40	100 5																20.0						
Fort McKavett (near)	30 37	100 7																30.0						
Hyman	32 9	101 6																2.0	*					8.0
Maryneal	32 14	100 30																7.0	4.0					4.0
Mendoza	30 0	97 41			*	6.5				6.5	6.5													
Miles	31 35	100 11										-	-	9.0	8.0	2.5	.5	20.0	-					2.5
Mountain Home (12 mi. W.)	30 10	99 30										-	-					7.0	-					5.2
Nix	31 6	98 22										-						7.6	-					5.5
Robert Lee	31 54	100 29										-	-					15.0	-	-	-			2.5
Robert Lee (5 mi. E.) (c)	31 54	100 24																*	*			-	-	18.3
Robert Lee (15 mi. N.W.)	32 2	100 42										-						17.0	-					
Rockwood	31 30	99 22										-	-					6.1	-	-				5.0
Roosevelt	30 30	100 5										-						16.0	-	-				1.5
Roosevelt (near)	30 33	100 7										-						30.0						

* Precipitation included in next following figure.
b Record furnished by Fargo Engineering Company.
c Record not used.

Table 4.—Rainfall, in inches, for periods shown, 1936—Continued

Station	Lat.	Long.	June			July				June 28 to		September												
			28	29	30	1	2	3	4	July 1	July 4	13	14	15	16	17	18	13-18	19-24	25	26	27	28	25-28
<u>Miscellaneous</u>—Continued																								
Colorado River Basin—Contd.:																								
Roosevelt (near)	30°32'	100° 3'																21.5						
Roosevelt (near)	30 32	100 1																20.0						
Rowena	31 39	100 4										-	-	4.0	-	8.0	-	12.0	-	-				
San Angelo (near)	31 36	100 33										-						26.0	-					
San Angelo (5 mi. E. 4 mi. N.)	31 32	100 20										-						27.5	-	-				2.7
San Angelo (10 mi. N.)	31 37	100 25										-						28.0	-	-	2.0	-	-	2.0
San Angelo (11 mi. S.) (c)	31 18	100 30										-	-	-				*	*			-	-	30.0
San Angelo (12 mi. N.E.) (c)	31 34	100 16										-						*	*				-	27.0
San Angelo (17 mi. S.E.)	31 15	100 18										-	7.6	5.0	-	3.0	-	15.6	-	4.0	-	-	-	4.0
Santa Anna	31 44	99 19										-	-					8.5	-	-				3.0
Sonora (25 mi. E.)	30 44	100 18										-						14.0	2.0					2.0
Sterling City (18 mi. N.W.)	31 59	101 15										-						4.0	*					7.5
Telegraph	30 21	99 54										-	-	4.0	-	-	-	4.0	-					
Tennyson	31 44	100 18										-	-	7.0	-	12.0	3.0	22.0	-	-				2.0
Trickham	31 36	99 14										-						5.0	-	-				5.0
Water Valley	31 41	100 42										-	4.5	1.5	-	20.4	-	26.4	-	3.5	-	-	-	3.5
Winchell	31 29	99 10										-	-					7.0	-	-				6.0
Winters	31 58	99 58										-	-					11.2	-	-				1.7
Zephyr	31 40	98 48										-						9.0	-					5.7
Lavaca River Basin:																								
Shiner	29 27	97 10	-	-	2.75		7.75	1.50		2.75	12.0													
Guadalupe River Basin:																								
Bebe	29 23	97 38			*	21				21	21													
Cheapside	29 18	97 23			*	13				13	13													
Dewitt	29 20	97 42			*	21				21	21													
Harwood	29 39	97 31			*	18				18	18													
Leesville	29 24	97 45			*	20				20	20													
Meyersville	28 57	97 21			*	14				14	14													
Mountain City	30 2	97 53			15.5					15.5	15.5													
Mountain Home	30 9	99 18										-	-					11.0	-					
Smiley	29 14	97 38		1.0	*	4.37				5.37	7													
Steen Gin	29 12	97 17			*	21				21	21													
Waelder	29 42	97 19			*	3.5				3	9													
Weser	28 52	97 19			*	8				8	8													
Wrightsboro	29 21	97 35			*	15				15	20													

* Precipitation included in next following figure.

c Record not used.

gages. Many of these gages are of standard United States Weather Bureau type or are vessels that are suitable for reasonably accurate measurement of the rainfall. Many persons make measurements in cans, tubs, troughs, washpots, stock water tanks, or other vessels; these measurements are perhaps not highly accurate, but they may be used with confidence when several such measurements in the same locality are found to agree satisfactorily.

Table 4 gives the available records of rainfall for the storm periods in June and July and in September 1936 and includes all United States Weather Bureau records for the State as well as miscellaneous records obtained in the flood areas.

The amounts of the daily rainfall are given as published by the United States Weather Bureau in "Climatological data, Texas section", but do not always represent the rainfall that occurred from midnight to midnight of the day indicated. Observations at many stations are made late in the afternoon, near sunset, and the precipitation for the 24 hours ending at the time of such observation is usually recorded under the date of observation. At about half the stations the precipitation for the preceding 24 hours is measured in the morning and may be recorded under the date of observation or the previous day. In the tables "T" indicates precipitation less than 0.01 inch, "-" indicates zero precipitation, and a blank indicates no record.

The location of rainfall stations over the State of Texas is shown in figure 6, in which the stations of the United States Weather Bureau are shown by a distinctive symbol.

THE JUNE-JULY FLOOD

General discussion

Flood-producing rains, amounting to as much as 21 inches in some places, fell from June 28 to July 4 over parts of the Rio Grande, Nueces, Guadalupe, Colorado, and Neches River Basins. Heavy rain, amounting to 17 inches at Eagle Pass, over a small area in the Rio Grande Basin raised small streams out of their banks. The flood on the Rio Grande itself was not serious, and the most damage was suffered in Piedras Negras, Mexico, opposite Eagle Pass. Floods in the Nueces and Colorado Rivers were of short duration and did not approach the maximum known stages. A rainfall of over 10 inches at Rockland, in the middle of the Neches River Basin, caused a moderate rise in the lower course of that stream. The heaviest recorded precipitation occurred over the central part of the Guadalupe River Basin. During the night of June 30-July 1 a rain of cloudburst intensity fell over this region, causing the loss of 26 lives and an estimated property damage of over $2,000,000. The greatest floods known occurred on the lower reaches of the Guadalupe River and several of its tributaries.

The Austin American for Thursday, July 2, carried the following account of the flood:

Thursday, 24 hours after spouts of water poured from the skies, the full story of the disaster was coming from the isolated regions. Soon after the cloudbursts dry stream beds contained torrents that swept everything before them. Hundreds of thousands of acres of farm lands were inundated, as were several towns. Property damage was estimated in the millions.

The cloudbursts struck in Gonzales and adjoining counties in South Texas. The flood waters were receding Thursday as rapidly as they rose, revealing a more grave picture than had been anticipated. The flood ripped through the settlement of Kyle, between Austin and San Antonio, where three bodies were found Thursday. Business buildings and streets in Gonzales were at one time under 3 to 5 feet of water. A number of frame houses were washed down the river.

The flood wrecked a train when it washed out a bridge north of Kyle. Two were known dead there.

The blinding cloudbursts descended in dim early daylight Wednesday. Scores of Mexicans at Kyle were trapped in their homes.

At Uhland 9 inches of rain fell within minutes. A 10-inch cloudburst at Gonzales swelled the tiny Guadalupe River into a roaring flood.

The water Thursday was sliding out of the dry arroyos from 300,000 acres of farm land in Guadalupe valley. The flood wiped out corn and cotton crops.

The San Antonio Express of Monday, July 6, contained the following dispatch:

Victoria, Tex., July 5.- Ravaging flood waters of the Guadalupe River flowed slowly Gulfward today, taking a heavy toll of crops, livestock, highways, and railroads.

Waters which flooded the Guadalupe and other South Texas rivers had taken a toll of 26 lives in the upper reaches, where sudden summer rains sent the streams bounding over their banks without warning.

The following description of the Guadalupe River Basin is taken from a report on the Guadalupe River by the Corps of Engineers, U. S. Army, (74th Cong., 1st sess., H. Doc. 238, pp. 11-12):

The Guadalupe River drains a narrow valley about 320 miles long, containing approximately 6,000 square miles. It rises in Kerr County and flows eastward about 150 miles over the Edwards Plateau, thence southeastward across the Coastal Plain, 275 miles, into San Antonio Bay, an estuary of the Gulf of Mexico. The total fall of the river is approximately 1,630 feet. From the source to New Braunfels the slope is 7.0 feet per mile for the first 150 miles, 3.25 feet per mile for the next 108 miles to Gonzales, and an average of 1.4 feet per mile for the remaining 167 miles to tidewater. Tidal effect extends 25 miles upstream from the mouth. The river varies greatly in width on the plateau, flowing between high banks and canyon walls. Between New Braunfels (mile 275) and Victoria (mile 52) the width increases from 150 to 200 feet, the average height of banks decreasing from 40 to 20 feet.

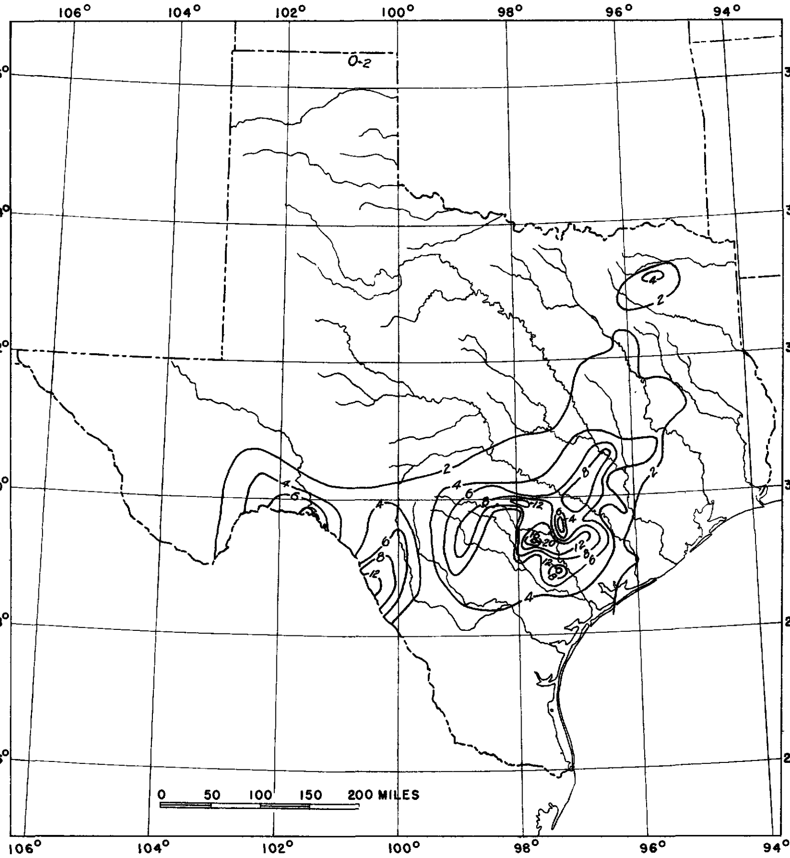


Figure 7.--Isohyetal map of Texas showing total rainfall, in inches, observed June 28 to July 1, 1936.

The watershed is divided into two topographic provinces by the Balcones escarpment, a series of limestone bluffs bearing northeast-southwest across Medina, Bexar, Comal, and Hays Counties, through which the Guadalupe and Blanco Rivers have cut channels 200 to 300 feet deep. The plateau to the northwest is characterized by bold relief, the high elevation covered by dwarf timber, with grazing land on the lower slopes. Southeast from the base of the escarpment, the Coastal Plain is featured by low hills and broad flat valleys, giving place to prairie along the Gulf coast. About 40 percent of the Coastal Plain is cleared and under cultivation.

The greatest and most destructive floods in the Guadalupe River Basin in 1936 occurred on Plum and Sandies Creeks. Plum Creek is formed from several small tributaries draining the eastern parts of Caldwell and Hays Counties and follows a winding course for about 40 miles to its junction with the San Marcos River below Luling. Sandies Creek, with a drainage area of 720 square miles, has its source in numerous small streams on the southern and western uplands of Gonzales County and flows

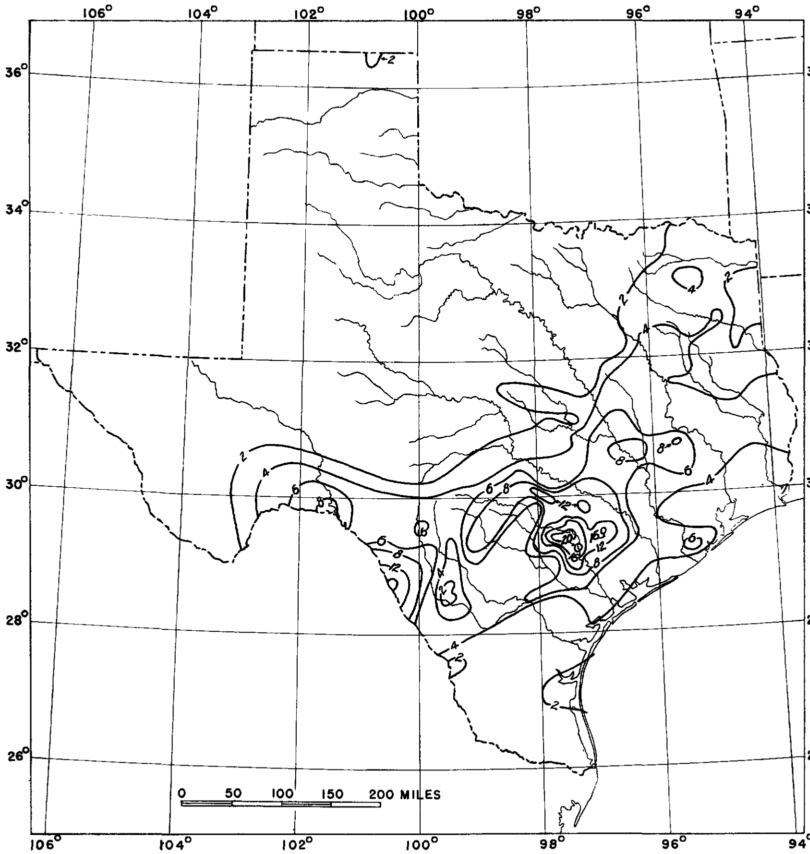


Figure 8.--Isohyetal map of Texas showing total rainfall, in inches, observed June 28 to July 4, 1936.

southeastward in a meandering course about 80 miles to join the Guadalupe River above the town of Cuero. It is interesting to note that the floods on both Plum and Sandies Creeks were caused by rainfall on the area below the Balcones escarpment.

The San Antonio River Basin lies south and west of and adjacent to the Guadalupe River Basin and is similar in topography, climate, and land character and use. The San Antonio River enters the Guadalupe River a few miles above its mouth and may be considered a tributary, although its basin is practically independent. The storm above the gaging station on the San Antonio River near Falls City caused the greatest peak discharge since the establishment of the station in 1925, although higher stages have been previously caused by backwater.

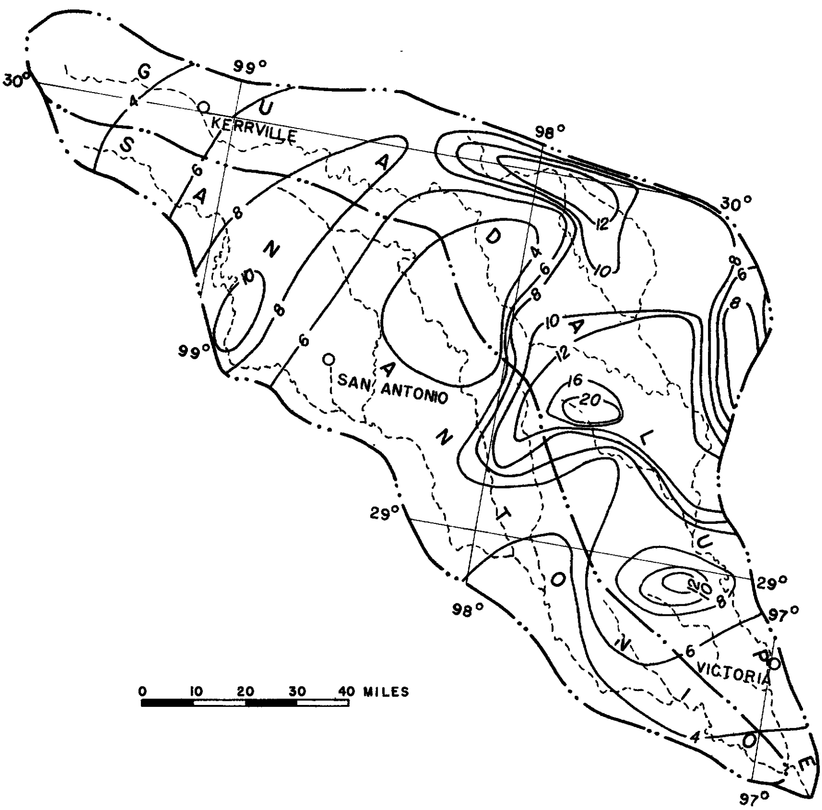


Figure 9.--Isohyetal map of the Guadalupe and San Antonio River Basins, showing total rainfall, in inches, observed June 28 to July 1, 1936.

Records of rainfall in addition to those of the United States Weather Bureau were obtained at 22 miscellaneous stations. All records are given in table 4.

The rain causing the floods in the Guadalupe River Basin came before July 1, but the heavy rain in east Texas, principally over the Neches River Basin, fell from July 2 to 4. The distribution of the rains over

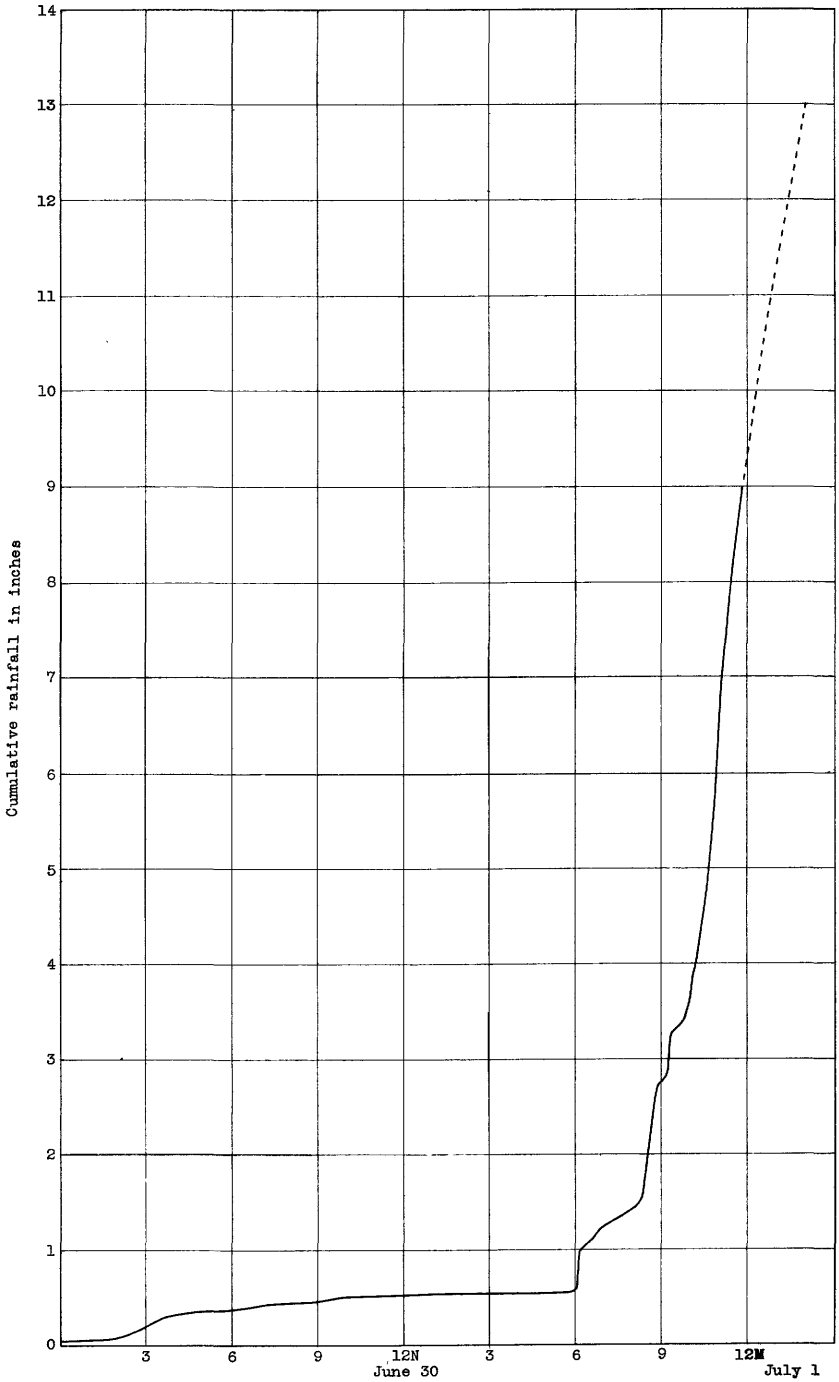


Figure 10.--Graph of cumulative rainfall, in inches, at Uhland, June 30 to July 1, 1936.

the State is shown by the isohyetal maps, figures 7 and 8, for the periods June 28 to July 1 and June 28 to July 4.

For the period June 28 to July 1 most of the rain fell in a few hours during the night of June 30-July 1 and was the cause of the extremely high river stages that occurred. Figure 9 is an isohyetal map of the Guadalupe and San Antonio River Basins showing the excessive rainfall for this period. A recording rain gage, operated by the Soil Conservation Service at Uhland, about 8 miles northeast of San Marcos, gives a record of the time and intensity of the rain. As the capacity of this gage is only 9 inches, the record above 9 inches is based on the measurement of the amount in the overflow can and an estimate by an employee of the Soil Conservation Service of the time the rain ceased. A graph of the accumulative rainfall as measured at this gage is shown in figure 10.

Stages and discharges

The July flood exceeded previously known stages only in the Guadalupe River Basin. Besides measurements made at the regular gaging stations, slope-area determinations of discharge were made at Bunton Branch near Kyle, O'Neil Creek near Leesville, Sandies Creek near Dewitt, and Sandies Creek near Westhoff. One storm centered in Bunton Branch, and the flood passed successively down Bunton Branch, Plum Creek, and the San Marcos River to the Guadalupe River. Another flood originated largely in upper Sandies Creek and passed down O'Neil Creek and Sandies Creek to the Guadalupe River. An unusually high flood, for that stream, passed down the San Antonio River. The places at which determinations of maximum discharges were made are shown in figure 32.

The peak discharge and the run-off for the period of the flood were computed at all gaging stations. At certain other places only the peak discharge was determined.

On the following pages there are presented stage and discharge records of the flood at the river-measurement stations in the areas that experienced unusual floods. These records consist essentially of a station description, a table of the mean daily discharge and the total run-off for the flood period, and a table of discharges at indicated times during the flood in sufficient detail for reasonably reliable delineation of the hydrograph. The last-mentioned table may be used to determine the rating curve for the station provided account is taken of the limits to which gage-heights were applied, as given in the "Gage-height record" paragraph of the station description, and of periods when the shifting-control method of determining discharge was used.

For some stream-measurement stations adjacent to the flood area there are also given records of the flood which include a station description and a table of daily discharges and total run-off for the flood period. These data are also given for stations on the Neches River near Rockland and at Evadale, to show the run-off caused by the excessive precipitation in the Neches River Basin.

In the "Drainage area" paragraph of the station description for some stations, the probable noncontributing area is noted. This is the area that lies above the Cap Rock and is believed never to contribute any surface run-off to the lower reaches of the streams.

The paragraph "Maxima" in the station description is divided into three subparagraphs. The first subparagraph, headed "1936", gives the maximum discharge and gage height occurring during the June-July flood, and for some stations also the maximum for that year when it did not occur in June or July. The second subparagraph, headed by the inclusive dates of systematic records, gives the maximum gage height and the corresponding discharge, when determined, which have occurred during the period of systematic records prior to September 30, 1935. The third subparagraph, headed by the inclusive dates, gives the maximum stage and discharge, if determined, during the period prior to the beginning of systematic records. The information in this third subparagraph is based mostly on local information.

Table 5.--Peak discharge at various points in the Guadalupe River Basin, June and July 1936

Stream	Lat.		Long.		Drainage area (sq. mi.)	Maximum discharge		
						Time	Sec.-ft.	Sec.-ft. per sq. mi.
Bunton Branch near Kyle	30°	1'	97°	51'	4.1	June 30	13,800	3,370
O'Neil Creek near Leesville	29	23	97	43	30	July 1, 12:30am	30,000	1,000
Sandies Cresk near Dewitt	29	20	97	40	95	July 1	54,300	572
Sandies Creek near Westhoff	29	12	97	26	493	July 2	92,700	188

The maximum discharges at all points of determination are summarized in table 5. This table gives the drainage area and discharge per square mile for each item. The drainage areas were measured from such topographic maps as were available and from airplane pictures, soil maps, and county road maps. The relatively small drainage area of Bunton Branch near Kyle was determined by a transit survey.

Figure 11 shows hydrographs of discharge at river-measurement stations on Plum Creek near Luling, San Marcos River at Ottine, and Guadalupe River at Victoria. As the crest of the flood progressed downstream it passed these stations in the order given.

3934 O—37——4

Guadalupe River at Victoria, Tex.

Location.- Lat. 28°47', long. 97°1', at Victoria-Goliad highway bridge in Victoria, Victoria County, and 1,300 feet above Galveston, Harrisburg & San Antonio Railway bridge.
Drainage area.- 5,676 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths below 4.0 feet and tenths above.
Stage-discharge relation.- Defined by current-meter measurements.
Maxima.- 1936: Discharge, 179,000 second-feet 4 p.m. July 3 (gage height, 31.22 feet).
1904-35: Discharge, 79,000 second-feet June 1, 1929 (gage height, 29.9 feet, present datum).
Remarks.- Low flow partly regulated by power plants upstream.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
June			2	33,600	66,640	7	30,000	59,500	12	3,960	7,850
29	1,220	2,420	3	129,000	255,900	8	21,100	41,850	13	3,550	7,040
30	4,230	8,390	4	122,000	242,000	9	13,300	26,380	14	3,190	6,330
July			5	75,200	149,200	10	6,220	12,340	15	2,940	5,830
1	13,600	26,980	6	44,400	88,070	11	4,730	9,380	16	2,860	5,670
									17	2,580	5,120
Run-off, in acre-feet, for period June 29 to July 17											1,027,000

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	June 29			July 2		6pm	29.62	59,000	8am	17.88	6,410
1am	5.58	1,160	2am	29.06	25,600	12M	29.45	53,500	12N	17.37	6,110
3	5.50	1,140	6	29.06	29,100		July 6		4pm	16.93	5,840
5	5.50	1,140	10	28.97	31,000	8am	29.26	47,500	8	16.52	5,620
2pm	5.95	1,270	2pm	28.95	35,000	4pm	29.02	40,000	12M	16.13	5,400
6	5.96	1,270	6	28.91	38,000	12M	28.82	36,000		July 11	
12M	5.89	1,240	9	28.99	40,000		July 7		8am	15.32	4,900
	June 30		11	29.08	43,000	8am	28.60	32,000	4pm	14.56	4,550
5am	5.85	1,220		July 3		4pm	28.38	28,200	12M	13.92	4,200
6	6.11	1,300	1am	29.26	47,500	12M	28.19	24,800		July 12	
8	10.30	2,740	2	29.37	50,500		July 8		8am	13.56	4,000
12N	16.43	5,480	4	29.66	62,000	8am	28.04	22,700	4pm	13.38	3,910
2pm	17.05	5,800	8	30.13	96,500	12N	27.92	20,800	12M	13.17	3,820
4	17.35	6,020	12N	30.96	159,000	4pm	27.81	19,800		July 13	
8	18.98	6,940	1pm	31.10	171,000	6	27.75	19,400	8am	12.86	3,640
12M	20.82	8,230	2	31.18	179,000	8	27.66	19,000	4pm	12.60	3,500
	July 1		4	31.22	179,000	10	27.58	18,400	12M	12.36	3,420
2am	21.22	8,550	6	31.18	179,000	12M	27.48	18,000		July 14	
4	21.30	8,630	7	31.16	175,000		July 9		8am	12.14	3,240
5	21.39	8,710	8	31.12	171,000	2am	27.37	17,700	8pm	11.77	3,100
8	22.64	9,770	10	31.04	167,000	4	27.23	17,100		July 15	
10	24.34	11,500	12M	30.94	159,000	8	26.79	16,000	6am	11.59	2,980
12N	25.76	13,200		July 4		10	26.42	15,000	3pm	11.46	2,900
1pm	26.66	14,400	4am	30.76	143,000	12N	25.80	13,200	8	11.46	2,900
2	27.18	15,200	8	30.64	135,000	2	25.12	12,600		July 16	
3	27.62	16,000	12N	30.47	119,000	4	24.30	11,500	1am	11.44	2,900
4	27.94	16,700	4pm	30.33	111,000	6	23.18	10,300	6	11.52	2,940
5	28.15	17,800	8	30.23	104,000	8	22.00	9,260	10	11.43	2,900
6	28.33	18,200	12M	30.16	96,500	10	20.92	8,400	6pm	11.14	2,780
8	28.63	20,600		July 5		12M	20.00	7,760		July 17	
10	28.84	23,000	6am	30.02	86,000		July 10		12N	10.56	2,540
12M	28.97	24,300	12N	29.84	75,500	4am	18.67	6,900	7pm	10.40	2,500
									12M	10.40	2,500

Note.- Discharge determined by shifting-control method July 2 (2am-2pm), 11-17.

San Marcos River at Ottine, Tex.

Location.- Lat. 29°36', long. 97°35', at highway bridge a quarter of a mile southwest of Ottine, Gonzales County. Zero of gage is 285.1 feet above mean sea level.
Drainage area.- 1,249 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to hundredths below 2.9 feet, half tenths between 2.9 and 4.4 feet, also 37.7 and 38.4 feet, tenths outside these limits.
Stage-discharge relation.- Defined by current-meter measurements below 12,000 second-feet; extended to peak discharge on basis of one slope-area measurement at 125,000 second-feet.
Maxima.- 1936: Discharge, 165,000 second-feet 1 p.m. July 1 (gage height, 42.05 feet), from rating curve extended above 12,000 second-feet by slope-area method.
1915-35: Discharge, 202,000 second-feet May. 29, 1929 (gage height, 43.32 feet), from rating curve extended above 12,000 second-feet by slope-area method.
Maximum stage known, 44.0 feet in December 1913 (discharge not determined).
Remarks.- Small diversions and power plants upstream affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
June			3	6,560	13,010	8	1,370	2,720	13	552	1,090
30	190	377	4	4,770	9,460	9	988	1,960	14	501	994
July			5	3,380	6,700	10	773	1,530	15	467	926
1	81,200	161,100	6	1,500	2,980	11	671	1,330			
2	21,200	42,050	7	1,140	2,260	12	603	1,200			
Run-off, in acre-feet, for period June 30 to July 15											249,700

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	June 30		2am	36.85	35,000	12N	20.58	4,360	12M	8.80	1,210
1am	2.60	172	3	36.50	32,300	1pm	20.50	4,320		July 8	
10pm	2.87	209	4	36.17	29,900	2	21.36	4,680	6am	9.25	1,290
11	3.75	348	6	35.48	25,500	3	21.82	4,850	6pm	9.95	1,450
12M	6.80	862	7	35.15	23,800	4	22.01	4,940	8	10.06	1,470
	July 1		10	34.22	19,200	5	21.89	4,900	10	9.98	1,450
1am	17.10	3,220	12N	33.51	16,800	8	21.50	4,720	12M	9.74	1,390
2	27.75	8,660	2pm	32.67	14,600	10	21.36	4,680		July 9	
3	30.26	11,100	4	31.86	13,100		July 5		6am	8.49	1,120
4	30.86	11,800	6	31.00	12,000	1am	21.35	4,680	12N	7.45	916
5	31.48	12,600	8	30.17	11,000	3	21.20	4,600	6pm	7.15	880
6	33.00	15,400	10	29.27	10,100	6	20.40	4,290	12M	6.90	826
7	35.56	26,100	12M	28.44	9,210	9	19.00	3,810		July 10	
8	37.50	43,900		July 3		12N	17.40	3,310	2am	6.89	790
9	39.90	105,000	2am	27.60	8,490	3pm	16.00	2,900	10	6.99	808
10	41.10	139,000	4	26.79	7,820	6	14.70	2,540	1pm	6.99	808
11	41.76	159,000	6	25.89	7,130	9	13.45	2,230	6	6.76	756
12N	42.03	165,000	8	25.00	6,520	12M	12.60	2,030		July 11	
1pm	42.05	165,000	10	24.11	5,980		July 6		12N	6.18	654
2	41.94	162,000	12N	23.30	5,550	4am	11.70	1,820		July 12	
3	41.69	156,000	2pm	22.90	5,350	8	10.80	1,620	5pm	5.73	586
4	41.30	145,000	4	23.34	5,550	12N	10.05	1,450	10	6.07	637
5	40.90	134,000	6	23.60	5,700	4pm	9.40	1,330		July 13	
6	40.40	119,000	8	23.70	5,760	8	8.85	1,210	12N	5.54	535
8	39.34	88,600	10	23.56	5,700	12M	8.55	1,170		July 14	
10	38.40	64,400	12M	23.16	5,500		July 7		12N	5.25	501
11	37.99	54,000		July 4		6am	8.30	1,120		July 15	
12M	37.59	45,600	3am	22.22	5,030	12N	8.05	1,060	11pm	4.99	450
	July 2		6	21.35	4,680	6pm	8.76	1,210			
1am	37.19	39,200	9	20.82	4,440	9	8.72	1,190			

Note.- Discharge determined by shifting-control method June 30, July 9-15.

Plum Creek near Luling, Tex.

Location.- Lat. 29°42', long. 97°37', at highway bridge 2 miles above Galveston, Harrisburg & San Antonio Railway bridge and 3 miles northeast of Luling, Caldwell County. Zero of gage is 326.5 feet above mean sea level.
Drainage area.- 356 square miles.
Gage-height record.- Water-stage recorder graph except for period 4 a.m. July 1 to 4 p.m. July 3, when it was determined from graph drawn from flood marks and staff-gage readings. Gage heights used to hundredths below 1.6 feet; half tenths from 1.6 to 2.8 feet and 15.8 to 19.5 feet; tenths outside these limits.
Stage discharge relation.- Defined by current-meter measurements below 5,200 second-feet; extended to peak discharge on basis of one additional current-meter measurement at 54,200 second-feet.
Maxima.- 1936: Discharge, 78,500 second-feet 7 a.m. July 1, 1936 (gage height, 25.7 feet, from flood marks), by extending rating curve above 54,200 second-feet.
1930-35: Discharge, 4,270 second-feet June 16, 1930; stage, 16.83 feet Jan. 5, 1932.
Highest known discharge and stage, that of July 1, 1936.
Remarks.- No diversions or regulation.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
June			2	5,980	11,860	7	92	182	12	35	69
29	13	26	3	2,180	4,320	8	627	1,240	13	31	61
30	48	95	4	1,790	3,550	9	167	331	14	28	56
July			5	733	1,450	10	96	190	15	27	54
1	43,800	86,880	6	108	214	11	48	95			
Run-off, in acre-feet, for period June 29 to July 15.											110,700

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	June 29		12N	16.65	4,570	4pm	10.56	1,080	12N	8.26	769
1am	0.02	12	2pm	16.35	3,940	5	10.62	1,080	1pm	8.35	783
	June 30		4	16.05	3,420	6	10.98	1,150	2	8.34	769
7pm	0.06	14	6	15.75	3,080	9	13.00	1,600	3	8.19	755
9	0.70	44	8	15.40	2,740	10	13.34	1,680	6	7.52	671
10	2.50	203	10	15.05	2,490	11	13.37	1,710	12M	5.05	410
11	4.90	419	12M	14.80	2,390	12M	13.08	1,620		July 9	
12M	9.90	1,030		July 3			July 5		4am	2.92	212
	July 1		3am	14.30	2,150	3am	11.17	1,190	6	2.45	172
1am	15.50	2,810	6	13.80	1,950	6	9.71	925	12N	2.10	140
2	16.86	5,060	8	13.65	1,890	9	9.18	839	6pm	1.70	104
3	21.70	38,800	9	14.10	2,070	12N	8.53	743	9	2.05	136
4	23.82	59,500	10	14.70	2,340	4pm	6.59	520	12M	2.41	167
5	24.70	68,500	11	15.10	2,550	8	4.26	329		July 10	
6	25.30	74,500	12N	15.15	2,610	12M	2.69	203	1am	2.51	172
7	25.70	78,500	1pm	14.95	2,490		July 6		2	2.55	176
8	25.65	77,500	3	14.40	2,190	4am	1.97	144	3	2.51	172
9	25.50	76,500	5	13.92	1,990	8	1.63	116	8	2.01	126
10	25.05	71,500	6	13.68	1,920	12N	1.43	98	4pm	1.24	58
12N	23.95	61,500	7	13.52	1,860	12M	1.08	67	12M	0.92	32
2pm	22.90	50,500	8	13.61	1,890		July 7			July 11	
4	21.90	40,600	9	14.06	2,070	5am	1.04	55	12N	0.75	48
6	21.10	33,400	10	14.70	2,340	10	1.20	69		July 12	
8	20.35	27,200	12M	15.42	2,740	3pm	1.05	56	12N	0.59	35
10	19.65	20,800		July 4		5	1.06	57		July 13	
12M	19.15	17,200	1am	15.52	2,550	8	1.57	101	12N	0.54	31
	July 2		2	15.53	2,550	10	3.45	266		July 14	
2am	18.60	13,400	3	15.47	2,550	12M	4.68	383	12N	0.50	28
4	18.15	10,500	6	15.06	2,340		July 8			July 15	
6	17.75	8,350	9	14.28	1,990	4am	6.50	553	11pm	0.48	27
8	17.40	6,800	12N	12.64	1,480	8	7.65	683			
10	17.00	5,450	3pm	10.88	1,130	11	8.11	743			

Note.- Daily discharge determined by shifting-control method June 29, 7 p.m. June 30, July 4-10.

San Antonio River near Falls City, Tex.

Location.- Lat. 28°57'5", long. 98°3'55", at highway bridge half a mile above Scared Dog Creek and 3.4 miles southwest of Falls City, Karnes County.
Drainage area.- 2,067 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 3.9 and 4.6 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements.
Maxima.- 1936: Discharge, 16,200 second-feet 8 p.m. July 3 (gage height, 19.44 feet).
1925-35: Discharge, 14,300 second-feet June 15, 1935 (gage height, 17.97 feet, affected by backwater); maximum gage height 22.3 feet June 13, 1935 (affected by backwater).
1875-1924: Stage, 28.36 feet in October 1913 (discharge not determined).
Remarks.- Flow partly regulated by 254,000 acre-feet of storage in Medina Reservoir on Medina River.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
June			3	15,400	30,550	8	2,020	4,010	13	996	1,980
30	1,080	2,140	4	13,500	26,780	9	1,820	3,610	14	948	1,880
July			5	6,860	13,610	10	1,380	2,740	15	900	1,790
1	4,600	9,120	6	3,640	7,220	11	1,180	2,340			
2	9,610	19,060	7	2,370	4,700	12	1,130	2,240			
Run-off, in acre-feet, for period June 30 to July 15. 133,800											

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	June 30		4am	8.60	6,540	4am	18.72	15,500	12M	3.97	2,170
1am	1.83	392	6	9.65	7,280	6	18.38	15,200		July 8	
8	2.00	490	8	10.70	8,120	8	18.00	14,800	6am	3.87	2,070
12N	2.27	669	10	11.65	8,860	10	17.47	14,300	12N	3.75	1,970
4pm	2.40	760	12N	12.55	9,710	2pm	16.45	13,200	6pm	3.77	1,970
7	2.40	760	2pm	13.45	10,410	7	14.92	11,800	12M	3.83	2,070
9	3.50	1,720	4	14.35	11,310	12M	13.17	10,200		July 9	
10	5.00	3,280	6	15.10	12,000		July 5		6am	3.78	2,020
11	6.90	5,170	8	15.72	12,500	3am	12.05	9,200	12N	3.62	1,820
12M	8.80	6,690	10	16.30	13,100	6	10.92	8,280	6pm	3.43	1,670
	July 1		12M	16.80	13,600	9	9.83	7,430	12M	3.30	1,520
1am	9.18	6,990		July 3		12N	8.80	6,690		July 10	
2	8.74	6,620	2am	17.25	14,000	3pm	7.88	6,000	6am	3.20	1,420
3	8.00	6,080	4	17.65	14,400	6	7.10	5,340	12N	3.12	1,330
4	7.00	5,260	6	18.00	14,800	9	6.58	4,890	6pm	3.07	1,280
5	6.53	4,800	8	18.30	15,100	12M	6.23	4,510	12M	3.02	1,240
8	5.92	4,220	10	18.62	15,400		July 6			July 11	
10	5.70	4,020	12N	18.82	15,600	4am	5.87	4,220	12N	2.93	1,200
12N	5.58	3,910	2pm	19.00	15,800	8	5.61	3,910		July 12	
2pm	5.55	3,910	4	19.16	16,000	12N	5.33	3,600	12N	2.93	1,200
4	5.60	3,910	6	19.37	16,200	6pm	4.92	3,170		July 13	
8	5.85	4,120	8	19.44	16,200	12M	4.59	2,840	12N	2.72	996
10	6.20	4,510	10	19.35	16,200		July 7			July 14	
12M	6.76	5,080	12M	19.19	16,000	6am	4.32	2,520	12N	2.66	948
	July 2			July 4		12N	4.10	2,320		July 15	
2am	7.55	5,760	2am	19.00	15,800	6pm	4.00	2,220	12N	2.60	900

Guadalupe River above Comal River at New Braunfels, Tex.

Location.- Lat. 29°42'55, long. 98°6'40", at New Braunfels, Comal County, 1.1 miles above Comal River. Zero of gage is 586.56 feet above mean sea level.
Drainage area.- 1,666 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 3.7 and 4.9 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 103,000 second-feet.
Maxima.- 1936: For June-July, discharge, 35,400 second-feet 6 a.m. July 1 (gage height, 20.66 feet). For year, 52,800 second-feet 7 p.m. Sept. 28 (gage height, 24.85 feet).
1928-35: Discharge, 101,000 second-feet 5:45 p.m. June 15, 1935 (gage height, 32.95 feet).
1869-1927: Stage, about 38 feet in 1869 and December 1913.
Remarks.- Small diversions and regulation upstream affect low flow only.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
June 29	275	July 7	1,500	July 15	816
30	8,590	8	1,330	16	773
July 1	23,500	9	1,440	17	2,170
2	4,410	10	1,160	18	1,400
3	3,070	11	1,040	19	938
4	2,200	12	949	20	784
5	2,340	13	903	21	713
6	1,760	14	859	22	693

Comal River at New Braunfels, Tex.

Location.- Lat. 29°42'5", long. 98°7'10", 200 feet upstream from San Antonio Street viaduct in New Braunfels, Comal County, and 1.1 miles above confluence with Guadalupe River. Zero of gage is 582.61 feet above mean sea level.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 3.7 and 5.4 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 1,200 second-feet.
Maxima.- 1936: For June-July, stage, 18.34 feet 8 p.m. June 30, affected by backwater from Guadalupe River (discharge not determined). For year, stage, 20.6 feet 7:30 p.m. Sept. 28, from flood marks, affected by backwater from Guadalupe River (discharge not determined).
1927-35: Stage, 30.71 feet June 15, 1935, from flood marks, affected by backwater from Guadalupe River (discharge not determined).
1913-26: Stage, 35.4 feet in December 1913 (affected by backwater from Guadalupe River (discharge not determined).
Remarks.- Flow partly regulated by steam power plant half a mile above station.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
June 29	394	July 7	365	July 15	358
30	912	8	365	16	358
July 1	499	9	369	17	365
2	419	10	358	18	358
3	398	11	354	19	358
4	394	12	390	20	365
5	380	13	365	21	365
6	369	14	358	22	358

Blanco River at Wimberley, Tex.

Location.- Lat. 29°59', long. 98°4', 800 feet below mouth of Cypress Creek and a quarter of a mile south of Wimberly, Hays County.
Drainage area.- 378 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 2.9 and 4.6 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 6,500 second-feet; extended to peak discharge on basis of two slope-area measurements.
Maxima.- 1936: Discharge, 25,300 second-feet 1 a.m. July 1 (gage height, 16.87 feet).
1924-26, 1928-35: Discharge, 113,000 second-feet, by slope-area measurement, May 28, 1929 (gage height, 31.10 feet).
Remarks.- No diversions or regulation.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
June 29	62	July 7	493	July 15	258
30	6,640	8	433	16	634
July 1	4,740	9	423	17	547
2	1,410	10	365	18	320
3	766	11	333	19	274
4	819	12	307	20	254
5	852	13	294	21	239
6	551	14	274	22	228

Cibolo Creek near Falls City, Tex.

Location.- Lat. 29°1', long. 97°56', 200 feet downstream from Cestohowa Bridge, 6 miles above confluence with San Antonio River, and 6 miles northeast of Falls City, Karnes County.
Drainage area.- 831 square miles.
Gage-height record.- Water-stage recorder graph except July 1, 2, Aug. 15 to Sept. 30, when it was determined from graph drawn from occasional gage readings. Gage heights used to half tenths between 2.6 and 4.9 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 15,400 second-feet; extended above.
Maxima.- 1936: Discharge, 16,200 second-feet 11:25 a.m. July 2 (gage height, 26.90 feet, observed at crest).
1931-35: Discharge, about 28,600 second-feet June 14, 1935 (gage height, 33.0 feet, from flood marks).
1913-30: Stage, about 38 feet in October 1913 (discharge not determined).
Remarks.- No large diversions or regulation above station.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
June 29	32	July 7	523	July 15	165
30	42	8	839	16	157
July 1	5,680	9	612	17	89
2	13,100	10	240	18	74
3	1,980	11	170	19	66
4	994	12	139	20	61
5	1,220	13	173	21	57
6	718	14	172	22	55

Neches River near Rockland, Tex.

Location.- Lat. 31°1'45", long. 94°23'50", half a mile above Texas & New Orleans Railroad bridge and 1 mile north of Rockland, Tyler County. Zero of gage is 91.3 feet above mean sea level.
Drainage area.- 3,539 square miles.
Gage-height record.- Graph drawn from two or more daily staff-gage readings. Gage heights used to half tenths between 0 and 1.2 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 35,000 second-feet; extended to peak discharge.
Maxima.- 1936: Discharge, 11,400 second-feet 12:10 p.m. July 5 (gage height, 19.7 feet, from graph based on staff gage readings).
1903-36: Discharge observed, 48,500 second-feet May 22, 1935 (gage height, 28.90 feet).
1884-1902: Stage, 34.9 feet in May 1884 (discharge not determined).
Remarks.- No diversions or regulation.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
June 29	232	July 7	9,250	July 15	1,510
30	232	8	7,870	16	1,760
July 1	298	9	5,500	17	1,810
2	1,570	10	4,290	18	1,900
3	4,090	11	1,980	19	1,720
4	8,460	12	1,590	20	1,390
5	11,000	13	1,510	21	1,150
6	10,800	14	1,510	22	957

Neches River at Evadale, Tex.

Location.- Lat. 30°21', long. 94°5', at highway bridge 200 feet upstream from Gulf, Colorado & Santa Fe Railway bridge at Evadale, Jasper County. Zero of gage is 8.3 feet above mean sea level.
Drainage area.- 7,908 square miles.
Gage-height record.- Graph drawn from two or more daily staff-gage readings. Gage heights used to tenths throughout.
Stage-discharge relation.- Defined by current-meter measurements below 72,000 second-feet; extended logarithmically to peak discharge.
Maxima.- 1936: Discharge, 14,600 second-feet, 7 a.m. to 6 p.m. July 11 (gage height, 14.98 feet, observed at crest).
1923-35: Discharge, 83,800 second-feet June 1, 1929 (gage height, 22.2 feet, observed at crest).
1884-1922: Discharge, 175,000 second-feet in May 1884 (gage height, 26.2 feet).
Remarks.- No diversions or regulation.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
June 29	713	July 7	10,000	July 15	6,490
30	686	8	11,800	16	5,410
July 1	686	9	13,500	17	4,990
2	826	10	15,100	18	4,710
3	1,870	11	15,500	19	4,540
4	4,600	12	15,100	20	4,290
5	7,050	13	13,100	21	4,050
6	8,390	14	9,290	22	3,530

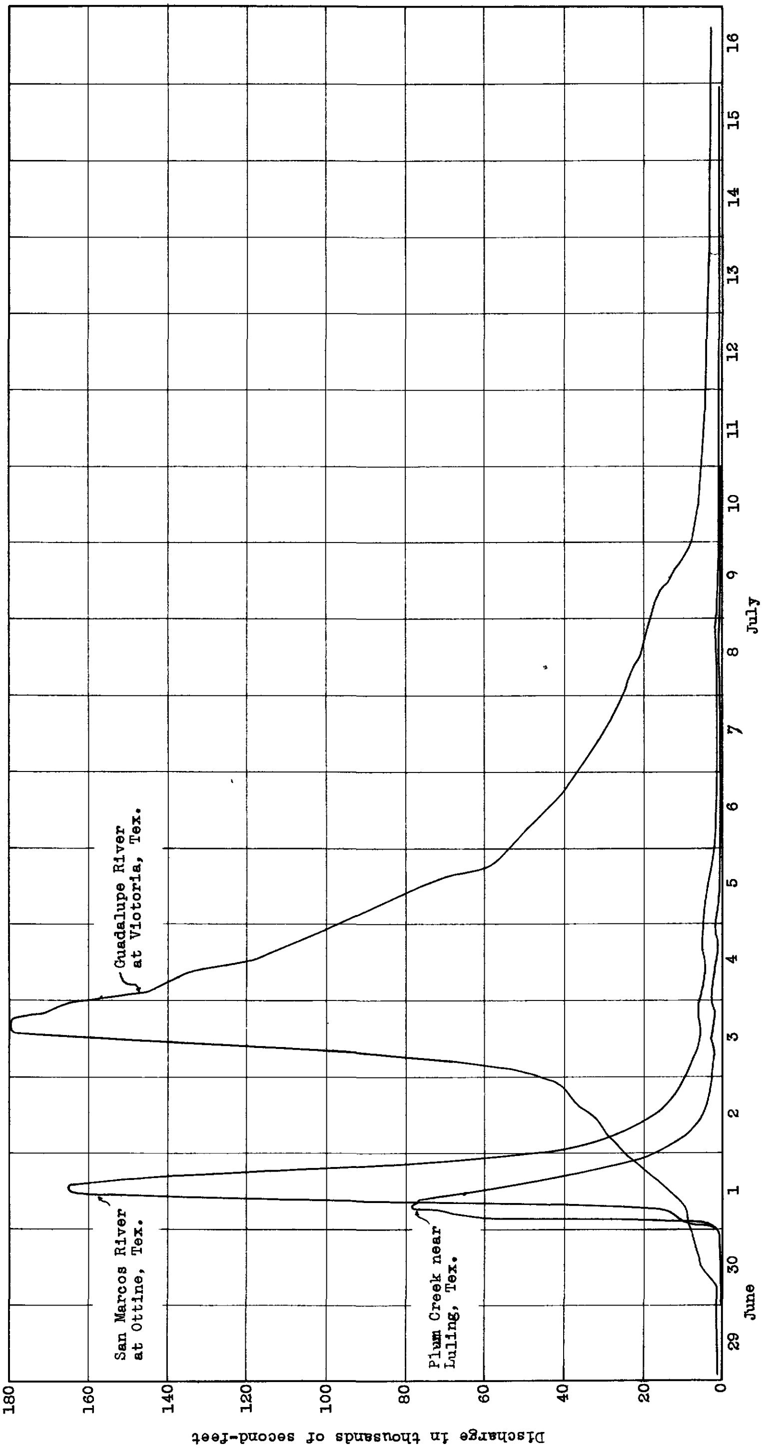


Figure 11.--Hydrographs of discharge, Plum Creek near Luling, San Marcos River at Ottine, and Guadalupe River at Victoria, June 29 to July 16, 1936.

THE SEPTEMBER FLOODS

During the last half of September torrential rains fell in almost every section of Texas, causing unusually large floods on many streams. Two lives were lost, and damages to property by these floods are estimated as about $6,000,000, according to reports of the local press. The most damage occurred at San Angelo, on the Concho River, a tributary of the Colorado River, where about 300 buildings were washed away and damage to property of about $2,000,000 was reported by county and city officials.

Maximum previously known stages were exceeded at several places in the Trinity, Brazos, and Colorado River Basins. The greatest floods occurred in the Colorado River Basin, principally in the Concho, San Saba, and Llano River drainage areas. In the Trinity River Basin only a small area near Kaufman experienced unusual flood conditions. The floods in the Brazos River Basin were confined to an area around Waco; several small streams immediately above Waco and the Brazos River at Waco had record-breaking stages.

In the Nueces River Basin floods occurred on September 16 on the Nueces River at Laguna and on the Frio River at Concan. Stages were unusually high, but the corresponding discharges were only about 60 percent as great as occurred in June 1935. Peak stages receded rapidly, and the total quantity of water passing the river-measurement stations was small.

There were floods but not of record-breaking size on streams in other river basins. The United States Weather Bureau reports* that flood stages were exceeded in September on the Sulphur River, in the Red River Basin, at Ringo Crossing from the 28th to 30th; on the Guadalupe River at Gonzales on the 18th to 19th and at Victoria from the 20th to 23d; on the Nueces River at Cotulla from the 16th to 24th; on the Rio Grande at Del Rio and Eagle Pass on the 28th and at Brownsville from the 17th to 19th, 21st to 23d, and from the 30th to October 5th.

Trinity River Basin

In the Trinity River Basin rainfall was generally light until after September 25, except that during the period September 19 to 24 a rain with a maximum depth of 7.65 inches occurred over a small area around

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* Climatological data, Texas section, September 1936, p. 72; October 1936, p. 80.

Weatherford, in the upper part of the drainage basin of the Clear Fork of Trinity River, which, however, caused no flood of consequence. The center of the most intense rain after September 25 was near Kaufman, within a small area drained principally by Cedar Creek, where over 15 inches fell from the 25th to the 28th. Stages on the Trinity River were not especially high, and, with the exception of a slope-area determination of discharge on Cedar Creek near Trinidad, no supplementary flood records were collected in the basin.

Records of the flow at the gaging stations on the Trinity River at Dallas and near Oakwood, which are situated above and below the mouth of Cedar Creek, respectively, are included in this report. From these records the run-off from the area receiving the excessive rainfall can be computed.

Brazos River Basin

During the period September 13 to 18 moderate rains, amounting to about 8.5 inches at Graham, fell over the upper part of the Brazos River Basin. Medium stages occurred on the upper and middle parts of the river, but there was no flood of consequence.

From September 19 to 24 rains fell over a wide area of the Staked Plains in the extreme upper part of the Brazos River Basin. The maximum rainfall measured was 9.39 inches at Tahoka; there was 8.32 inches at Lubbock. From this area, lying above the Cap Rock, the run-off is small and is generally produced by the rain that falls in the immediate area of the narrow canyons through which the few streams flow. Heavy rains outside these narrow river valleys seldom, if ever, produce floods. Two slope-area determinations of discharge made in this area showed that the heavy rains during this period did not cause high discharges. One determination of discharge was made of White River, or Blanco Canyon, about 7 miles south of Floydada. The rainfall over this area in a period of less than 3 days was between 5 and 6 inches. Higher stages are known to have occurred in the past at this point on White River. The other determination of discharge was made on the Double Mountain Fork of the Brazos River (known also as Yellowhouse Canyon), at a reach about 5 miles northeast of Slaton. The rainfall over the drainage area above this point was about 8 inches. Much of the peak flow of this stream is reported to have come from storm sewers in the city of Lubbock. No higher stage is known to have occurred at this point in the last 45 years.

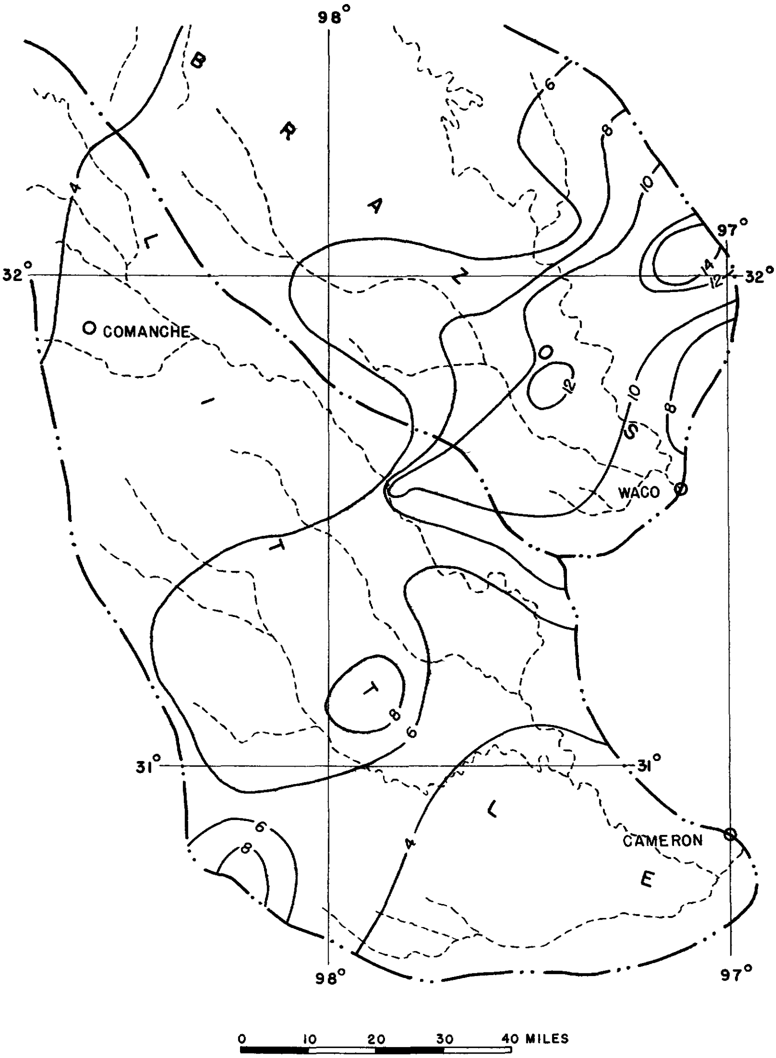


Figure 12.--Isohyetal map of part of the Brazos River Basin above Waco and of the Little River Basin above Cameron, showing total rainfall, in inches, observed September 25-28, 1936.

A heavy rain, amounting to over 15 inches at Hillsboro and ranging from that amount down to about 6 inches, fell over a relatively small area of the Brazos River Basin above Waco from September 25 to 28. Figure 12 is an isohyetal map of the area on the Brazos River above Waco and on the Little River above Cameron, showing the excessive rainfall, for this period that caused the high peak stages on several small streams in the region. More moderate rainfall caused moderate stages and discharges on the river above this place, as shown by the slope-area determination of discharge of the Brazos River near Whitney. Slope-area determinations of discharge were made of several small tributaries entering the Brazos River above Waco and below Whitney, on which the stages were the highest known. The flow of the Bosque River over Lake Waco Dam was computed for the period September 26 to 29 from data obtained from the engineering department of the city of Waco. The results of the determinations of maximum discharges on various streams are given in table 9.

The Brazos River reached the highest stage of record at Waco, but below Waco the stages were generally much less than those previously recorded. A considerable portion of the eastern part of Waco was inundated, causing considerable damage to business houses, industrial plants, and residences. Plate 4 (p. 17) shows air views of the flood on the Brazos River below Waco.

The progress of the flood down the river is shown by the hydrographs of discharge past river-measurement stations in figure 23. The inflow from tributaries on which gaging stations are maintained is shown in figure 24 by hydrographs of discharge past these stations.

Table 6 shows the flood crest stages as determined at points on the Brazos River from one near Kopperl, about 65 miles above Waco, to Richmond, 328 miles below Waco.

Table 6.--Flood crest stages along the Brazos River, 1936

River distance from mouth (miles)	Place of determination	Time of crest	Altitude above mean sea level (feet)
489.5	Kopperl, near..............	Sept.26 or 27	512.0
480.5	Steiner....................	Sept.27	492.3
470	Nela Siding................	Sept.27	471.8
464	Greenwade Bridge...........	Sept.27	*461.4
442	Patrick Ford...............	Sept.27	420.2
435	Bosqueville, near..........	Sept.27	412.4
429	East Waco..................	Sept.27	405.9
425	Waco, U. S. Geological Survey....................	Sept.27,9:30pm	397.9
418	South Waco, near...........	Sept.27	385.5
415	South Waco, near...........	Sept.27	380.5

* Altitude from Corps of Engineers, United States Army, Mineral Wells, Tex.

Table 6.--Flood crest stages along the Brazos River, 1936--Continued

River distance from mouth (miles)	Place of determination	Time of crest	Altitude above mean sea level (feet)
396	Dean Farm..................		356.8
386	Marlin Bridge..............		347.0
375	Highbank...................		326.1
366.5	Eloise.....................		314.5
349	Black Bridge...............		289.5
342	Wildcat Bridge.............		279.5
335.5	Port Sullivan..............		*274
331.5	Valley Junction, U. S. Weather Bureau gage.....	Oct.I,7am	267.5
308	Stone City		*239.5
303	Bryan, U. S. Geological Survey gage near........	Oct.1,7pm	234.2
296	Jones Bridge...............		*227
253	Washington, U. S. Weather Bureau gage.............		181.2
97	Richmond, U. S. Geological Survey gage.............	Oct.5,2am	73.0

* Altitude from Corps of Engineers, United States Army, Mineral Wells, Tex.

Colorado River Basin

Colorado River flood

The upper Colorado River Basin was subjected to intense rains, amounting to 30 inches in some places, during the last half of September. The rains fell mostly west of the Colorado River, producing extremely high stages in the Concho, San Saba, and Llano River Basins. Maximum floods on the Concho and upper Colorado Rivers on September 17 reached their junction at about the same time and caused the highest stages known on the Colorado River for some distance below the mouth of the Concho.

The following accounts of the flood in the Colorado River have been taken from the San Angelo newspapers:

Morning Times, September 19: Rockwood, Coleman County, Sept. 18.--Hundreds of farmers and their families were fleeing from the Colorado River bottoms near here tonight as the river reached a flood stage of 70 feet, 17 feet higher than ever known. The steel highway bridge at Stacy and the one here went out this afternoon under the hammering of heavy debris pounded against them by the turbulent flood. The Colorado, already on a rise from recent heavy rains upstream, reached its highest stage this afternoon under the impetus of flood waters poured into it at Leady, north of here, from the Concho River.* * * Farm homes along a 50-mile stretch of the Colorado River through Coleman County and McCulloch County, on the south side of the stream, were abandoned. Flood stage here is 35 feet. The previous high-water mark here was set in 1906, when the river reached 55.5, long-time residents said.

Standard-Times, September 20: Brownwood, Sept. 19.--The treacherous flood waters of the Colorado River late today claimed their second victim when a farmer was drowned while attempting to save his livestock.* * * The angry river was 2 miles wide at Indian Creek community, in Brown County, washing away a number of homes and barns. The flood stage climbed to 72 feet where the Brownwood-Brady highway bridge crosses the Colorado. This mark is 14 feet higher than any ever recorded before. Gradual recession of the high water south of Coleman was reported as the crest of the torrent raged through a vast farming region. At Coleman the Colorado

River rose to the highest flood stage on record; lives and property were menaced in its wild sweep through several hundred miles of the richest farming country in Texas. Hundreds of farm families in the inundated river bottoms fled for their lives and only the daring work of boatmen saved some from death in the muddy current, which spread widely over thousands of acres of fertile land.

Evening Standard, September 21: San Saba, Sept. 21.--The rampaging Colorado River reached a stage today of 62 feet--2 feet higher than ever before--as its destructive waters spread widely over the San Saba-Lometa bridge area. Apparently the flood crest had reached the bridge, for it held stationary at 62 feet. The water was raging 2 feet below the bridge flooring, and all houses in the vicinity were under water.

Table 7 gives flood-crest stages at points along the Colorado River from Ballinger to Austin. From Kingsland, at the mouth of the Llano River, to Austin, the crests of the flood from the upper Colorado River were lower than those reached by later floods coming from the Llano River.

Table 7.--Flood crest stages along the Colorado River, 1936

River distance above mouth (miles)	Place of determination	Time of crest	Altitude above mean sea level (feet)
637.5	Ballinger, U. S. Geological Survey gage........	Sept.18,12:30am	1,622.5
610	Concho River, mouth.......	--	--
603	Leaday, 1¼ miles south....	Sept.18	1,518.0
599	Leaday, 2 3/4 miles southeast..................	Sept.18	1,504.1
585	Stacy, 2 miles northeast..	Sept.18	1,458.9
566	Waldrip, 1½ miles north...	Sept.18	1,402.8
555.5	Mitchell crossing.........	Sept.18	1,383.5
538.5	Winchell..................	Sept.19	1,327.7
535	Milburn, former U. S. Geological Survey gage near..................	Sept.19	1,314.9
514.5	Whittet crossing, ½ mile below..................	Sept.20	1,280.4
506.5	Regency...................	Sept.20	1,262.1
496	Ratler crossing...........	Sept.20	1,241.7
477	San Saba-Goldthwaite bridge, 1 mile below...	Sept.20	1,197.7
451	Chadwick, railroad bridge near..................	Sept.21	1,156.5
449	San Saba, U. S. Geological Survey gage............	Sept.21,11:30am	1,152.9
433.5	Bend, 1¼ miles upstream...	Sept.21	1,102.6
405	Tow, former U. S. Geological Survey gage near...	Sept.21	985.8
395	Bluffton Bridge...........	Sept.22	953.2
382.5	Inks Dam..................	Sept.22	857.7
373	Kingsland, railroad bridge	Sept.22	822.3
355.5	Marble Falls, U. S. Weather Bureau gage.........	Sept.22	*733.0
317.5	Mud, U. S. Weather Bureau gage†..................	Sept.22	600.6
288.5	Marshall Ford Dam site**..	Sept.22	520.7
263.5	Austin, U. S. Geological Survey gage............	Sept.23	446.3

* Approximate altitude.
† Information from Houston & Texas Central Railroad.
** Information from U. S. Bureau of Reclamation.

Most of the damage done by the Colorado River was in the section between Ballinger and Kingsland; several bridges were destroyed, pecan trees washed down, livestock drowned, farm houses flooded, and fields swept clean. Plate 5, A shows the wreckage of the railroad bridge across the Colorado River at Winchell.

Below the mouth of the Llano River the stages reached on the Colorado River during the floods of 1936 were much lower than the stages in the notable floods of 1935. Hydrographs of discharges at river-measurement stations on the Concho and Colorado Rivers in figures 25 and 26 show the progress of the floods down the Concho and Colorado Rivers. Hydrographs of discharge at river-measurement stations on tributaries of the Colorado River are shown in figure 27.

Slope-area determinations were made of the discharges of the Colorado River near Stacy and near San Saba. At Ballinger and stations below it, except at the station near San Saba, the peak discharges were determined from rating curves based on current-meter measurements of discharge. The maximum discharges at various additional stations are shown in table 9.

A rain of 6 to 10 inches fell over a relatively small area from Marble Falls west on September 14 and 15 and caused Sandy and Walnut Creeks, draining areas of 344 and 24 square miles respectively, to reach the highest stages known. Again on September 25 and 26 a rain of 6 to 10 inches fell over a small area between Marble Falls and Burnet, causing Hamilton Creek, with a drainage area of 67 square miles, to rise higher than at any other time since 1884. The peak discharges of these creeks were determined by the slope-area method. The results of such determinations are given in table 9.

Concho River flood

The main Concho River begins at the eastern edge of the city of San Angelo at the confluence of the South Concho and North Concho Rivers. The drainage area above the river-measurement station just below the confluence is 4,217 square miles, not including noncontributing area, and lies in a fan shape to the south, west, and north of San Angelo. The South Concho River, not including the Middle Concho River, drains an area of about 1,250 square miles south of San Angelo; the Middle Concho River, which is tributary to the South Concho River, drains an area of about 1,150 square miles west of San Angelo; the North Concho River drains about 1,680 square miles northwest and north of San Angelo.

Rains exceeding 30 inches in some places fell during September over a large part of the Concho River drainage basin. Three separate flood

A. COLORADO RIVER AT WINCHELL.
Railroad bridge destroyed by flood of September 19, 1936.

B. RAILROAD BRIDGE NEAR MILES.
Bridge over small creek between San Angelo and Ballinger damaged by flood of September 17, 1936.

A. CONCHO RIVER NEAR PAINT ROCK.

Railroad bridge destroyed by flood of September 17, 1936. Pile of rock in background marks end of embankment. Stumps of piles sheared off near ground may be seen between pier on left bank and end of embankment. Recording gage was attached to downstream, or bottom, side of overturned pier.

B. NORTH CONCHO RIVER AT SAN ANGELO.

Abe Street Bridge damaged by flood of September 17, 1936.

A. LOOKING WEST AT BEAUREGARD STREET TOWARD BRIDGE OVER NORTH CONCHO RIVER.

B. LOOKING EAST ON CONCHO STREET.

Showing fire station and other buildings partly submerged.

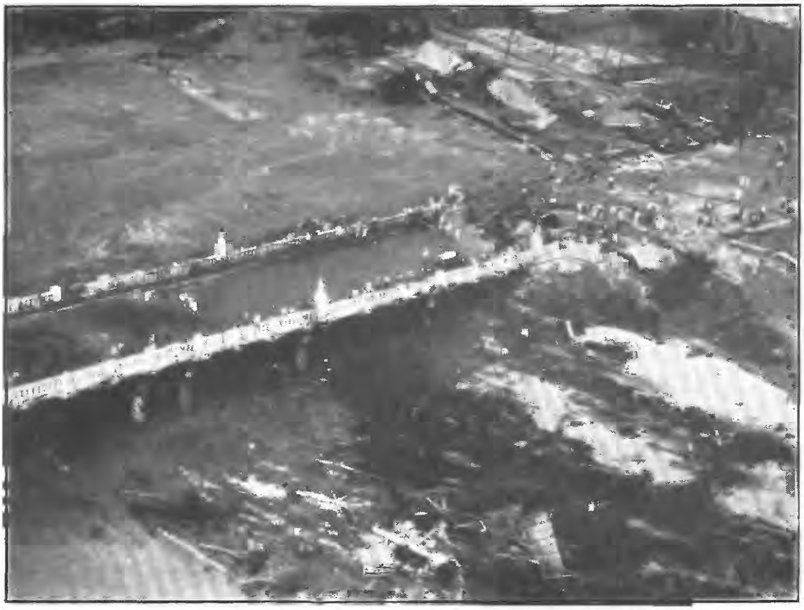
NORTH CONCHO RIVER AT SAN ANGELO AT ABOUT PEAK OF FLOOD OF SEPTEMBER 17, 1936.

A. LOOKING SOUTH ON CHADBOURNE STREET.

B. LOOKING SOUTH ACROSS OAKES STREET BRIDGE.

The South Concho River is shown in background.

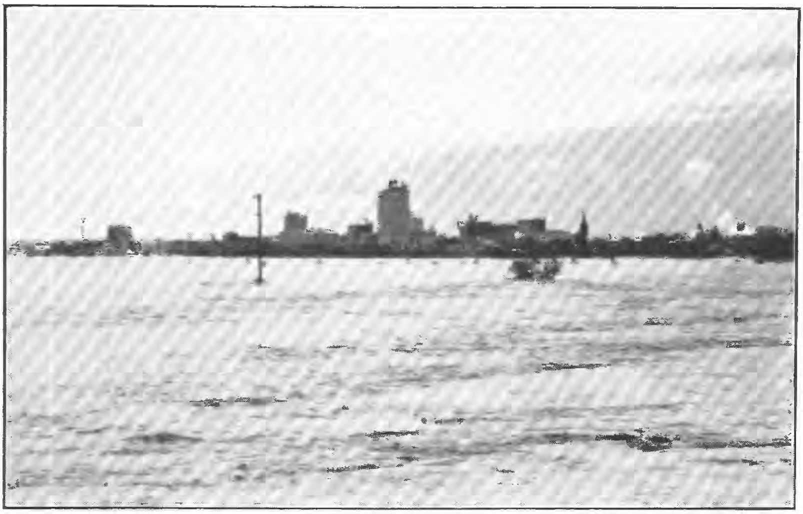
NORTH CONCHO RIVER AT SAN ANGELO AT ABOUT PEAK OF FLOOD OF SEPTEMBER 17, 1936.



A. LEFT END OF OAKES STREET BRIDGE AFTER FLOOD HAD RECEDED.
Courtesy of Associated Press and San Angelo Standard-Times.

B. STREET AND BUILDINGS NEAR LEFT END OF OAKES STREET BRIDGE.

DAMAGE AT SAN ANGELO CAUSED BY FLOOD OF SEPTEMBER 17, 1936, ON NORTH CONCHO RIVER.



A. NORTH CONCHO RIVER AT SAN ANGELO.
Looking upstream from railroad bridge at about peak of flood of September 17, 1936.

B. FLOOD OF AUGUST 1906 AT BALLINGER.
Looking west from top of Runnels County Courthouse. Town flooded by Colorado River and Elm Creek. Main channel of Colorado River is shown in the background. Courtesy of C. A. Doose.

peaks occurred on the main Concho River, on September 15, 17, and 26, the peak on September 17 being the highest. Previous flood stages on the South, Middle, and main Concho Rivers near San Angelo have slightly exceeded those reached in September 1936, but on the North Concho and other smaller streams the stages reached in September 1936 were higher than known before.

The city of San Angelo suffered greater damage than any other place in the State. On September 17 the discharge of the South Concho River reached a maximum of 111,000 second-feet and caused stages which backed water up the North Concho River to the center of the city. Just as this water began to recede, the flood from the North Concho River with a peak discharge of 184,000 second-feet, reached the city. The river channel was inadequate for this enormous quantity of water and the river broke over its banks, flooding large areas of the residential and business sections of the city.

The story of the flood as taken from newspapers is given below:

San Angelo Morning Times, September 18: An insane burst of brown waters wrapped round the dust of a prolonged drought leaped the channels of the Concho rivers here yesterday, hurled to destruction an approximate of 300 houses in all parts of town and left an uninsured flood damage of about $1,500,000, the worst water damage in the history of this 68-year-old city. It is the major catastrophe of all time for San Angelo. More than 100 persons were rescued from drowning on the streets or from flooded houses, while many hundred more were removed under conditions less dangerous. There was an estimated 300 homeless families last night, who were sleeping in the schoolhouses and in other public buildings, in stores, while hotels were filled. Numerous buildings not destroyed were flooded and filled with silt. The North Concho River, chief trouble maker of the day, charged drunkenly into the negro and Mexican section, threw houses and shacks against the Sixth Street Bridge now under construction, spread wanton piles of other wrecked houses here and there. Then it moved into the elite residential district, climbed a 40-foot cliff to run a stream knee-deep in the home of Preston Northrup. It tore the C. R. Hallmark home from its foundations, raced it over the Santa Fe Golf Course, and cracked it into matchwood at the submerged Millspaugh Bridge. The Casino, place of song and dance, was leaned against the Murphy Bridge over West Beauregard, the east end of this bridge being in part washed away.

San Angelo Evening Standard, September 18: The enraged stream of yesterday had taken all that 25-inch cloudbursts could give and swirled unrelentlessly against low-lying houses to run up a toll estimated all the way from 200 to 300. Sometimes the shell-like framework broke as it tumbled into the waters; more often one of three bridges in the heart of the city cracked up the structures. Today Santa Fe Park, residential and business districts bore the marks of rushing waters, which left silt, splinters, animal carcasses and the odds and ends of civilization scattered profusely. House-cleaning days had come to town for owners of 700 residences and business buildings here. Renewing of wood work, refurbishing of furniture and rugs, cleaning of clothes that could be salvaged--these provided labor for hundreds, for loss to some was gain to others. Perhaps the most dramatic episode of the flood in downtown San Angelo was the evacuation of approximately 75 persons from the Naylor Hotel, at Chadbourne and Concho, at midafternoon. A crowd of at least 1,000 persons witnessed the rescues. The water flowed 6 feet deep through the lobby of the hotel, which stands on the site of the old Landon Hotel, destroyed by fire. The 1906 flood had brought the water up to within 2 feet of the old Landon.

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San Angelo Morning Times, September 19: Free from the clutches of angry flood waters that curled around the heart of the city Thursday, San Angelo today, water-raked, debris-covered, and scarred along the Concho front, looks to rehabilitation after the greatest flood in its history had subsided, leaving hundreds destitute and property losses at $2,000,-000. Dried mud caked on the floors of countless homes, the countryside was strewn with carcasses of drowned sheep and goats, communications were disrupted, and public services in many parts of town were barely functioning, but the city's 26,000 inhabitants met the disaster fortunately without loss of life.* * * The Red Cross organized to feed refugees from soup kitchens set up in two churches. More than 300 destitute persons were taken care of Friday. Highway traffic was resumed Friday afternoon over badly washed roads, and the first mail in 2 days was sent out. The washing out of the railroad bridge and shifting of another in flood waters blocked rail transportation, but it was considered possible repair crews might open a rail line early today.* * * Besides the damage to hundreds of homes, business establishments suffered untold losses as murky waters rolled into basements and ground floors, ruining stocks, fixtures, and buildings. Several expensive bridges were hard hit, streets were piled with debris, shrubbery and trees were uprooted, and paving was undermined. Special guards patrolled the streets to prevent looting of smashed residences. Thieves were caught lurking in the ruins last night, and police, hastily deputizing dozens of special officers, put a quick stop to the forays. Many citizens, armed with guns, kept watch over the remains of their property.

San Angelo Standard-Times, September 20: The relief picture in San Angelo presented a degree of orderliness for the first time Saturday as the total number aided climbed to approximately 1,500 persons.

Fort Worth Star Telegram, September 27: San Angelo, Sept. 26.--This central western Texas city, recovering from a $5,000,000 flood last week, braced Saturday against possible new high water danger. Fed by 3-inch rains over its watershed, the North Concho River developed a 30-foot crest near Water Valley, 10 miles northwest of here. The Middle Concho, reported by observers near Mertzon at the highest level in its history, created an additional hazard.

San Angelo Standard-Times, September 27: The two Concho Rivers, which run through San Angelo, achieving a parallel to the lightning which struck twice in the same place, raced through this city again Saturday at record heights for the second time in 9 days. The South Concho, carrying more water into San Angelo in a fortnight than it produces ordinarily in a year, was one up on the North Concho, for on Tuesday, Sept. 15, it sent northward the flood which touched off the three-round battle of the waters. But fortunately, as in the first two instances, the high waters from the two streams did not reach their junction at the eastern city limits here simultaneously, and damage Saturday was calculated in the thousands of dollars where it had been listed as high as $5,000,000 in the major catastrophe of Thursday, Sept. 17.* * * Early this morning the North Concho had dropped about 9 feet from its peak Saturday afternoon at 4 o'clock of about 38 feet at the Chadbourne Street Viaduct. Seven persons were marooned at the 12-mile bridge on the Middle Concho at 12:30 this morning, while the river on the biggest rise in its recorded history rose and fell, only to rise again. The seven persons were caught when the waters rushed out down the stream about 8 o'clock yesterday morning. From that time on they never had a chance to escape. Between them and safety on each side were one-quarter of a mile of water, swift, often 15 feet deep, while it was not known whether the full crest of the flood from the Centralia Draw country had been reached.

The altitude of the flood crest on the Concho River was determined at several places as shown in table 8.

Table 8.--Flood crest stages along the Concho River, 1936

River distance (miles)	Place of determination	Time of crest	Altitude above mean sea level (feet)
57.0	San Angelo, U. S. Geological Survey gage...............	Sept.17,1pm	1,823.4
51.7	Sixmile crossing..............	Sept.17	1,792.5
19.5	Paint Rock, U. S. Geological Survey gage...............	Sept.17,9pm	1,628.0
4.5	Winkler ford..................	Sept.18,1am	1,549
0	Mouth.........................	--	--

The drainage area between San Angelo and Paint Rock received a very heavy rain, which tended not only to sustain the flood discharge but probably increased it somewhat between these two places. The highest stage known on the Concho River at Paint Rock occurred on September 17, 1936.

Plate 5, B,is a view of a railroad trestle across a small creek between San Angelo and Ballinger showing damage done by flood of September 17, 1936. Plate 6, A,is a view of part of the remains of a plate-girder railroad bridge over the Concho River near Paint Rock, destroyed by the flood of September 17. A recording-gage structure is attached to the downstream or bottom side of the bridge pier shown in horizontal position on the bed of the stream.

The recording-gage installations on the Concho River near San Angelo and near Paint Rock and on the North Concho River near Carlsbad were destroyed by the flood.

At regular river-measurement stations and at many miscellaneous stations where there were extremely high stages, the peak discharge was determined by the slope-area or other methods. The result of the determinations of maximum discharges at various places are given in table 9.

Hydrographs of discharge at river-measurement stations on the Concho River and its tributaries are shown in figures 28 and 29. Plates 6, B,to 10, A,are views of the flood in San Angelo.

San Saba River flood

The floods in the San Saba River Basin were more severe than had been known before, or were extremely high, on the upper part of the main and on tributaries near the headwaters. In the vicinity of Fort McKavett, where the San Saba River drains an area of 688 square miles, over 10 inches of rain fell from September 13 to 16, and on the head of Terrett Draw, about 10 miles south of Fort McKavett, between 21 and 25 inches of rain fell from noon September 15 to noon September 16, causing very high stages in all streams of that region. At Menard and San Saba the river was slightly lower than in 1899.

Discharge determinations were made by the slope-area method at several reaches on tributaries in the upper part of the basin, on the San Saba River near Fort McKavett, and at the river-measurement station at Menard. The discharge at the river-measurement station at San Saba was determined from an extension of the rating curve as defined by current-meter measurements. The results of the determinations of maximum discharges are given in table 9.

Llano River flood

A very heavy rain of 8 to 30 inches, with a concentration of 14 inches in about 2½ hours at one place, occurred in the North Llano River Basin from September 13 to 16. The North Llano River, having a drainage area of 914 square miles at the river-measurement station near Junction, experienced the highest stage known. The rainfall centered below Roosevelt and caused small streams in that region to reach the maximum stages of record. The South Llano and Llano Rivers had stages considerably below those of 1935.

The maximum discharges of the North Llano River near Roosevelt and at the river-measurement station near Junction and of West Copperas and Copperas Creeks near Roosevelt and Bear Creek near Junction were determined by the slope-area method. The results of the determinations are given in table 9.

At the river-measurement station on the North Llano River near Junction the recording-gage installation was destroyed. A gage-height record was obtained, but the rating curve for this station is too poorly defined to use in computing discharges.

The maximum discharges at the river-measurement stations on the Llano River near Junction and near Castell were determined by the slope-area method and were used to check the rating curves at these stations. The total flow for the flood period was computed at these stations.

Discussion of precipitation

All rainfall records for the September storms are given in table 4. In addition to records of rainfall obtained by the United States Weather Bureau, records were obtained at 134 other stations, most of which are in the Colorado River Basin. At 62 stations systematic written records of the daily amount of rainfall are kept, which are accurate and reliable and which have been listed under the heading "Supplementary" in table 4. The data for 72 stations, listed in table 4 under the heading "Miscellaneous", were generally measurements or estimates of the total rainfall for the period of rain at places at which no systematic records are kept.

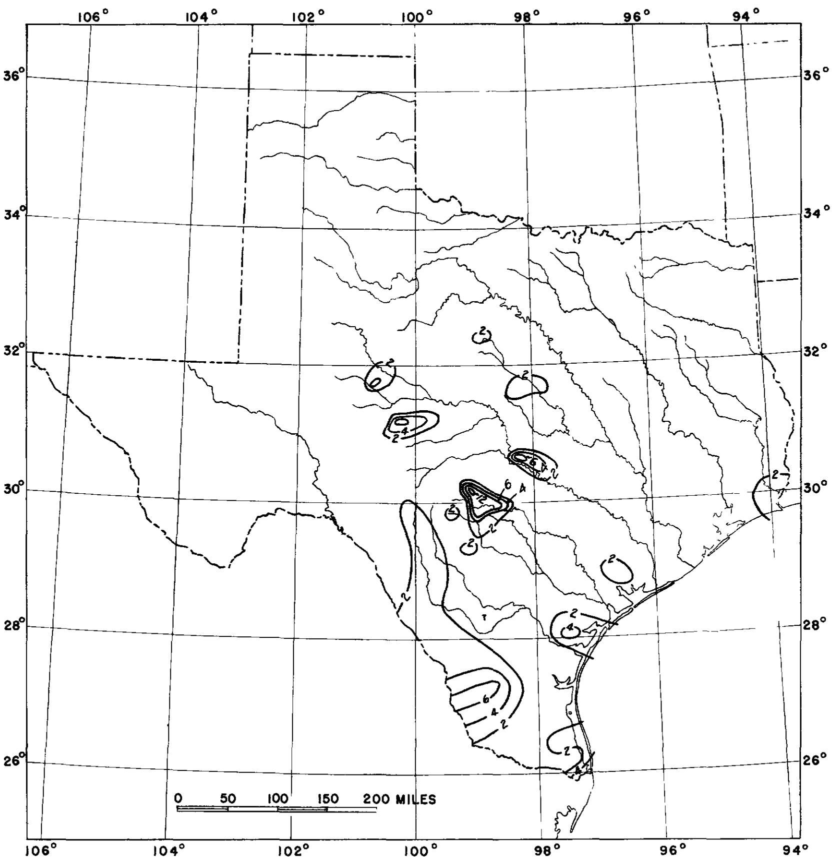

Figure 13.--Isohyetal map of Texas showing total rainfall, in inches, observed September 13-14, 1936.

To show the amount and distribution of the rainfall over the State, isohyetal maps showing the total rainfall for the periods September 13 to 14, 13 to 16, and 13 to 18 during the first storm, and for the periods September 25 to 26 and 25 to 28 during the second storm are presented in figures 13 to 17. The total rainfall for the period September 19 to 24 is given in table 4. This rain did not produce excessive floods; an isohyetal map is shown for this period as figure 18.

Figure 19 is an isohyetal map showing in detail the rainfall over the Concho, San Saba, and Llano River Basins for the period September 13 to 18, and figure 20 is an isohyetal map showing in detail the rainfall over the Concho River Basin for the period September 25 to 28.

A continuous record of the rainfall was obtained by a recording gage maintained by the United States Soil Conservation Service about 11 miles

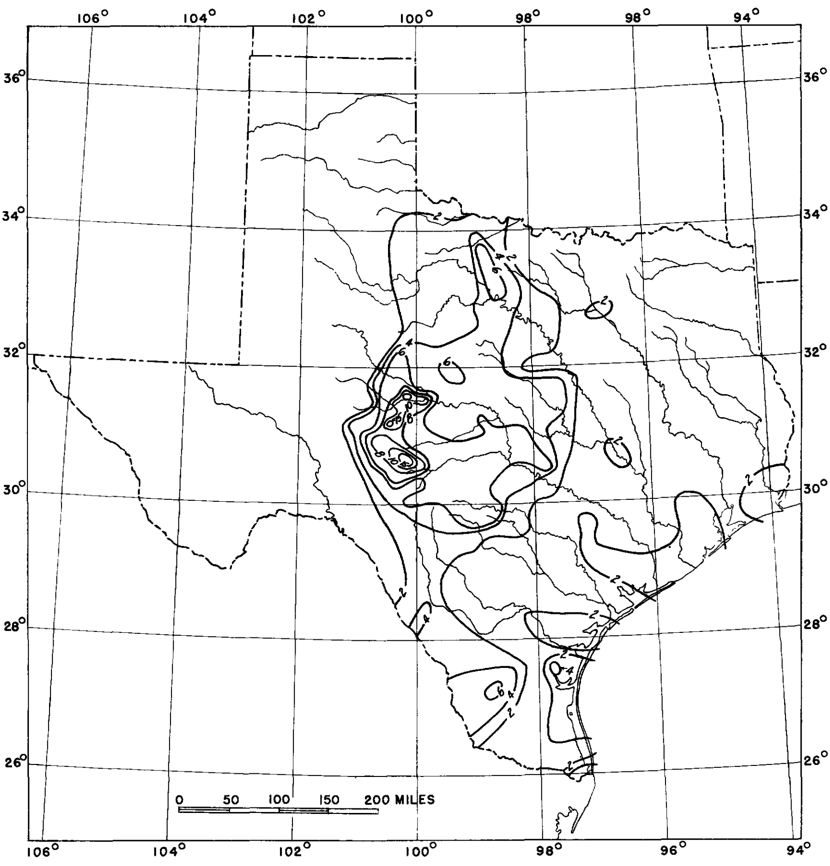

Figure 14.--Isohyetal map of Texas showing total rainfall, in inches, observed September 13-16, 1936.

in an airline northwest of San Angelo. Figure 21 showing the record for the period September 14 to 18, and figure 22 for the period September 23 to 26, indicate the intensity of the rainfall in the area near San Angelo that received the heaviest rain.

The following account of the September storms has been prepared by Mr. C. E. Norquest, senior meteorologist, United States Weather Bureau, Houston, Tex.:

An excellent index of the unusual character of the rainfall in Texas during September 1936 is afforded by the flood stages, some of which are without precedent, recorded on the principal rivers of the State. The Rio Grande, Nueces, Guadalupe, and Colorado were in flood for varying periods but mostly in the second decade of the month. However, a second sharp rise was experienced in these streams in the third decade, when flood stages were reached also in the upper and middle reaches of the

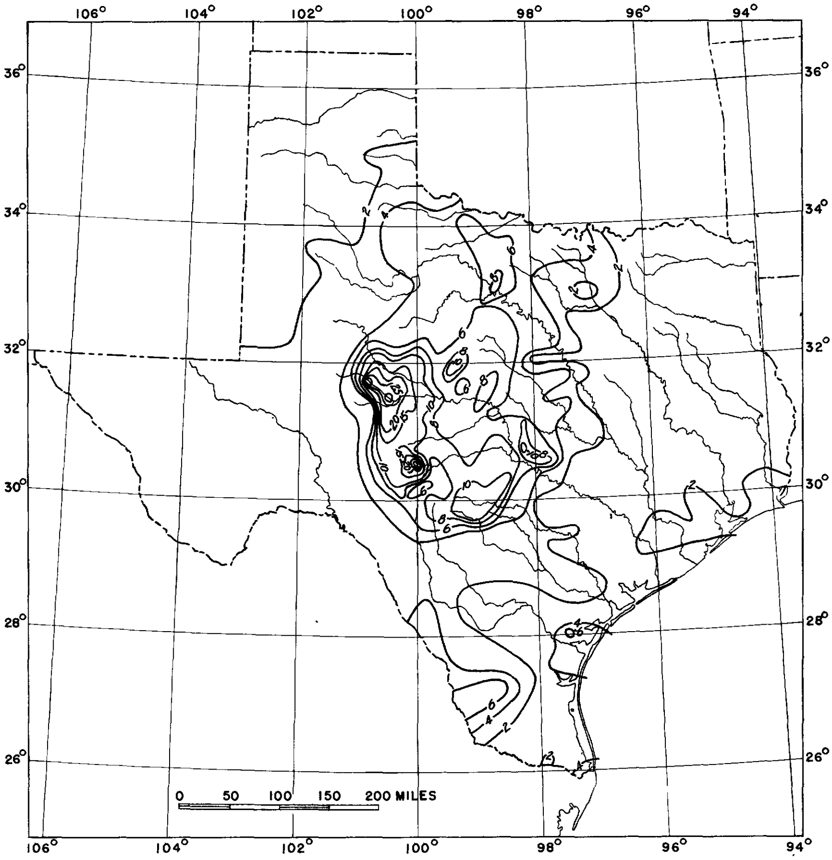

Figure 15.--Isohyetal map of Texas showing total rainfall, in inches, observed September 13-18, 1936.

Brazos and Trinity Rivers. The fact that these great floods occurred at a season and under conditions not most favorable for a rapid rise in the rivers accentuates the unusual character of the September rains.

During August and the first decade of September Texas rainfall was generally and decidedly deficient. The deficiency was most pronounced in the western division. It was the season when drainage basins are covered by lush vegetation and when extensive areas are under cultivation--conditions that tend to check run-off. In spite of these retarding influences the rivers rose rapidly and in places reached unprecedented stages. Such floods can be produced only by exceptionally heavy and prolonged rainfall over extensive areas.

There were two well-defined storm periods. The first prevailed from the 13th to the 18th, inclusive, while the second obtained from the 25th to the 28th, inclusive.

The first series of the accompanying isohyetal charts shows the development and progress of the precipitation area attendant on the first storm from its beginning over the lower Rio Grande Valley and lower Texas coast on September 13th to its culmination on the 18th, by which time it

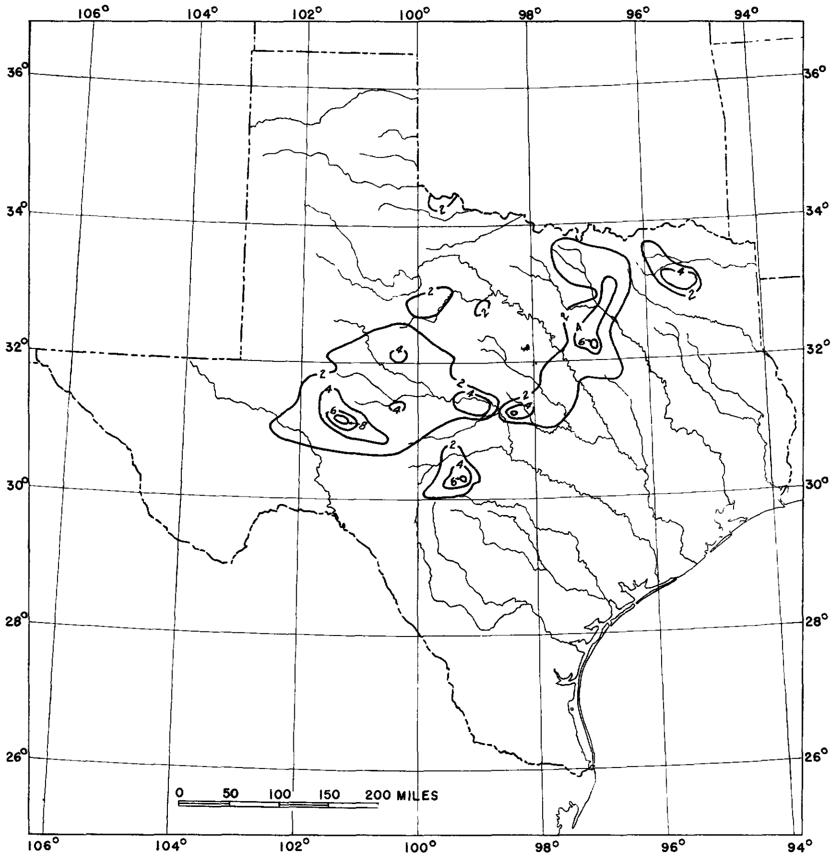

Figure 16.--Isohyetal map of Texas showing total rainfall, in inches, observed September 25-26, 1936.

had overspread middle Texas. The next series of charts shows the development of the precipitation area accompanying the second storm, which began on the 25th over the headwaters of the Colorado and spread rapidly eastward and northward over the drainage basins of the Brazos and Trinity Rivers, culminating on the 28th.

Available weather maps show that an extensive low-pressure system was present off the west coast of Mexico and Central America from the first of the month and that this development was accompanied by heavy rainfall over central and southern Mexico. During this period a vast body of tropical maritime air overlay the Gulf States and extended far up into the middle Mississippi Valley.

The morning map of September 13 shows a well-developed storm center off the lower Texas coast. This storm moved inland north of Brownsville, attended by heavy rains in the lower Rio Grande Valley and on the lower Texas coast. The slow northwestward movement of this center of low pressure induced strong southeasterly winds over Texas. These in-blowing winds transported vast masses of air from the tropics. The far fetch of this warm air across the Caribbean Sea and the Gulf of Mexico had laden it, probably well-nigh to capacity, with moisture.

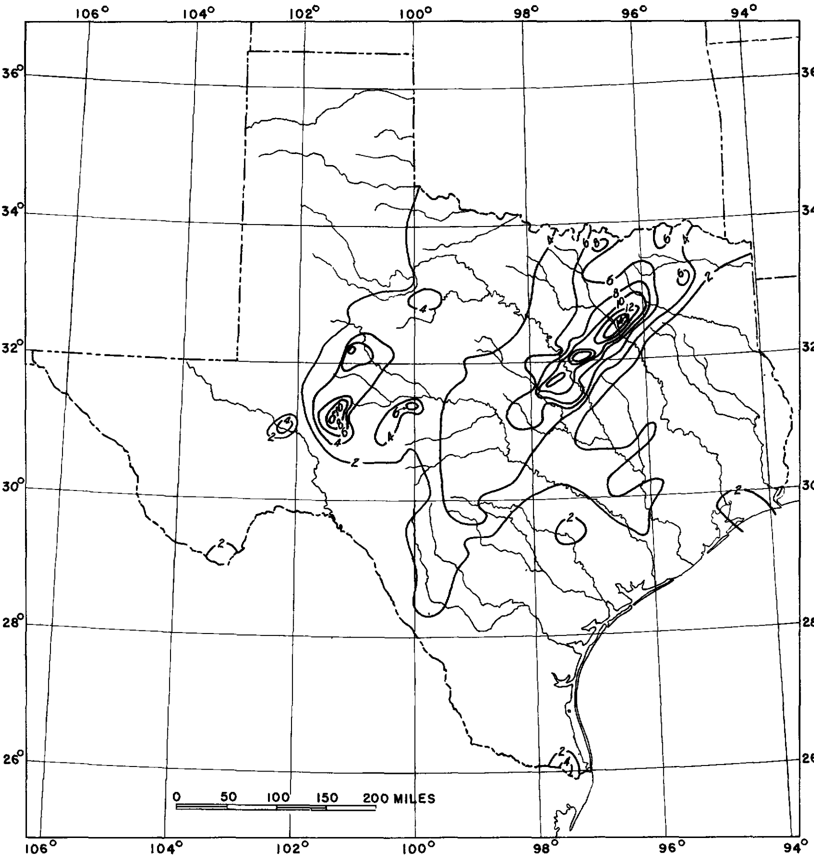

Figure 17.--Isohyetal map of Texas showing total rainfall, in inches, observed September 25-28, 1936.

One of the most effective processes of condensation of atmospheric moisture is the raising of moisture-laden air over a barrier, such as a mountain range or such as that interposed by a mass of dense cold air--a cold front. In this instance the effects of both types of barrier were in operation. Great rivers of tropical maritime air were flowing up country, from sea level to an elevation of 2,000 feet over the Edwards Plateau section, and also against the barrier interposed by a cold front that from the 13th to the 15th was practically stationary over eastern New Mexico and from the 16th to the 18th advanced slowly across the northern portion of the State, finally moving out of the Texas picture on the 19th. During the slow advance of the cold front the flow of broad, deep streams of tropical air continued, transporting vast quantities of moisture, which was released as excessive rainfall over extensive areas as the air masses moved up country and up the cold-front barrier. With the passage of this cold front the rain ceased.

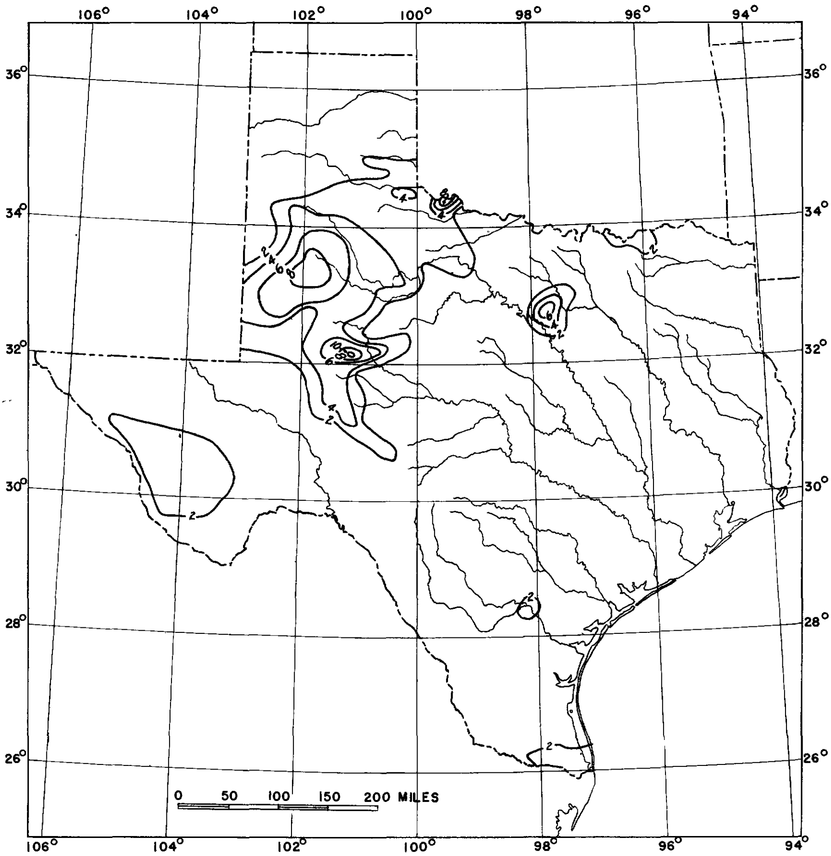

Figure 18.--Isohyetal map of Texas showing total rainfall, in inches, observed September 19-24, 1936.

Similar processes were in operation during the second storm period. Near the middle of the third decade the cold front of a vast mass of polar continental air entered the Texas Panhandle from the north. During its slow progress from the Panhandle to the Gulf coast this cold front interposed an effective barrier to the in-flowing masses of tropical maritime air, effectually depriving them of their load of moisture, which fell in excessive amounts over much of east Texas.

The second storm was of shorter duration than the first, and the rainfall was generally not as intense; but as this rain fell on soil still soaked from the first storm the run-off was rapid and the rise of streams was quick.

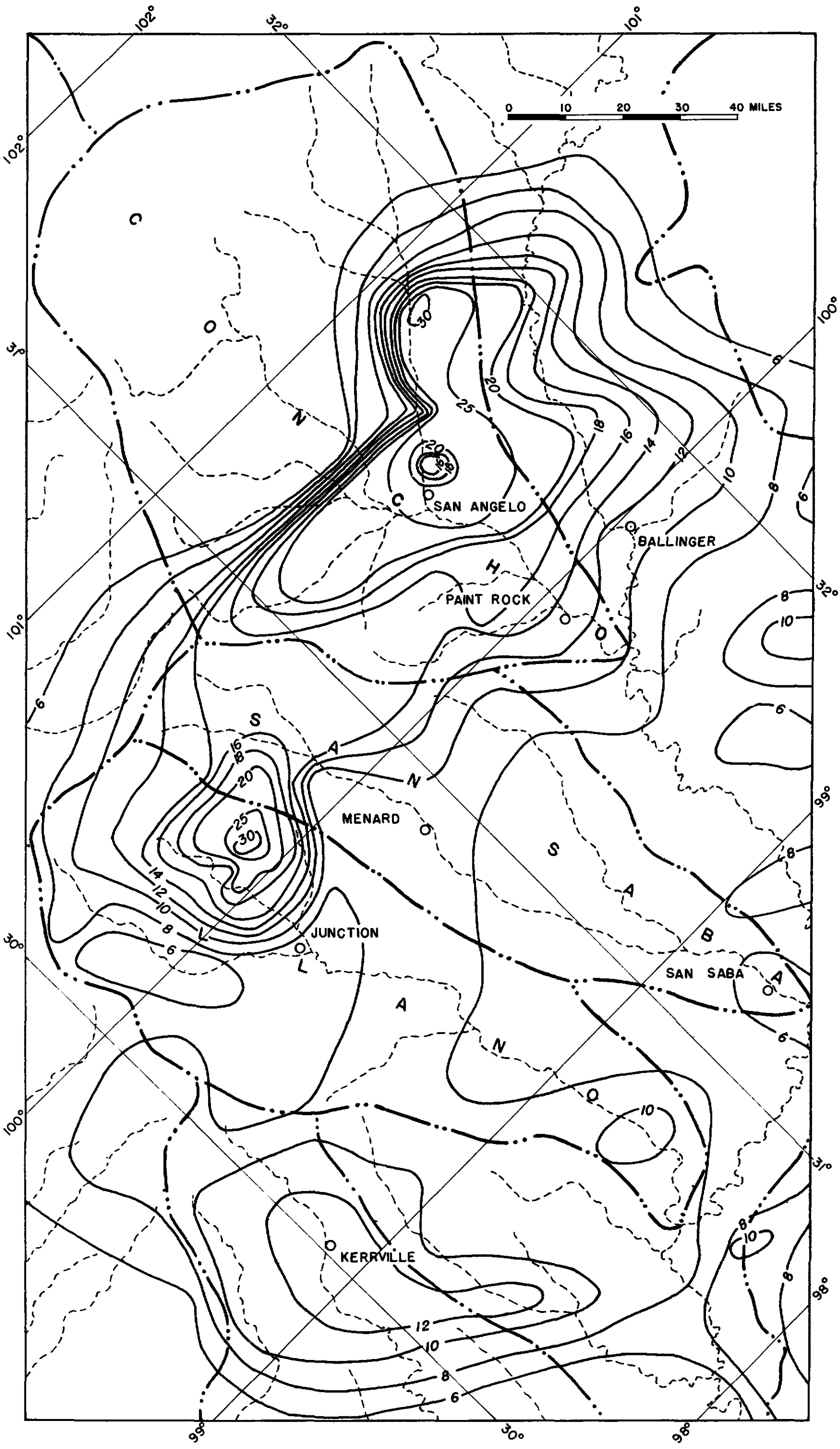

Figure 19.--Isohyetal map of the Concho, San Saba, Llano, and parts of adjacent river basins, showing total rainfall, in inches, observed September 13-18, 1936.

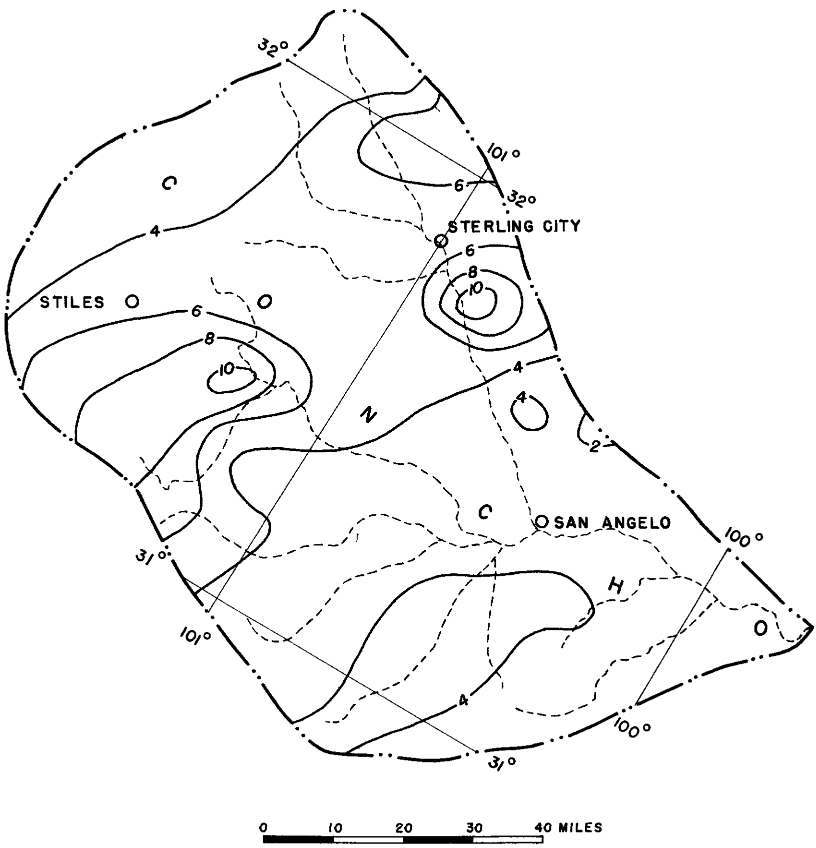

Figure 20.--Isohyetal map of the Concho River Basin showing total rainfall, in inches, September 25-28, 1936.

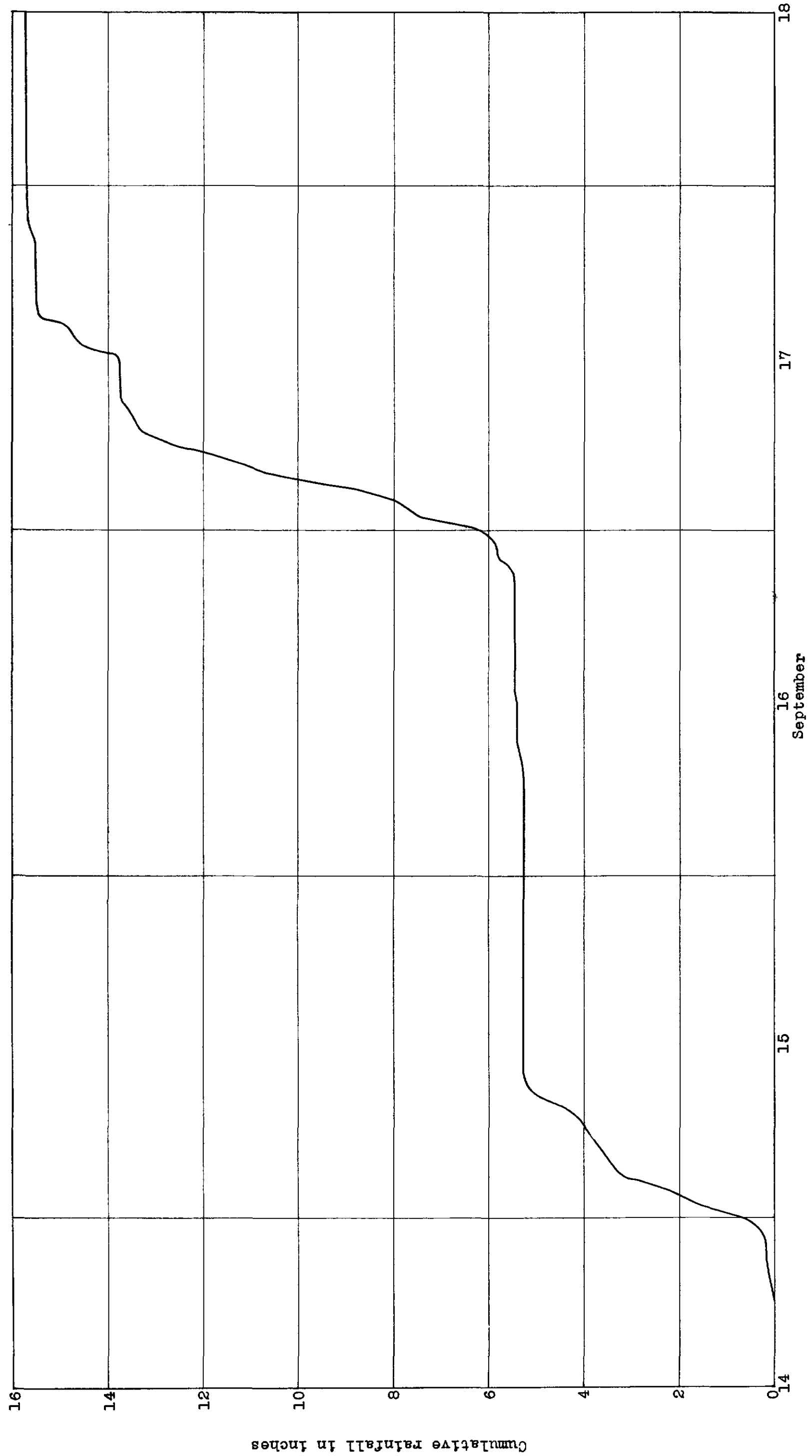

Figure 21.--Graph of cumulative rainfall, in inches, at point about 11 miles northwest of San Angelo, September 14-18, 1936.

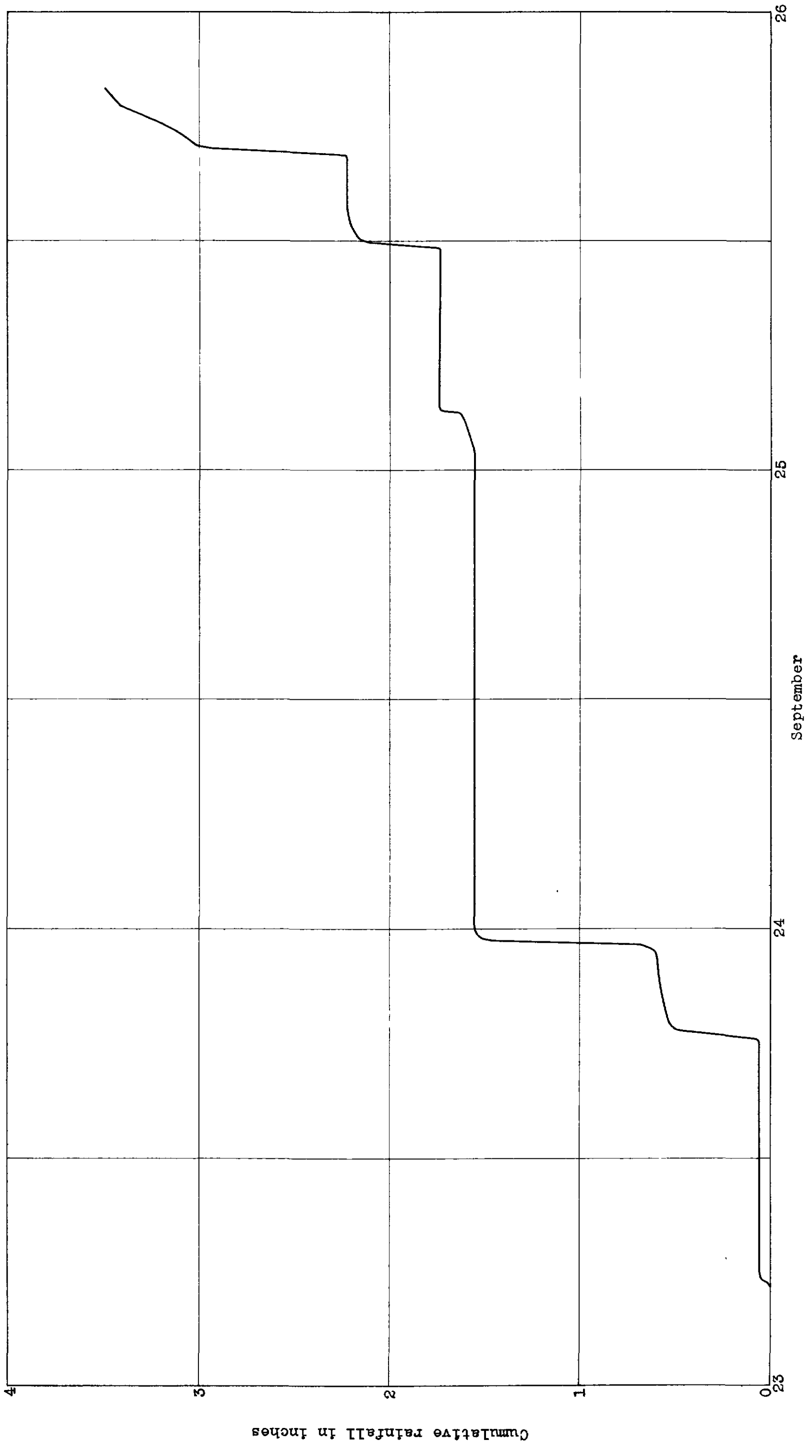

Figure 22.--Graph of cumulative rainfall, in inches, at point about 11 miles northwest of San Angelo, September 23-26, 1936.

Stages and discharges

At river-measurement stations in the flood areas, except at the station on the North Llano River near Junction, the flow past the stations during the flood period has been computed. At various other places the peak discharge was determined, but insufficient data were obtained for determining the volume of flow during the entire flood period.

On the following pages there are given for each river-measurement station in the flood areas a station description, a table of daily discharges and total run-off for the flood period, and a table of gage heights and discharges at indicated times during the flood in sufficient detail for reasonably reliable delineation of the hydrograph. For further explanation of the data that are presented reference is made to the description pertinent to records of the July flood as presented on pages 41 and 42.

Maximum discharges

The maximum discharges at the various points of determination are summarized in table 9. Drainage areas and maximum discharges per square mile of the streams above the points of determinations are also given in this table for the stations listed. The drainage areas were measured from such topographic maps as were available and from airplane pictures, soil maps, and county road maps. The small drainage area of Red Bank Creek near San Angelo was determined by a transit survey.

Table 9.--Maximum discharge at various points during floods of September 1936

Stream	Lat.	Long.	Drainage area (sq. mi.)	Maximum discharge		
				Time	Sec.-ft.	Sec.-ft. per sq. mi.
Trinity River Basin						
Cedar Creek near Trinidad	32°13'	96° 5'	910	Sept.29	35,400	39.0
Brazos River Basin						
Double Mountain Fork of Brazos River near Slaton	33 27	101 33	(a)	Sept.21	1,070	-
Brazos River near Whitney	31 51	97 19	16,940	Sept.28(b)	63,000	-
White River near Floydada	33 52	101 19	(a)	Sept.21	875	-
Childress Creek near China Springs	31 43	97 20	79	Sept.26 or 27 (c)	47,000	595
Aquilla Creek near Gholson	31 44	97 12	372	Sept.27,12N	84,500	227
Bosque River at Lake Waco Dam	31 34	97 12	1,660	Sept.27,1pm	96,000	57.8
Sevenmile Draw at Ames	31 31	97 47	2.4	Sept.26, 10:30pm	5,140	2,140
Sulphur Creek near Lampasas	31 4	98 8	112	Sept.27,12N	30,400	271
Colorado River Basin						
Colorado River near Stacy	31 31	99 40	11,660	Sept.18	356,000	30.5
Colorado River near Tow	30 52	98 27	19,320	Sept.21	202,000	10.5
Concho River Basin						
Pecan Creek near San Angelo	31 19	100 27	81	Sept.15, 6:30am	30,500	377
North Concho River at San Angelo	31 27	100 26	1,675	Sept.17,4pm	184,000	110
Grape Creek near Carlsbad	31 38	100 34	53	Sept.17	31,800	600
Grape Creek at railroad bridge near Carlsbad	31 34	100 34	79	Sept.17	45,600	577
East Fork of Grape Creek near Carlsbad	31 39	100 34	32	Sept.17	23,500	734
West Fork of Grape Creek near Carlsbad	31 40	100 35	17	Sept.17	14,200	836
Dry Creek near San Angelo	31 40	100 29	14	Sept.17	24,600	1,760
Dry Creek at railroad bridge near San Angelo	31 33	100 32	48	Sept.17	19,200	400
Red Bank Creek near San Angelo	31 41	100 26	.76	Sept.17	2,490	3,280
San Saba River Basin						
San Saba River near Fort McKavett	30 52	100 1	688	Sept.16	50,700	73.7
North Valley Prong of San Saba River near Fort McKavett	30 51	100 8	328	Sept.16	38,800	118
Middle Valley Prong of San Saba River near Fort McKavett	30 50	100 8	188	Sept.16	20,900	111
East Fork of Terrett Draw near Fort McKavett (d)	30 41	100 11	19	Sept.16	12,100	637
East Fork of Terrett Draw near Fort McKavett (e)	30 43	100 10	33	Sept.16	18,700	567
Terrett Draw near Fort McKavett	30 50	100 7	103	Sept.16	35,800	348
West Fork of Terrett Draw near Fort McKavett	30 45	100 10	21	Sept.16	5,880	280
Colston Draw near Fort McKavett	30 47	100 7	24	Sept.16	10,000	417
Llano River Basin						
North Llano River at Roosevelt	30 30	100 3	443	Sept.16	22,600	51.0
West Fork of Copperas Creek near Roosevelt	30 33	100 3	81	Sept.16	50,400	622
Copperas Creek near Roosevelt	30 31	100 0	118	Sept.16	98,900	838
Bear Creek near Junction	30 32	99 50	155	Sept.16	31,300	202
South Llano River below Telegraph	30 21	99 54	540	Sept.16	87,600	-
Miscellaneous Basins						
Sandy Creek near Marble Falls	30 34	98 28	344	Sept.15	41,500	121
Walnut Creek near Marble Falls	30 32	98 27	24	Sept.15	13,600	567
Hamilton Creek near Marble Falls	30 38	98 14	67	Sept.26	29,100	435
Nueces River Basin						
West Nueces River near Brackettville	29 44	100 24	402	Sept.16	32,500	-

a Indeterminate.
b Peak early in morning.
c Peak during night.
d Above Coal Kiln Draw.
e Below Coal Kiln Draw.

Brazos River near Glen Rose, Tex.

Location.- Lat. 32°15'40", long. 97°41'50", a quarter of a mile above Glen Rose-Cleburne highway bridge, 4 miles northeast of Glen Rose, Somervell County. Zero of gage is 566.66 feet above mean sea level.

Drainage area.- 24,840 square miles, of which about 9,240 square miles is probably non-contributing.

Gage-height record.- Water-stage recorder graph except Sept. 20 to 8 p.m. Sept. 26 and Oct. 1-20, when it was determined from graph drawn on basis of daily Weather Bureau gage readings. Gage heights used to half tenths between 2.7 and 4.5 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements below 67,400 second-feet; extended to peak stage.

Maxima.- 1936: Discharge, 67,300 second-feet 9 p.m. Sept. 27 (gage height, 19.42 feet).
1923-35: Discharge, 97,600 second-feet May 18, 1935 (gage height, 23.68 feet), by rating curve extended above 67,400 second-feet.
Maximum stage known, about 30.0 feet May 8 or 9, 1922 (discharge not determined).

Remarks.- No diversions of consequence.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			25	25,100	49,790	4	7,980	15,830	14	851	1,690
16	1,240	2,460	26	19,700	39,070	5	5,720	11,350	15	740	1,470
17	13,400	26,580	27	45,100	89,450	6	5,240	10,390	16	719	1,430
18	40,500	80,330	28	58,300	115,600	7	4,170	8,270	17	648	1,290
19	23,700	47,010	29	58,000	115,000	8	3,000	5,950	18	610	1,210
20	13,200	26,180	30	42,900	85,090	9	2,230	4,420	19	572	1,130
21	9,850	19,540	Oct.			10	1,740	3,450	20	536	1,060
22	7,550	14,980	1	24,700	48,990	11	1,440	2,860			
23	8,550	16,960	2	15,600	30,940	12	1,230	2,440			
24	13,000	25,790	3	10,700	21,220	13	1,010	2,000			
Run-off, in acre-feet, for period Sept. 16 to Oct. 20											931,200

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 16			September 21		8am	10.76	26,500	6pm	6.10	10,100
1am	0.53	33	12N	5.95	10,100	9	10.73	26,100	12M	5.82	9,280
9	.60	52	6pm	5.70	9,280	10	11.18	28,100		October 4	
3pm	1.06	272	12M	5.50	8,760	12N	12.95	35,700	12N	5.28	7,720
4	2.49	1,940		September 22		3pm	17.13	54,600	12M	4.66	6,200
6	3.90	4,760	12N	5.00	7,460	6	19.03	64,900		October 5	
7	4.61	6,440	12M	4.65	6,440	8	19.38	67,300	3am	4.50	5,840
8	4.67	6,680		September 23		10	19.37	67,300	6pm	4.44	5,720
9	3.53	3,840	1am	4.70	6,680		September 28			October 6	
11	1.62	761	4	5.80	9,540	3am	17.64	57,200	6am	4.37	5,480
12M	1.50	638	7	6.30	10,900	6	17.44	56,200	12N	4.30	5,360
	September 17		12N	5.80	9,540	7	17.34	55,700	12M	4.07	4,760
2am	1.64	784	6pm	5.00	7,460	11	17.62	57,200		October 7	
4	3.68	4,170	12M	4.50	6,200	3pm	17.73	57,700	12N	3.79	4,170
6	3.87	4,640		September 24		7	18.07	59,900		October 8	
7	3.86	4,640	3am	4.40	5,960	12M	18.16	60,400	12N	3.28	3,000
10	3.67	4,170	6	4.60	6,440		September 29			October 9	
1pm	3.49	3,840	10	5.60	9,020	9am	18.38	61,500	12N	2.87	2,230
2	5.22	7,980	12N	6.40	11,200	11	18.16	60,400		October 10	
3	6.77	12,400	6pm	8.80	19,000	6pm	17.20	55,100	12N	2.56	1,720
4	8.13	16,500	12M	10.60	25,700	12M	16.20	50,300		October 11	
6	11.08	27,700		September 25			September 30		12N	2.38	1,440
12	13.50	37,900	3am	11.25	28,100	6am	15.58	47,500		October 12	
	September 18		5	11.40	29,000	12N	15.00	44,700	12N	2.23	1,230
3am	14.20	41,000	8	11.15	28,100	6pm	13.67	38,800		October 13	
6	14.44	41,900	3pm	10.30	24,500	12M	11.92	31,100	12N	2.08	1,010
7	14.47	42,400	12M	9.00	19,700		October 1			October 14	
8	14.46	42,400		September 26		6am	11.05	27,300	12N	1.97	851
3pm	14.14	40,600	12N	7.85	15,600	12N	10.34	24,500		October 15	
5	14.13	40,600	5pm	7.40	14,300	6pm	9.62	21,800	12N	1.89	740
9	13.76	39,200	6	7.70	15,200	12M	8.94	19,300		October 16	
	September 19		7	9.10	20,000		October 2		12N	1.87	719
6am	11.50	29,400	8	10.80	26,500	6am	8.30	17,200		October 17	
12N	9.60	21,800	11	13.20	36,600	12N	7.72	15,200	12N	1.80	648
6pm	8.34	17,200	12M	13.40	37,500	6pm	7.29	14,000		October 18	
12M	7.70	15,200		September 27		12M	6.97	13,000	12N	1.76	610
	September 20		1am	13.48	37,900		October 3			October 19	
12N	7.00	13,000	2	13.24	36,600	6am	6.67	11,500	12N	1.72	572
6pm	6.70	12,100	4	11.97	31,500	12N	6.38	10,700		October 20	
12M	6.45	11,200	6	11.17	28,100				12N	1.68	536

Note.- Discharge determined by shifting-control method Sept. 16, 17, Oct. 3-20.

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Brazos River at Waco, Tex.

Location.- Lat. 31°33'40", long. 97°7'45", at Washington Avenue Bridge in Waco, McLennan County, 2½ miles below Bosque River. Zero of gage is 357.10 feet above mean sea level.
Drainage area.- 28,500 square miles, of which about 9,240 square miles is probably noncontributing; 1,661 square miles affected by 39,000 acre-feet of storage in Lake Waco on Bosque River.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 8.5 and 10.7 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements.
Maxima.- 1936: Discharge, 246,000 second-feet 9:30 p.m. Sept. 27 (gage height, 40.9 feet).
1898-1935: Stage 39.7 feet Dec. 3, 1913 (levee on left bank broken, discharge not determined).
1854-97: Discharge, 119,000 second-feet May 28, 1885 (gage height, 34.2 feet).
Remarks.- Small diversions above affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			25	16,800	33,320	3	18,200	36,100	12	3,600	7,140
17	3,250	6,450	26	25,600	50,780	4	10,700	21,220	13	1,650	3,270
18	19,300	38,280	27	143,000	283,600	5	7,080	14,040	14	1,500	2,980
19	28,300	56,130	28	158,000	313,400	6	7,430	14,740	15	1,400	2,780
20	18,500	36,690	29	72,800	144,400	7	6,210	12,320	16	1,300	2,580
21	13,100	25,980	30	54,200	107,500	8	4,110	8,150	17	1,170	2,320
22	11,300	22,410	Oct.			9	3,330	6,600	18	1,040	2,060
23	7,810	15,490	1	40,400	80,130	10	2,620	5,200	19	2,670	5,300
24	13,400	26,580	2	24,100	47,800	11	2,090	4,150	20	888	1,760
Run-off, in acre-feet, for period Sept. 17 to Oct. 20 1,442,000											

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 17		9am	15.89	13,400	3pm	36.41	138,000	7am	14.04	10,000
1am	7.03	222	10	16.43	14,700	8	35.17	117,000	8	13.69	9,410
12N	7.71	556	12N	16.84	15,800	12M	33.82	100,000	12N	11.99	6,180
1pm	9.15	1,700	2pm	16.86	16,000		September 29		9pm	11.45	5,230
2	10.98	4,030	7	16.37	14,700	6am	31.67	80,900	10	11.61	5,540
5	12.27	6,020	9	15.17	11,800	12N	30.00	70,000	12M	12.63	7,220
6	12.40	6,180		September 25		6pm	28.73	62,800		October 7	
8	13.45	8,000	2am	13.88	9,000	10	28.16	60,100	3am	13.35	8,800
10	13.62	8,400	3	13.79	8,800	11	28.31	60,600	5	13.47	9,000
	September 18		4	14.25	9,620		September 30		6	13.48	9,000
1am	13.67	8,600	7	16.24	14,200	1am	28.23	60,100	7	13.41	8,800
4	13.94	9,000	12N	17.72	18,300	7	27.78	58,000	8	12.85	7,600
6	15.69	13,000	3pm	18.15	19,800	8	27.52	56,500	12N	11.53	5,380
9	17.71	18,300	7	18.74	21,400	12N	26.89	53,500	4pm	11.15	4,930
12N	19.04	22,300		September 26		9pm	25.93	49,000	12M	10.91	4,480
3pm	19.21	22,900	1am	18.98	22,300		October 1			October 8	
7	20.13	25,800	2	19.79	24,900	6am	24.96	45,200	12N	10.54	4,030
12M	20.32	26,600	3	19.88	25,200	12N	24.00	41,000		October 9	
	September 19		5	19.83	24,900	6pm	22.80	36,200	12N	9.87	3,260
4am	20.75	28,300	8	19.68	24,500	12M	21.41	30,600		October 10	
10	20.91	28,600	10	19.65	24,200		October 2		12N	9.26	2,620
6pm	20.95	29,000	1pm	19.23	22,900	6am	20.19	26,200		October 11	
8	20.73	28,000	3	20.77	28,300	1pm	19.13	22,600	11pm	8.65	1,920
	September 20		5	21.30	30,200	3	19.52	23,900	12M	9.37	2,740
3am	19.38	23,600	6	21.30	30,200	4	19.39	23,600		October 12	
12N	17.45	17,500	8	20.43	26,900	6	18.73	21,400	2am	10.93	5,080
3pm	16.88	16,000	12M	19.29	23,300	12M	18.09	19,500	4	11.47	6,020
6	16.66	15,500		September 27			October 3		6	11.67	6,340
	September 21		1am	20.55	27,600	9am	17.55	18,600	7	11.68	6,340
1am	16.51	16,000	2	23.08	37,400	11	18.23	20,400	8	11.18	5,540
6	16.21	14,200	3	24.98	45,200	1pm	18.37	21,100	11	9.74	3,400
6pm	15.27	12,000	4	27.30	65,500	2	18.36	21,100	3pm	8.92	2,320
12M	14.92	11,100	5	29.30	66,200	3	17.78	19,200	6	8.68	2,090
	September 22		7	31.97	83,000	6	16.92	16,600	9	8.55	1,920
4am	14.96	11,300	9	33.97	102,000	12M	16.00	14,200	12M	8.47	1,820
2pm	15.28	12,000	12N	36.65	141,000		October 4			October 13	
5	15.28	12,000	3pm	38.71	187,000	8am	14.67	11,800	12N	8.27	1,650
7	14.99	11,300	6	39.90	217,000	4pm	13.86	9,620		October 14	
10	14.42	10,000	8	40.81	243,000	12M	13.06	8,000	12N	8.04	1,500
	September 23		9	40.91	246,000		October 5			October 15	
3am	14.34	9,830	10	40.75	243,000	12N	12.34	6,680	12N	7.83	1,400
12N	13.24	7,600	12M	40.37	232,000	8pm	12.00	6,180		October 16	
10pm	12.80	6,860		September 28		9	12.37	6,860	12N	7.62	1,300
11	12.88	7,040	3am	39.81	215,000	11	13.50	9,000		October 17	
	September 24		6	38.77	189,000		October 6		12N	7.44	1,170
1am	14.49	10,200	11	37.29	155,000	1am	13.89	9,830		October 18	
5	15.65	12,700	12N	37.19	153,000	2	13.97	10,000	11pm	7.24	994

Note.- Discharge determined by shifting-control method Oct. 3-18.

Brazos River near Bryan, Tex.

Location.- Lat. 30°37', long. 96°29', 2.4 miles below mouth of Little Brazos River and 9 miles southwest of Bryan, Brazos County. Zero of gage is 192.2 feet above mean sea level.

Drainage area.- 38,430 square miles, of which about 9,240 square miles is probably non-contributing.

Gage-height record.- Water-stage recorder graph except Oct. 7 to 5 p.m. Oct. 14, 1936, when it was determined from graph plotted from two or more gage readings daily. Gage heights used to hundredths between 4.8 and 7.0 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements.

Maxima.- 1936: Discharge, 133,000 second-feet 6-9 p.m. Oct. 1, 1936 (gage height, 41.96 feet).

1918-35: Stage observed, 46.1 feet, present site and datum, May 20, 1930 (discharge not determined).

1899-1917: Stage, about 54.0 feet (present datum) Dec. 3, 1913 (discharge not determined).

Remarks.- Small diversions above affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			25	14,700	29,160	3	59,000	117,000	12	6,240	12,380
17	1,100	2,180	26	17,300	34,310	4	32,900	65,260	13	6,070	12,040
18	6,060	12,020	27	30,400	60,300	5	22,400	44,430	14	5,600	11,110
19	24,600	48,790	28	54,600	108,300	6	18,100	35,900	15	4,890	9,700
20	34,400	68,230	29	82,300	163,200	7	18,500	36,700	16	4,470	8,870
21	23,200	46,020	30	105,000	208,300	8	18,300	36,300	17	4,050	8,030
22	14,800	29,360	Oct.			9	16,900	33,520	18	3,790	7,520
23	12,900	25,590	1	128,000	253,900	10	14,200	28,170	19	3,530	7,000
24	10,100	20,030	2	106,000	210,200	11	8,250	16,360	20	3,410	6,760
Run-off, in acre-feet, for period Sept. 17 to Oct. 20 1,817,000											

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.
	September 17	
3am	3.48	385
12N	3.67	484
3pm	4.40	940
6	5.43	1,730
9	6.14	2,360
12M	6.67	2,940
	September 18	
3am	7.27	3,660
6	7.92	4,470
12N	8.98	6,070
3pm	9.42	6,800
6	9.69	7,400
9	9.89	7,820
12M	10.33	8,710
	September 19	
3am	12.26	13,700
5	13.55	17,400
9	15.32	22,700
6pm	17.58	30,200
12M	18.41	32,800
	September 20	
6am	18.96	34,800
10	19.19	35,400
3pm	19.20	35,400
5	19.14	35,100
9	18.75	34,100
	September 21	
3am	17.64	30,200
9	16.13	25,300
3pm	14.78	21,100
9	13.92	18,300
	September 22	
6am	13.19	16,200
12N	12.73	14,800
9pm	12.16	13,400
12M	12.07	13,200
	September 23	
4pm	12.08	13,200
9	11.79	12,400

Time	Feet	Sec.ft.
12M	11.55	11,800
	September 24	
9am	10.97	10,400
3pm	10.75	9,880
	September 25	
1am	10.61	9,400
4	11.02	10,400
5	11.98	12,900
9	13.41	16,800
10	13.57	17,400
11	13.58	17,400
12N	13.50	17,100
3pm	13.02	15,600
5	12.87	15,300
6	12.84	15,000
10	12.84	15,000
12M	12.91	15,300
	September 26	
3am	13.16	16,200
5	13.65	17,400
9	14.50	20,200
11	14.58	20,500
1pm	14.23	19,300
3	14.50	20,200
5	16.17	25,600
9	16.63	27,000
	September 27	
3am	17.02	28,200
12N	17.34	29,200
8pm	17.66	30,500
9	17.79	30,800
10	18.22	32,200
12M	20.08	38,400
	September 28	
6am	22.03	45,300
12N	24.20	52,900
6pm	26.60	61,400
12M	28.59	69,000
	September 29	
6am	30.39	76,000

Time	Feet	Sec.ft.
12N	32.06	81,900
6pm	33.51	87,900
12M	35.00	93,600
	September 30	
3am	35.76	97,300
6	36.63	100,000
9	37.54	104,000
12N	38.48	107,000
3pm	39.28	109,000
6	40.07	111,000
9	40.58	115,000
12M	41.00	119,000
	October 1	
3am	41.34	123,000
6	41.50	125,000
9	41.66	128,000
12N	41.77	130,000
3pm	41.87	131,000
6	41.96	133,000
9	41.96	133,000
12M	41.91	131,000
	October 2	
3am	41.75	126,000
9	41.06	113,000
3pm	39.82	100,000
9	38.00	88,000
12M	36.79	81,700
	October 3	
3am	35.38	75,500
6	33.79	69,100
12N	30.58	57,900
6pm	27.45	48,400
12M	24.70	41,200
	October 4	
6am	22.75	36,500
6pm	19.83	29,300
12M	18.57	26,600
	October 5	
12N	16.68	22,200

Time	Feet	Sec.ft.
	October 6	
6pm	14.52	17,200
12M	14.87	18,100
	October 7	
3am	14.97	18,300
6	15.06	18,500
11pm	15.06	18,500
	October 8	
6am	14.93	18,100
6pm	15.00	18,300
12M	14.91	18,100
	October 9	
6pm	14.21	16,500
12M	13.54	14,800
	October 10	
6am	13.21	15,000
12N	13.16	15,000
6pm	12.89	14,200
12M	11.40	10,400
	October 11	
6am	10.54	8,710
	October 12	
12N	9.20	6,070
	October 13	
7am	8.80	5,450
12N	9.07	5,910
7pm	9.59	6,800
	October 14	
12N	8.75	5,450
	October 15	
12N	8.33	4,890
	October 16	
12N	8.00	4,330
	October 17	
12N	7.72	4,050
	October 18	
12N	7.63	3,790
	October 19	
12N	7.29	3,410
	October 20	
12N	7.09	3,170

Note.- Discharge determined by shifting-control method Sept. 17-30, Oct. 11-20.

Brazos River at Richmond, Tex.

Location.- Lat. 29°35', long. 95°45', on highway bridge in Richmond, Fort Bend County, about 1,500 feet downstream from Galveston, Harrisburg & San Antonio Railway bridge. Zero of gage is 40.8 feet above mean sea level.
Drainage area.- 44,050 square miles, of which about 9,240 square miles is probably noncontributing.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths below 4.0 feet and tenths above this limit.
Stage-discharge relation.- Defined by current-meter measurements.
Maxima.- 1936: Discharge, 77,100 second-feet 12:01 a.m. to 4 a.m. Oct. 5, 1936 (gage height, 32.17 feet).
1903-6, 1922-35: Discharge, 120,000 second-feet June 6, 1929 (gage height, 40.6 feet).
1899-1902, 1907-21: Stage, 45.4 feet (present datum) December 1913 (discharge not determined).
Remarks.- Considerable water diverted above station for irrigation and municipal use.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			28	22,600	44,830	6	65,100	129,100	15	6,890	13,670
20	1,260	2,500	29	32,600	64,660	7	45,000	89,260	16	7,400	14,680
21	15,600	30,940	30	47,200	93,620	8	30,200	59,900	17	6,890	13,670
22	23,400	46,410	Oct.			9	24,000	47,600	18	5,970	11,840
23	17,600	34,910	1	59,800	118,600	10	20,900	41,450	19	5,550	11,010
24	13,300	26,380	2	68,100	135,100	11	18,400	36,500	20	5,020	9,960
25	11,900	23,600	3	73,000	144,800	12	14,600	29,000			
26	10,800	21,420	4	76,100	150,900	13	11,000	21,820			
27	14,100	27,970	5	75,700	150,100	14	8,480	16,820			
Run-off, in acre-feet, for period Sept. 20 to Oct. 20											1,663,000

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.
	September 20	
1am	3.79	1,060
8pm	3.85	1,090
9	4.08	1,220
10	5.00	1,770
11	6.44	2,830
12M	7.90	4,320
	September 21	
1am	9.13	5,830
2	10.12	7,400
3	10.82	8,660
6	12.48	12,400
12N	14.36	17,100
6pm	15.48	20,000
12M	15.98	21,400
	September 22	
4am	16.27	24,600
6	16.28	24,600
9	16.17	24,300
6pm	15.57	22,600
	September 23	
6am	14.29	18,900
6pm	13.20	16,100
	September 24	
6am	12.38	14,100
6pm	11.88	12,800
	September 25	
6am	11.63	12,100
6pm	11.37	11,700
	September 26	
12N	10.92	10,600
4pm	10.93	10,600
9	11.12	11,000

Time	Feet	Sec.ft.
	September 27	
6am	11.74	12,400
12N	12.19	13,600
3pm	12.54	14,300
9	13.45	16,600
	September 28	
6am	14.92	20,600
12N	15.72	22,800
6pm	16.30	24,600
12M	16.93	26,400
	September 29	
6am	17.74	29,000
12N	18.78	32,600
6pm	19.84	35,900
12M	20.98	39,900
	September 30	
6am	22.11	43,500
12N	23.27	47,500
6pm	24.38	51,100
12M	25.33	54,100
	October 1	
6am	26.32	57,400
12N	27.12	60,000
6pm	27.86	62,700
12M	28.58	65,000
	October 2	
6am	29.15	67,000
12N	29.60	68,300
6pm	30.02	69,600
12M	30.43	71,000
	October 3	
6am	30.76	72,300
12N	31.00	73,000
6pm	31.30	74,000

Time	Feet	Sec.ft.
12M	31.54	74,700
	October 4	
6am	31.78	75,700
12N	31.96	76,400
6pm	32.12	76,800
12M	32.17	77,100
	October 5	
4am	32.17	77,100
8	32.07	76,800
12N	31.93	76,100
6pm	31.49	74,700
12M	30.89	72,700
	October 6	
6am	29.97	69,600
12N	28.82	65,600
6pm	27.37	61,000
12M	25.77	55,700
	October 7	
6am	24.20	50,500
12N	22.30	44,200
6pm	20.90	39,600
12M	19.74	35,600
	October 8	
6am	18.80	32,600
12N	17.95	30,000
6pm	17.31	27,700
12M	16.84	26,100
	October 9	
6am	16.34	24,600
12N	16.02	23,700
6pm	15.80	23,100
12M	15.61	22,600
	October 10	
6am	15.40	21,400

Time	Feet	Sec.ft.
12N	15.21	20,900
6pm	14.99	20,300
12M	14.80	19,800
	October 11	
6am	14.55	19,200
12N	14.30	18,400
6pm	14.01	17,600
12M	13.64	16,600
	October 12	
8am	13.10	15,300
4pm	12.56	14,100
	October 13	
12N	11.28	11,000
	October 14	
12N	10.24	8,480
	October 15	
7am	9.20	6,730
11	9.14	6,570
4pm	9.23	6,730
12M	9.52	7,230
	October 16	
6am	9.62	7,400
2pm	9.66	7,570
12M	9.49	7,230
	October 17	
12N	9.26	6,890
	October 18	
12N	8.84	5,970
	October 19	
12N	8.47	5,550
	October 20	
12N	8.12	5,020

Note.- Discharge determined by shifting-control method Sept. 20, 21, Oct. 10-20.

North Bosque River near Clifton, Tex.

Location.- Lat. 31°48', long. 97°35', a quarter of a mile above Gulf, Colorado & Santa Fe Railway bridge and 1.4 miles northwest of Clifton, Bosque County. Zero of gage is 622.7 feet above mean sea level.

Drainage area.- 974 square miles.

Gage-height record.- Graph drawn from two or more readings daily of staff gage and readings of peak stages from marks left on gage. Gage heights used to half tenths between 1.9 and 2.8 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements and one slope-area measurement at an intermediate stage.

Maxima.- 1936: Discharge, 34,700 second-feet 8:45 a.m. Sept. 27 (gage height, 19.8 feet, observed at crest).

1923-35: Discharge, 38,300 second-feet May 18, 1935 (gage height, 21.3 feet, from flood marks).

1887-1922: Stage, about 25 feet May 9, 1922 (discharge not determined).

Remarks.- No diversions.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			19	138	274	23	26	52	27	26,700	52,960
16	2,320	4,600	20	49	97	24	37	73	28	9,400	18,640
17	3,990	7,910	21	35	69	25	239	474	29	608	1,210
18	1,120	2,220	22	26	52	26	2,700	5,360	30	302	599
Run-off, in acre-feet, for period Sept. 16-30											94,590

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 16		6pm	1.92	680	3am	2.90	1,860	8pm	14.50	24,900
1am	0.87	62	12M	1.54	373	6	2.50	1,340	12M	12.60	21,900
7	0.83	53		September 19		12N	1.70	500		September 28	
10	1.07	123	6am	1.22	176	2pm	1.50	342	2am	11.70	20,300
12N	1.29	229	12M	.91	65	3	1.45	308	4	10.75	18,700
2pm	1.65	484		September 20		4	1.50	342	6	9.90	17,000
4	2.88	1,860	12N	.84	49	5	1.60	420	8	8.90	14,900
6	4.20	3,990		September 21		6	2.30	1,100	10	7.55	11,700
8	5.47	6,650	12N	.77	35	8	4.65	4,770	12N	6.20	8,240
10	6.85	9,950		September 22		10	7.00	10,200	2pm	4.80	5,170
11	7.00	10,200	12N	.72	26	12M	9.25	15,600	4	3.45	2,590
12M	6.96	10,200		September 23			September 27		5	2.90	1,860
	September 17		12N	.72	26	1am	10.45	18,000	6	2.75	1,660
1am	6.60	9,200		September 24		2	11.55	20,200	8	2.50	1,340
4	4.95	5,590	12N	.78	37	3	12.65	21,900	10	2.35	1,160
6	4.02	3,610		September 25		4	13.95	24,100	12M	2.15	935
7	3.97	3,610	4pm	0.85	51	6	16.10	27,600		September 29	
8	3.94	3,430	6	1.25	192	8	18.35	31,800	4am	1.90	730
12N	3.81	3,250	8	1.70	500	9	19.80	34,700	8	1.80	626
6pm	3.62	2,910	10	2.25	1,040	10	19.80	34,700	12M	1.50	373
10	3.27	2,440	12M	2.70	1,600	11	19.00	33,000		September 30	
	September 18			September 26		12N	18.40	31,800	12M	1.30	240
6am	2.68	1,600	1am	2.95	2,000	2pm	17.10	29,400			
12N	2.25	1,040	2	3.00	2,000	4	16.10	27,600			

Note.- Discharge determined by shifting-control method Sept. 16, 29, 30.

Bosque River at Lake Waco, near Waco, Tex.

Location.- Lat. 31°34'30"; long. 97°12'0", at Lake Waco Dam on Bosque River, 5 miles above mouth and 6 miles northwest of Waco, McLennan County. Zero of gage is at mean sea level.

Drainage area.- 1,660 square miles.

Gage-height record.- Water-stage recorder graph.

Stage-discharge relation.- Variable, depending on position of gates. Discharge record of gate openings and copy of water-stage recorder graph furnished by Water Department of City of Waco.

Maxima.- 1936: Discharge, 96,000 second-feet 1 p.m. Sept. 27 (gage height, 430.65 feet).

1929-35: Discharge not known but was less than in 1936.

Remarks.-Storage capacity of lake is 27,000 acre-feet at spillway crest, 415.0-foot stage, and 80,000 acre-feet at top of gates, 430.0-foot stage.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Second-feet	Acre-feet
September 26	6,000	11,900
27	68,400	135,700
28	29,600	58,710
29	2,040	4,050
Run-off, in acre-feet, for period September 26-29 - - 210,400		

Discharge, in second-feet, at indicated time, 1936

Time	Sec.-ft.	Time	Sec.-ft.	Time	Sec.-ft.	Time	Sec.-ft.
September 26		2:45am	28,000	6:00pm	84,600	5:55am	30,600
10:40am	0	2:45	32,000	6:15	85,100	5:55	36,400
10:45	9,880	3:05	32,400	6:15	79,500	7:00	36,200
11:30	10,000	3:05	36,400	7:00	80,400	8:25	35,800
12:25pm	9,880	3:10	37,800	8:05	79,500	8:25	30,100
12:25	14,800	3:50	38,200	8:05	74,000	10:00	30,300
12:40	14,700	3:50	42,300	8:10	74,000	11:20	30,300
12:40	19,600	5:15	44,100	8:10	68,500	11:20	28,600
1:30	18,800	5:15	48,400	8:15	69,300	1:00pm	28,700
2:30	18,000	5:25	49,400	8:15	63,700	3:00	28,900
3:25	17,200	5:25	53,800	8:20	64,400	4:00	28,400
3:25	12,900	6:00	55,100	8:20	58,700	5:00	28,200
5:00	12,400	6:00	59,600	8:30	59,400	6:00	27,600
5:00	8,250	6:15	60,400	8:30	53,600	6:00	22,100
6:00	8,080	6:15	64,900	9:00	54,700	7:00	22,000
8:00	7,860	6:30	65,700	10:00	54,700	8:30	21,200
10:00	7,500	6:30	74,900	11:00	53,700	8:30	15,900
12:00M	7,350	7:00	75,900	12:00M	52,800	8:45	15,700
September 27		8:00	79,400	September 28		8:45	10,500
1:30am	7,660	9:00	85,100	1:00am	51,900	10:00	10,400
1:30	11,500	10:00	89,400	1:55	51,400	11:00	10,300
1:40	11,600	11:00	94,700	1:55	45,900	12:00M	10,100
1:40	15,400	12:00N	95,300	3:00	45,400	September 29	
1:50	15,500	1:00pm	96,000	3:00	40,000	1:25am	9,780
1:50	19,400	2:00	94,700	3:15	40,000	1:25	4,890
2:00	19,600	3:00	93,600	3:15	34,500	3:00	4,830
2:00	23,500	4:00	92,600	4:00	34,900	6:00	4,740
2:10	23,600	5:00	91,600	4:50	35,500	8:40	4,660
2:10	27,600	6:00	90,200	4:50	29,900	8:40	0

Little River at Cameron, Tex.

Location.- Lat. 30°50', long. 96°57', 2,100 feet above Cameron-Rockdale highway bridge, 2 miles southeast of Cameron, Milam County. Zero of gage is 281.9 feet above mean sea level.

Drainage area.- 7,034 square miles.

Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 5.0 and 6.2 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements below 84,000 second-feet; extended to peak stage on basis of logarithmic curve and slope-area measurement of 647,000 second-feet made Sept. 10, 1921.

Maxima.- 1936: Discharge, 150,000 second-feet 4 p.m. Sept. 29 (gage height, 38.75 feet, present site and datum).

1916-35: Discharge, 647,000 second-feet, by slope-area method, Sept. 10, 1921 (gage height, 53.2 feet, present site and datum).

1852-1915: Stage, 52.4 feet, present site and datum, in 1852 (discharge not determined).

Remarks.- Small diversions affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			25	3,330	6,600	4	9,400	18,640	14	2,290	4,540
16	1,220	2,420	26	3,540	7,020	5	9,200	18,250	15	1,980	3,930
17	5,830	11,560	27	4,470	8,870	6	9,480	18,800	16	1,790	3,550
18	8,480	16,820	28	8,220	16,300	7	10,300	20,430	17	1,640	3,250
19	7,070	14,020	29	80,000	158,700	8	11,600	23,010	18	1,560	3,090
20	3,770	7,480	30	60,300	119,600	9	9,350	18,550	19	1,450	2,880
21	1,640	3,250	Oct.			10	4,490	8,910	20	1,370	2,720
22	2,610	5,180	1	25,800	51,170	11	2,810	5,570			
23	3,090	6,130	2	16,200	32,130	12	2,450	4,860			
24	3,210	6,370	3	11,500	22,810	13	2,410	4,780			
Run-off, in acre-feet, for period Sept. 16 to Oct. 20 662,200											

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.
	September 16	
1am	3.97	167
9	4.02	179
11	5.06	517
3pm	8.13	1,680
12M	12.13	3,250
	September 17	
6am	14.05	4,040
12N	17.70	5,660
6pm	21.85	7,550
9	23.28	8,300
12M	24.25	8,750
	September 18	
4am	24.80	9,050
8	24.50	8,900
10pm	22.14	7,700
	September 19	
6am	21.37	7,350
6pm	20.36	6,880
12M	18.68	6,120
	September 20	
6am	16.18	5,000
12N	13.02	3,620
6pm	10.26	2,530
12M	8.52	1,830
	September 21	
4am	7.70	1,520
8	7.44	1,410
12N	7.58	1,490
6pm	8.46	1,830
12M	9.30	2,140
	September 22	
6am	10.06	2,450
12N	10.61	2,650
6pm	11.06	2,850
12M	11.41	2,970

Time	Feet	Sec.ft.
	September 23	
12N	11.75	3,130
	September 24	
12N	11.99	3,210
	September 25	
12N	12.25	3,290
	September 26	
12N	12.83	3,540
	September 27	
6am	13.90	4,000
12N	14.78	4,380
6pm	16.12	4,950
12M	17.32	5,480
	September 28	
6am	19.76	6,610
12N	23.20	8,250
6pm	26.06	9,760
12M	28.46	11,200
	September 29	
6am	31.07	12,800
7	31.87	13,500
8	32.61	15,500
9	34.13	28,800
10	35.77	56,600
11	36.81	80,600
12N	37.71	108,000
1pm	38.23	126,000
2	38.62	142,000
3	38.71	146,000
4	38.75	150,000
5	38.70	146,000
6	38.60	142,000
8	38.29	129,000
10	37.98	118,000
12M	37.62	104,000
	September 30	
3am	37.09	88,800

Time	Feet	Sec.ft.
6am	36.57	75,400
9	36.10	63,200
12N	35.69	54,500
3pm	35.34	46,700
6	35.01	41,700
9	34.74	37,200
12M	34.50	34,200
	October 1	
6am	34.08	28,800
12N	33.76	25,600
6pm	33.52	22,700
12M	33.28	20,900
	October 2	
6am	33.08	19,200
12N	32.77	16,800
6pm	32.38	14,400
9	32.10	13,700
12M	31.64	13,200
	October 3	
6am	30.47	12,400
12N	29.02	11,400
6pm	27.46	10,600
12M	26.38	9,920
	October 4	
6am	25.68	9,540
12N	25.31	9,320
6pm	25.15	9,260
	October 5	
2pm	25.10	9,200
	October 6	
12N	25.53	9,420
8pm	25.75	9,590
12M	26.27	9,860
	October 7	
12N	27.00	10,200
12M	28.00	10,800

Time	Feet	Sec.ft.
	October 8	
12N	29.50	11,800
5pm	29.68	11,900
12M	29.33	11,600
	October 9	
6am	28.13	10,900
12N	25.65	9,480
6pm	22.56	7,950
12M	19.48	6,480
	October 10	
6am	16.93	5,310
12N	14.62	4,300
6pm	13.00	3,620
12M	11.96	3,210
	October 11	
12N	10.88	2,770
12M	10.38	2,570
	October 12	
6pm	10.02	2,410
	October 13	
12M	9.98	2,410
	October 14	
12N	9.75	2,330
	October 15	
12N	8.91	1,980
	October 16	
12N	8.42	1,790
	October 17	
12N	8.01	1,640
	October 18	
12N	7.74	1,520
	October 19	
12N	7.51	1,450
	October 20	
12N	7.32	1,370

Colorado River at Ballinger, Tex.

Location.- Lat. 31°43'50", long. 99°56'25", at Ballinger-Paint Rock highway bridge in Ballinger, Runnels County, 2,000 feet above Elm Creek. Zero of gage is 1,593.94 feet above mean sea level.

Drainage area.- 16,840 square miles, of which about 11,500 square miles is probably noncontributing.

Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 3.7 and 5.1 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements below 55,200 second-feet; extended to peak stage on basis of one float measurement of 65,500 second-feet.

Maxima.- 1936: Discharge, 75,400 second-feet 12:30 a.m. Sept. 18 (gage height, 28.6 feet).

1903-35: Maximum stage observed, about 32 feet Aug. 6, 1906, present site and datum (discharge not determined; probably less than in 1936); affected by backwater from Elm Creek.

1882-1902: Stage, about 36 feet in 1884.

Remarks.- Small diversions for irrigation above station affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			22	576	1,140	30	2,050	4,070	7	268	532
15	7,760	15,390	23	7,150	14,180	Oct.			8	235	466
16	2,540	5,040	24	8,900	17,650	1	1,100	2,180	9	216	428
17	48,200	95,600	25	3,160	6,270	2	736	1,460	10	200	397
18	54,300	107,700	26	10,500	20,830	3	549	1,090			
19	6,120	12,140	27	28,300	56,130	4	432	857			
20	2,080	4,130	28	14,300	28,360	5	364	722			
21	864	1,710	29	7,370	14,620	6	313	621			
Run-off, in acre-feet, for period Sept. 15 to Oct. 10											413,700

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15		3pm	28.21	67,400		September 22		12N	12.28	12,800
1am	1.10	2	6	28.34	69,400	11pm	2.68	576	4pm	12.12	12,500
7	1.27	9	8	28.42	71,400	12M	3.17	965		September 29	
8	4.00	1,900	10	28.54	73,400		September 23		2am	12.54	13,000
10	8.00	6,950	12M	28.58	75,400	1am	4.61	2,560	4	12.44	12,900
1pm	11.08	11,100		September 18		9	7.22	5,880	10	8.58	7,760
4	12.54	13,000	1am	28.58	75,400	6pm	10.00	9,660	1pm	6.48	4,980
8	13.64	14,600	2	28.56	75,400	12M	11.36	11,500	12M	4.80	2,860
9	13.75	14,900	4	28.50	73,400		September 24			September 30	
10	13.63	14,600	9	28.00	63,600	6am	12.02	12,400	12N	4.08	2,020
12M	11.85	12,100	10	27.82	59,800	8	11.98	12,400	12M	3.67	1,510
	September 16		12N	27.43	54,700	4pm	7.46	6,280		October 1	
1am	9.80	9,380	4pm	26.22	46,500	8	5.90	4,220	12M	3.39	1,100
3	6.15	4,600	6	25.28	42,700		September 25			October 2	
6	4.13	2,080	8	23.60	36,500	3pm	4.48	2,500	12N	3.00	736
9	3.62	1,460	10	20.96	28,300	12M	6.06	4,480		October 3	
12N	3.36	1,160	12M	18.14	21,700		September 26		12N	2.75	549
1pm	3.48	1,300		September 19		8am	6.45	4,850		October 4	
4	3.12	917	1am	16.36	18,700	1pm	11.16	11,300	12N	2.57	432
7	3.00	810	2	12.50	13,000	6	14.92	16,500		October 5	
9	3.06	863	5	5.56	3,850	12M	16.80	19,400	12N	2.45	364
10	3.60	1,430	7	4.56	2,620		September 27			October 6	
11	6.35	4,850	9	4.23	2,200	3am	18.76	23,000	12N	2.35	313
12M	8.90	8,160	12N	6.98	5,620	5	20.28	26,400		October 7	
	September 17		1pm	7.46	6,280	7	21.48	29,800	12N	2.25	268
1am	11.25	11,300	3	7.74	6,680	10	22.40	32,600		October 8	
3	14.37	15,700	5	7.50	6,280	12N	22.67	33,500	12N	2.17	235
5	16.74	19,200	12M	5.68	3,980	2pm	22.73	33,500		October 9	
6	17.90	21,300		September 20		4	22.36	32,600	12N	2.12	216
7	19.27	24,100	12N	4.03	1,900	7	21.26	29,200		October 10	
8	21.40	29,500	6pm	3.59	1,370	9	20.12	26,000	12N	2.08	200
9	23.97	37,900	12M	3.28	1,010	10	19.56	24,800			
10	25.93	45,100		September 21		12M	18.23	21,900			
11	27.10	52,300	6am	3.14	880		September 28				
12N	27.68	58,000	11	3.25	984	3am	15.98	18,100			
1pm	28.01	63,600	6pm	3.04	785	6	13.95	15,200			
2	28.13	65,500	12M	2.87	643	9	12.73	13,300			

Note.- Discharge determined by shifting-control method Sept. 20, 21 and 1 a.m. 23, Oct. 1-10.

Colorado River near San Saba, Tex.

Location.- Lat. 31°12'45", long. 98°34'1", at Red Bluff Crossing, 5.7 miles below confluence with San Saba River and 9.2 miles east of San Saba, San Saba County. Zero of gage is 1,096.22 feet above mean sea level.
Drainage area.- 30,600 square miles, of which about 11,800 square miles is probably noncontributing.
Gage-height record.- Water-stage recorder graph except for periods 7 p.m. Sept. 20 to 5 p.m. Sept. 27, 7 p.m. Sept. 27 to 9 a.m. Sept. 28, 6 p.m. Sept. 29 to 9 a.m. Oct. 1, 4 a.m. Oct. 3 to Oct. 20, when it is determined from graph plotted from flood marks and two or more gage readings daily. Gage heights used to half tenths between 3.9 and 6.8 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 120,000 second-feet; extended to peak discharge (219,000 second-feet) on basis of one slope-area measurement.
Maxima.- 1936: Discharge, 219,000 second-feet 11:30 a.m. Sept. 21 (gage height, 56.7 feet by flood marks).
1916-35: Discharge, 181,000 second-feet 3 p.m. Apr. 26, 1922 (gage height, about 54 feet, present site and datum).
1900-15: Discharge, 234,000 second-feet Sept. 25, 1900 (gage height, about 57.5 feet, present site and datum).
Remarks.- Small diversions above station for irrigation and municipal use affect low flow only.

Mean dischare, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			24	6,970	13,820	3	10,800	21,420	13	2,320	4,600
15	284	563	25	6,070	12,040	4	8,110	16,090	14	2,140	4,240
16	7,700	15,270	26	12,200	24,200	5	5,340	10,590	15	2,050	4,070
17	46,200	91,640	27	26,900	53,360	6	4,640	9,200	16	1,960	3,890
18	55,600	110,300	28	63,900	126,700	7	4,810	9,540	17	1,880	3,730
19	66,900	132,700	29	56,600	112,300	8	8,080	16,030	18	1,760	3,490
20	96,800	192,000	30	97,500	193,400	9	5,760	11,420	19	1,760	3,490
21	202,000	400,700	Oct.			10	3,740	7,420	20	1,720	3,410
22	125,000	247,900	1	100,000	198,300	11	3,080	6,110			
23	49,000	97,190	2	50,800	100,800	12	2,660	5,280			
Run-off, in acre-feet, for period Sept. 15 to Oct. 20.											2,267,000

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15		6am	36.00	69,300	2pm	8.98	6,080	4am	45.62	114,000
3am	2.18	56	8	36.98	73,300	6	11.00	9,780	6	45.23	112,000
1pm	3.36	504	10	38.50	79,500	12M	11.89	11,500	12N	43.48	103,000
11	3.00	328	12N	40.50	88,300		September 26		4pm	41.86	94,900
	September 16		2pm	42.16	96,400	6am	12.25	12,200	8	40.00	86,000
3am	4.50	1,210	4	44.16	106,000	12N	12.16	12,000	12M	38.04	77,400
7	6.63	3,140	6	46.00	116,000	6pm	12.64	12,800		October 2	
9	8.13	5,340	8	48.50	132,000	12M	12.00	11,600	4am	35.97	69,300
11	9.50	7,920	10	51.00	151,000		September 27		8	33.62	59,800
4pm	11.34	11,300	12M	52.50	165,000	2am	12.53	13,600	12N	30.76	50,500
7	12.13	12,800		September 21		10	19.10	26,100	6pm	25.26	37,900
11	12.54	13,600	2am	53.87	180,000	1pm	20.44	28,600	12M	16.60	21,300
	September 17		6	55.66	203,000	3	20.45	28,600		October 3	
1am	13.05	14,500	7	56.00	208,000	9	25.67	38,600	2am	13.92	16,200
7	18.00	24,000	8	56.24	211,000	11	28.80	45,300	4	11.98	12,600
10	26.61	40,400	9	56.40	214,000		September 28		6	11.08	10,900
1pm	32.50	55,900	10	56.52	216,000	1am	32.08	54,500	12N	9.82	8,480
3	34.71	64,100	11	56.70	219,000	3	35.28	66,500		October 4	
5	36.00	69,300	12N	56.70	219,000	4	36.02	69,300	8am	9.90	8,660
6	36.34	70,500	1pm	56.66	219,000	5	36.40	70,900	4	9.52	7,920
7	36.46	71,300	2	56.58	218,000	7	36.50	71,300		October 5	
8	36.46	71,300	3	56.48	216,000	8	36.43	70,900	6am	8.26	5,520
9	36.36	70,900	4	56.32	213,000	10	36.12	69,700		October 6	
10	36.18	70,100	5	56.13	209,000	12N	35.60	67,700	12N	7.70	4,470
11	35.90	68,900	6	55.92	206,000	2pm	35.00	65,300		October 7	
12M	35.56	67,700	9	55.04	194,000	4	34.38	62,900	6am	7.94	4,980
	September 18		12M	53.66	178,000	8	33.02	57,600	6pm	7.67	4,640
3am	34.38	62,900		September 22		12M	32.16	54,900		October 8	
9	31.88	53,900	5am	51.00	151,000		September 29		1am	7.75	4,810
12N	31.17	51,700	12N	47.16	123,000	7am	31.66	53,300	8	10.00	8,850
3pm	31.00	51,100	6pm	43.14	101,000	12N	31.86	53,900	10	10.34	9,400
6	31.23	51,700	12M	39.16	82,500	5pm	32.34	55,200	4pm	10.34	9,400
12M	33.00	57,600		September 23		9	35.00	65,300		October 9	
	September 19		6am	34.36	62,900	12 M	36.57	71,700	2pm	8.10	5,340
3am	34.26	62,500	10	31.53	52,600		September 30			October 10	
6	36.20	66,100	1pm	26.00	39,200	3am	38.18	78,200	12N	7.16	3,740
9	35.78	68,500	12M	17.34	22,700	7	40.00	86,000		October 11	
12N	36.03	69,300		September 24		12N	43.21	101,000	12M	6.48	2,840
2pm	36.11	69,700	5am	10.44	8,300	6pm	45.09	111,000		October 13	
6	35.97	69,700	12N	8.22	4,310	9	45.74	114,000	12M	5.90	2,230
8	35.72	68,100	4pm	8.90	5,520	11	45.87	115,000		October 17	
12M	35.43	66,900	12M	7.72	3,600		October 1		12M	5.48	1,880
	September 20			September 25		2am	45.90	115,000		October 20	
3am	35.46	67,300	1pm	7.19	3,210	3	45.81	115,000	11pm	5.20	1,640

Note.- Discharge determined by shifting-control method Sept. 24-26, Oct. 5-7, 10-20.

Colorado River at Austin, Tex.

Location.- Lat. 30°16', long. 97°45', at Congress Avenue viaduct in Austin, Travis County. Zero of gage is 421.86 feet above mean sea level.
Drainage area.- 38,150 square miles, of which about 11,800 square miles is probably noncontributing.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 1.4 and 3.6 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements.
Maxima.- 1936: Discharge, 234,000 second-feet 3 to 5 a.m. Sept. 29 (gage height, 31.40 feet).
1898-1935: Discharge, 481,000 second-feet June 15, 1935 (gage height, 42.0 feet, from flood marks).
1843-97: Stage, about 43 feet July 7, 1869 (discharge not determined).
Remarks.- Low flow partly regulated by diversions and reservoirs upstream.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			24	74,300	147,400	3	70,700	140,200	13	5,500	10,910
15	7,380	14,640	25	21,800	43,240	4	26,400	52,360	14	5,020	9,960
16	90,500	179,500	26	11,800	23,400	5	13,400	26,580	15	4,420	8,770
17	115,000	228,100	27	73,800	146,400	6	9,800	19,440	16	4,280	8,490
18	97,800	194,000	28	166,000	329,300	7	9,770	19,380	17	4,150	8,230
19	84,000	166,600	29	81,400	161,500	8	10,300	20,430	18	4,150	8,230
20	70,500	139,800	30	66,100	131,100	9	8,650	17,160	19	4,020	7,970
21	74,800	148,400	Oct.			10	10,800	21,420	20	3,760	7,460
22	111,000	220,200	1	79,000	156,700	11	7,870	15,610			
23	127,000	251,900	2	96,600	191,600	12	6,010	11,920			
Run-off, in acre-feet, for period Sept. 15 to Oct. 20.											3,288,000

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
September 15			6am	14.34	67,600	12M	29.56	204,000	12M	18.30	91,200
3am	-0.74	490	8	14.43	68,200	September 28			October 3		
11	.28	2,050	2pm	14.80	70,500	2am	31.30	232,000	3am	17.66	87,600
4pm	1.63	4,420	8	15.05	71,700	4	31.40	234,000	9	16.04	77,600
6	1.65	4,420	12M	15.03	71,700	6	31.26	232,000	1pm	14.71	69,900
8	5.22	18,600	September 21			7	30.90	225,000	6	12.88	59,300
11	9.00	37,000	10am	15.01	71,700	9	29.58	204,000	12M	10.29	44,200
September 16			2pm	15.28	73,500	12N	27.07	166,000	October 4		
1am	9.70	40,800	12M	17.61	87,000	3pm	23.84	130,000	3am	9.08	37,600
3am	9.88	42,000	September 22			6	21.55	111,000	9	7.22	27,700
6	13.48	62,800	6am	19.53	98,200	9	19.64	98,800	12N	6.57	24,800
12N	20.37	104,000	12N	21.66	112,000	12M	18.19	90,600	6pm	5.50	19,600
3pm	22.68	120,000	10pm	24.00	132,000	September 29			12M	4.82	16,300
5	22.97	122,000	September 23			3am	17.31	85,300	October 5		
6	22.83	120,000	3am	24.44	136,000	6	16.90	82,900	12M	4.14	13,200
8	22.13	115,000	5	24.48	137,000	7	16.83	82,300	October 6		
11	20.62	105,000	7	24.39	136,000	11	16.76	82,300	6am	3.52	10,800
September 17			11	24.00	132,000	2pm	16.68	81,700	10pm	3.13	9,070
1am	19.66	99,400	5pm	23.00	122,000	3	16.60	81,100	October 7		
2	19.54	98,200	12M	21.00	107,000	9	15.83	76,400	2am	3.39	10,300
3	19.67	99,400	September 24			12M	15.32	73,500	4pm	3.21	9,490
5	20.68	105,000	6am	18.63	92,900	September 30			12M	3.47	10,600
9	23.26	125,000	12N	15.74	75,800	6am	14.30	67,600	October 8		
12N	23.93	131,000	6pm	12.28	55,800	9	13.90	65,200	6am	3.48	10,800
1pm	24.15	134,000	12M	9.00	37,000	12N	13.66	64,000	12M	3.26	9,700
3	23.78	130,000	September 25			3pm	13.57	63,400	October 9		
5	23.14	123,000	3am	7.78	31,200	6	13.57	63,400	12N	2.88	8,440
8	21.77	113,000	7	6.59	25,300	12M	13.78	64,600	6pm	2.82	8,040
12M	19.76	100,000	11	5.69	21,000	October 1			12M	3.07	9,070
September 18			10pm	4.20	14,000	1am	13.94	65,200	October 10		
2am	19.32	97,100	September 26			3	14.28	67,600	11am	3.70	11,800
4	19.44	97,700	1am	3.80	12,700	6	14.85	70,500	6pm	3.57	11,000
7	19.98	101,000	5	3.62	11,800	9	15.52	74,600	12M	3.30	9,910
10	20.00	101,000	2pm	3.40	11,000	12N	16.24	78,800	October 11		
1pm	19.66	99,400	6	3.50	11,400	3pm	16.97	83,500	12N	2.78	7,850
5	19.00	95,300	12M	3.88	13,200	7	17.87	88,800	October 12		
12M	18.06	90,000	September 27			12M	18.78	94,100	12N	2.20	6,010
September 19			3am	4.28	14,000	October 2			October 14		
6am	17.88	88,800	7	4.92	16,800	3am	19.16	96,500	12N	1.70	5,020
11	17.68	87,600	8	5.62	20,000	6	19.30	97,700	October 16		
3pm	17.03	83,500	9	7.80	30,700	9	19.50	98,200	12N	1.47	4,280
12M	14.75	70,500	12N	15.40	74,100	2pm	19.46	98,200	October 18		
September 20			3pm	17.83	88,200	3	19.40	97,700	12N	1.39	4,020
3am	14.38	68,200	6	20.26	103,000	6	19.16	96,500	October 20		
4	14.34	67,600	9	26.39	158,000	9	18.76	94,100	12N	1.28	3,760

Note.- Discharge determined by shifting-control method Sept. 15 (3am-8pm), 25, 26, Oct. 6-20.

Colorado River at Smithville, Tex.

Location.- Lat. 30°1', long. 97°10', 1,200 feet above highway bridge at Smithville, Bastrop County. Zero of gage is 270.14 feet above mean sea level.
Drainage area.- 39,650 square miles, of which about 11,800 square miles is probably noncontributing.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 2.9 and 5.2 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 148,000 second-feet; extended to 1935 peak stage on basis of one slope-area measurement of that peak.
Maxima.- 1936: Discharge, 148,000 second-feet at 2 p.m. Sept. 29 (gage height, 31.2 feet).

1920-35: Discharge, 305,000 second-feet June 16, 1935 (gage height, 42.5 feet, from flood marks), by slope-area method.

1913-19: Stage, about 47.4 feet December 1913 (discharge not determined).

Remarks.- Low flow partly regulated by diversions and reservoirs upstream.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			25	92,600	183,700	4	75,700	150,100	14	6,140	12,180
16	11,200	22,210	26	21,200	42,050	5	23,000	45,620	15	5,820	11,540
17	64,500	127,900	27	14,800	29,360	6	13,200	26,180	16	5,500	10,910
18	86,000	170,600	28	72,900	144,600	7	12,000	23,800	17	5,180	10,270
19	92,400	183,300	29	138,000	273,700	8	11,300	22,410	18	4,860	9,640
20	85,300	169,200	30	107,000	212,200	9	10,600	21,020	19	4,700	9,320
21	73,600	146,000	Oct.			10	9,320	18,490	20	4,500	8,930
22	73,600	146,000	1	78,100	154,900	11	10,400	20,630			
23	88,600	175,700	2	81,800	162,200	12	8,300	16,460			
24	113,000	224,100	3	93,400	185,300	13	7,020	13,920			
Run-off, in acre-feet, for period Sept. 16 to Oct. 20.											3,184,000

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 16		6pm	24.72	95,000	3pm	31.17	148,000	12M	9.74	11,800
1am	1.95	455	12M	25.85	103,000	4	31.10	147,000		October 7	
2pm	2.13	548		September 24		6	30.64	142,000	3pm	9.74	11,800
3	6.20	5,020	6am	26.70	110,000	12M	29.47	132,000	9	9.94	12,300
5	11.34	15,900	12N	27.34	114,000		September 30			October 8	
7	14.08	28,600	7pm	27.61	117,000	3am	28.58	125,000	1am	9.94	12,300
9	15.63	37,500	10	27.46	116,000	9	26.92	111,000	1pm	9.28	10,900
12M	17.04	45,900		September 25		3pm	25.46	100,000	5	9.30	10,900
	September 17		3am	26.96	112,000	9	24.14	91,200	12M	9.43	11,100
3am	18.06	52,500	6	26.56	109,000		October 1			October 9	
9	19.60	61,900	12N	25.36	99,800	6am	22.62	81,400	7am	9.36	11,100
3pm	20.72	69,000	3pm	24.22	91,800	12N	21.86	76,800	6pm	9.16	10,600
9	21.52	74,200	6	22.17	78,800	6pm	21.47	74,200	12M	8.93	9,980
12M	21.87	76,800	12M	16.66	44,100	10	21.49	74,200		October 10	
	September 18			September 26		12M	21.60	74,900	12N	8.51	9,100
6am	22.56	81,400	3am	14.58	31,500		October 2		8pm	8.53	9,100
12N	23.38	86,600	6	13.44	24,800	6am	22.06	78,200	12M	8.81	9,760
6pm	24.05	90,500	9	12.60	20,800	12N	22.66	82,000		October 11	
12M	24.47	93,800	12N	12.14	18,600	6pm	23.19	85,300	6am	9.24	10,600
	September 19		6pm	11.26	15,900	12M	23.76	89,200	12N	9.37	10,900
9am	24.46	93,800	12M	10.62	14,000		October 3		6pm	9.15	10,400
11	24.40	93,100		September 27		6am	24.22	91,800	12M	8.82	9,540
6	24.08	91,200	6am	10.27	13,200	2pm	24.71	95,000		October 12	
	September 20		12N	10.10	12,700	8	24.67	95,000	12N	8.24	8,300
6am	23.49	87,200	6pm	10.51	13,700	12M	24.56	94,400		October 13	
12N	23.15	85,300	8	11.10	15,300		October 4		12N	7.54	7,020
6pm	22.67	82,000	9	12.30	19,400	6am	24.00	90,500		October 14	
12M	22.12	78,200	11	14.06	28,600	12N	22.63	81,400	12N	7.14	6,140
	September 21			September 28		6pm	19.80	63,200		October 15	
9am	21.30	73,000	1am	16.33	41,700	9	17.90	51,300	12N	6.89	5,820
12N	21.23	72,300	3	17.42	48,300	12M	16.05	39,900		October 16	
10pm	21.10	71,600	9	19.77	63,200		October 5		12N	6.69	5,500
	September 22		12N	21.77	76,200	6am	13.87	27,400		October 17	
6am	21.19	72,300	6pm	23.54	87,200	12N	12.55	20,800	12N	6.51	5,180
12N	21.32	73,000	12M	26.89	111,000	6pm	11.67	17,200		October 18	
6pm	21.59	74,900		September 29		12M	11.12	15,300	12N	6.34	4,860
12M	22.13	78,200	3am	28.50	124,000		October 6			October 19	
	September 23		9	30.50	142,000	6am	10.66	14,200	12N	6.20	4,700
6am	22.80	82,700	12N	31.12	147,000	12N	10.29	13,200		October 20	
12N	23.63	87,900	1pm	31.18	148,000	6pm	9.98	12,500	12N	6.10	4,550

Note.- Discharge determined by shifting-control method Oct. 10-20.

Colorado River near Eagle Lake, Tex.

Location.- Lat. 29°35', long. 96°25', at Lakeside Irrigation Co.'s pumping plant, 5 miles southwest of Eagle Lake, Colorado County. Zero of gage is 139.56 feet above mean sea level.
Drainage area.- 40,940 square miles, of which about 11,800 square miles is probably noncontributing.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 2.7 and 5.5 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements.
Maxima.- 1936: Discharge, 123,000 second-feet 8 a.m. Oct. 2, 1936 (gage height, 24.4 feet).
1930-35: Discharge, 177,000 second-feet June 19, 1935 (gage height, 29.45 feet).
1913-29: Stage, about 32.0 feet December 1913, present site and datum (discharge not determined).
Remarks.- Diversions above for irrigation and municipal use affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			25	89,800	178,100	3	102,000	202,300	12	12,100	24,000
17	10,900	21,620	26	99,200	196,800	4	95,100	188,600	13	10,400	20,630
18	49,400	97,980	27	67,500	133,900	5	93,200	184,900	14	8,810	17,470
19	65,800	130,500	28	30,900	61,290	6	41,300	81,920	15	7,670	15,210
20	76,800	152,300	29	62,800	124,600	7	22,700	45,020	16	7,050	13,980
21	83,400	165,400	30	88,600	175,700	8	19,500	38,680	17	6,500	12,890
22	83,400	165,400	Oct.			9	15,200	30,150	18	6,160	12,220
23	78,600	155,900	1	109,000	216,200	10	13,200	26,180	19	5,830	11,560
24	81,000	160,700	2	120,000	238,000	11	11,500	22,810	20	5,520	10,950
Run-off, in acre-feet, for period Sept. 17 to Oct. 20.											3,334,000

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 17		12M	21.67	84,700		October 2			October 8	
1am	2.83	832		September 25		6am	24.38	123,000	12N	11.25	19,000
12N	2.69	742	12N	22.03	88,500	8	24.40	123,000	12M	10.71	17,200
1pm	2.78	805	12M	22.50	95,100	11	24.37	123,000		October 9	
2	5.30	3,620		September 26		4pm	24.20	120,000	12N	10.00	14,800
3	8.20	9,570	12N	22.90	101,000	8	24.00	116,000	12M	9.75	14,200
4	10.40	16,100	8pm	23.03	102,000	12M	23.74	112,000		October 10	
5	11.70	20,900	12M	22.97	102,000		October 3		12M	9.25	12,400
7	13.35	27,700		September 27		6am	23.25	105,000		October 11	
9	14.35	31,900	3am	22.77	99,200	6pm	22.60	96,400	12N	8.87	11,500
12M	15.46	36,800	6	22.27	92,400	12M	22.48	95,100	6pm	8.79	11,200
	September 18		9	21.30	79,800		October 4		12M	8.91	11,500
6am	16.98	44,300	12N	20.00	65,500	12N	22.48	95,100		October 12	
12N	17.97	50,400	6pm	16.65	42,000	12M	22.60	96,400	12N	9.27	12,600
6pm	18.71	55,100	12M	14.35	31,900		October 5		12M	8.95	11,800
12M	19.20	58,600		September 28		6am	22.66	97,800		October 13	
	September 19		11am	12.50	24,000	12N	22.62	96,400	12N	8.50	10,400
12N	20.06	66,500	1pm	12.70	24,800	3pm	22.52	95,100		October 14	
9pm	20.57	71,700	3	13.65	28,500	6	22.25	91,100	12N	7.88	8,810
	September 20		6	15.10	35,000	9	21.75	85,900		October 15	
12N	21.11	77,400	12M	17.22	45,400	12M	20.90	75,000	12N	7.43	7,670
	September 21			September 29			October 6			October 16	
12N	21.64	83,400	6am	18.74	55,100	6am	18.20	51,700	12N	7.12	7,050
11pm	21.78	85,900	12N	19.76	63,600	12N	15.50	36,800		October 17	
	September 22		6pm	20.60	71,700	6pm	13.80	29,400	12N	6.85	6,500
12N	21.67	84,700	12M	21.20	78,600	12M	12.76	25,200		October 18	
12M	21.36	81,000		September 30			October 7		12N	6.60	6,160
	September 23		12N	21.95	88,500	6am	12.18	22,800		October 19	
3pm	21.08	77,400	12M	22.80	99,200	12N	12.00	22,000	12N	6.40	5,830
12M	21.12	77,400		October 1		9pm	12.16	22,800		October 20	
	September 24		12N	23.53	109,000	12M	12.11	22,400	12N	6.24	5,520
12N	21.32	79,800	12M	24.17	120,000						

South Concho River at Christoval, Tex.

Location.- Lat. 31°13', long. 100°30', at Panhandle & Santa Fe Railway bridge in Christoval, Tom Green County. Zero of gage is 2,010.22 feet above mean sea level.
Drainage area.- 434 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 3.7 and 5.2 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 8,300 second-feet; extended to peak discharge on basis of slope-area measurement at the peak.
Maxima.- 1936: Discharge, 80,100 second-feet 6 a.m. Sept. 17 (gage height, 20.5 feet) by slope-area measurement.
1930-35: Stage, 20.2 feet Oct. 13, 1930 (discharge not determined).
1882-1929: Stage, about 23 feet Aug. 6, 1906 (discharge not determined).
Remarks.- Diversions above station affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			18	376	746	23	46	91	28	300	595
14	188	373	19	62	123	24	46	91	29	123	244
15	22,900	45,420	20	48	95	25	46	91	30	80	159
16	569	1,130	21	47	93	26	20,100	39,870			
17	24,100	47,800	22	46	91	27	1,440	2,860			
Run-off, in acre-feet, for period Sept. 14-30.											139,900

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 14			September 16		6am	2.88	491	4pm	17.08	46,400
12N	0.86	3	4am	2.93	515	9	2.39	299	5	16.73	43,400
8pm	.86	3	10	2.12	210	12N	2.07	196	6	15.85	36,900
9	1.09	18	1pm	2.34	282	6pm	1.72	122	7	14.00	25,800
10	4.80	1,840	3	3.08	591	12M	1.51	87	8	12.40	18,100
10:10	4.84	1,880	5	2.50	336		September 19		9	10.50	11,400
11	4.03	1,240	6	3.29	709	12N	1.32	59	10	8.40	6,380
12M	9.00	7,620	8	2.90	501		September.20		11	6.90	3,900
	September 15		10	4.25	1,400	12N	1.23	48		September 27	
1am	14.50	28,700	12M	3.87	1,100		September 21		1am	5.22	2,160
2	16.70	43,400		September 17		12N	1.21	46	3	4.26	1,400
3	18.15	55,700	1am	5.50	2,420		September 22		6	3.52	864
3:30	18.48	58,500	2	11.50	14,700	12N	1.21	46	7	3.32	728
4	18.15	55,700	3	14.50	28,700		September 23		8	3.81	1,060
5	15.90	37,500	4	16.76	44,100	12N	1.21	46	9	3.78	1,060
6	13.40	34,200	5	19.00	63,200		September 24		10	4.47	1,560
7	11.90	16,200	6	20.50	80,100	12N	1.21	46	11	5.50	2,420
8	10.23	10,500	7	19.81	71,800		September 25		12N	5.63	2,510
9	10.43	11,100	8	19.25	65,400	12N	1.21	46	1pm	5.52	2,420
11	11.75	15,800	9	18.45	57,600		September 26		5	4.47	1,560
12N	12.50	18,500	10	17.15	47,200	5am	1.25	50	8	3.62	934
2pm	15.13	32,300	11	15.00	31,600	6	4.43	1,560	12M	2.89	496
3	16.15	39,700	12N	13.00	20,800	7	7.40	4,600		September 28	
4	16.77	44,100	1pm	11.10	13,300	8	10.65	11,700	6am	2.60	375
5	15.50	34,900	3	8.70	6,990	9	14.50	28,700	12N	2.37	292
6	12.83	19,800	5	7.20	4,310	10	15.58	35,600	12M	2.03	186
7	9.66	9,210	7	5.57	2,510	11	15.85	36,900		September 29	
8	7.20	4,310	10	5.46	2,420	12N	16.05	38,200	12N	1.83	123
9	6.00	2,870	12M	4.57	1,640	1pm	16.34	40,400		September 30	
10	5.00	2,000		September 18		2	16.90	44,900	12N	1.62	80
12M	4.00	1,200	2am	3.83	1,100	3	17.14	46,400			

Note.- Discharge determined by shifting-control method Sept. 14 (12N-9 pm), 29, 30.

South Concho River at San Angelo, Tex.

Location.- Lat. 31°26'45", long. 100°25'30", at highway bridge half a mile south of San Angelo, Tom Green County, and 1 mile above confluence with North Concho River. Zero of gage is 1,802.94 feet above mean sea level.

Drainage area.- 2,687 square miles, of which about 152 square miles is probably noncontributing, affected by 11,000 acre-feet of storage in reservoirs upstream.

Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 4.4 and 6.7 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements below 11,800 second-feet, formula for flow over control dam from 11,800 to 40,000 second-feet; extended to peak discharge on basis of study of flow over Lake Nasworthy Dam, 6½ miles upstream.

Maxima.- 1936: Discharge, 111,000 second-feet at 12:30 p.m. Sept. 17 (gage height, 23.4 feet, affected by backwater) by slope-area measurement.

1931-35: Discharge, 44,000 second-feet May. 10, 1932 (gage height, 10.98 feet), from rating curve for 1936, discharge not previously published.

1854-1930: Stage, 29.7 feet Aug. 6, 1906 (discharge not determined).

Remarks.- Flow partly regulated by 10,500 acre-feet of storage in Lake Nasworthy, 6½ miles upstream, and by about 500 acre-feet of storage in small reservoirs below Lake Nasworthy.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			18	8,170	16,200	22	400	793	26	41,000	81,320
15	54,400	107,900	19	1,630	3,230	23	300	595	27	44,200	87,670
16	7,410	14,700	20	475	942	24	276	547	28	2,970	5,890
17	53,100	105,300	21	445	883	25	2,900	5,750	29	1,280	2,540
									30	743	1,470
Run-off, in acre-feet, for period Sept. 15-30											435,700

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15		5am	4.53	5,380	5pm	2.80	535	12N	12.20	28,000
1am	2.08	9	6	9.46	35,700		September 21		2pm	16.50	47,100
2	2.95	800	7	14.20	63,600	1am	2.72	415	4	19.46	74,100
3	4.14	3,940	8	16.80	73,900	6	2.85	620	5	19.87	83,000
4	5.91	11,400	10	22.00	97,400	4pm	2.70	385	6	19.94	87,200
5	7.08	18,700	11	23.01	101,000		September 22		7	19.77	89,700
6	12.07	50,400	12N	23.4	111,000	2am	2.67	349	10	19.05	90,800
8	18.34	91,600	3pm	22.82	72,800	6	2.74	445	12M	18.79	93,500
10	20.16	105,000	5	22.53	68,100	10	2.74	445		September 27	
11	20.60	108,000	8	19.76	53,800		September 23		2am	18.01	84,600
12N	19.95	104,000	10	16.50	42,000	12N	2.63	300	4	16.58	69,800
2pm	16.92	81,800	12M	12.64	29,900		September 24		6	15.16	56,100
4	13.43	58,500		September 18		12N	2.61	276	8	13.94	47,800
6	9.95	38,500	2am	9.21	22,700		September 25		12N	11.95	39,300
8	9.44	35,100	4	7.27	16,400	5am	2.64	312	4pm	10.39	33,400
10	10.22	39,600	6	5.28	9,880	7	3.04	973	6	9.42	30,200
11	11.18	45,100	10	4.38	4,750	9	3.14	1,170	8	7.92	24,200
12M	10.88	43,400	11	4.79	6,330	12N	3.64	2,410	10	6.43	15,900
	September 16		12N	4.60	5,560	7pm	4.75	6,140	12M	5.27	8,270
1am	9.67	36,800	6pm	3.49	1,990	8	4.81	6,330		September 28	
2	8.28	27,600	7	3.46	1,920	9	4.79	6,330	2am	4.59	5,560
4	6.10	12,500		September 19		10	4.67	5,750	6	3.90	3,190
7	4.24	4,260	2am	4.02	3,560		September 26		9	3.65	2,440
2pm	3.18	1,260	9	3.28	1,480	2am	3.67	2,500	12N	3.53	2,100
4	3.15	1,200	6pm	2.95	800	4	3.35	1,640	6pm	3.50	2,020
7	2.61	276		September 20		5	3.25	1,410	12M	3.42	1,810
11	2.37	89	11am	2.76	475	6	3.34	1,620		September 29	
	September 17		2pm	2.64	312	8	4.89	6,740	12N	3.13	1,150
4am	3.69	2,530	4	2.78	505	10	6.73	16,100		September 30	
									12N	2.89	688

Note.- Backwater 8 a.m. Sept. 17 to 6 a.m. Sept. 18; 12N Sept. 26 to 10 p.m. Sept. 27.

Concho River near San Angelo, Tex.

Location.- Lat. 31°27'10", long. 100°24'40", half a mile below confluence of North Concho and South Concho Rivers and 1 3/4 miles southeast of San Angelo, Tom Green County. Zero of gage is 1,776.8 feet above mean sea level.
Drainage area.- 4,492 square miles, of which about 275 square miles is probably non-contributing.
Gage-height record.- Graph drawn on basis of comparison with South Concho at San Angelo, recorder chart, flood marks, points obtained by levels to water surface, local information, and staff-gage readings. Gage heights given to tenths.
Stage-discharge relation.- Defined by current-meter measurements below 22,000 second-feet; extended to peak stage on basis of one float and three slope-area measurements.
Maxima.- 1936: Discharge, 230,000 second-feet 1 p.m. Sept. 17 (gage height, 46.6 feet, from flood marks), by slope-area measurement.
1915-35: Discharge, 109,000 second-feet (revised) Apr. 26, 1922 (gage height, 36.8 feet).
1854-1914: Discharge, about 246,000 second-feet Aug. 6, 1906 (gage height, 47.5 feet), by extension of 1936 curve.
Remarks.- Flow partly regulated by diversions and reservoirs upstream.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			19	3,040	6,030	24	352	698	29	1,810	3,590
15	82,300	163,200	20	594	1,180	25	3,280	6,510	30	1,010	2,000
16	14,700	29,160	21	1,280	2,540	26	81,400	161,500			
17	131,000	259,800	22	702	1,390	27	70,600	140,000			
18	17,000	33,720	23	424	841	28	10,300	20,430			
Run-off, in acre-feet, for period Sept. 15-30											832,600

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
September 15			6am	22.0	22,600	September 21			12N	32.5	77,100
12:30	0.73	4	7	30.0	60,600	3pm	2.7	424	1pm	36.5	107,000
1am	9.0	5,140	8	36.0	103,000	4	3.8	952	2	39.7	136,000
2	17.4	15,600	9	41.2	151,000	6	7.1	3,340	3	41.9	158,000
3	20.0	19,200	10	44.6	196,000	6	8.1	4,240	5	42.6	167,000
4	22.1	22,800	11	45.9	218,000	7	7.9	4,060	6	42.4	164,000
5	24.0	28,400	12N	46.4	226,000	9	6.6	2,890	8	41.7	156,000
6	30.0	60,600	1pm	46.6	230,000	12M	4.7	1,500	10	41.4	153,000
7	36.5	107,000	6	45.6	213,000	September 22			12M	40.8	146,000
8	40.2	140,000	7	45.1	204,000	6am	3.4	740	September 27		
9	42.0	160,000	8	43.6	181,000	12N	3.0	549	2am	39.8	137,000
10	43.0	172,000	10	39.2	131,000	September 23			4	37.2	113,000
12N	43.6	181,000	12M	33.5	84,100	12N	2.7	424	6	34.7	92,800
1pm	42.0	160,000	September 18			September 24			8	33.0	80,600
2	40.2	140,000	2am	27.4	45,000	12N	2.5	352	12N	30.8	65,400
3	37.2	113,000	4	24.4	29,900	September 25			3pm	28.9	54,000
4	34.7	92,800	6	21.3	21,100	1am	2.4	318	6	26.7	40,900
5	32.0	73,600	10	15.5	13,000	6	3.8	952	7	25.5	34,800
6	29.2	55,800	4pm	9.4	5,580	9	6.2	2,570	8	24.6	30,700
7	27.3	44,400	8	8.2	4,340	12N	8.0	4,150	9	23.6	27,000
9	26.9	42,000	September 19			3pm	9.5	5,690	10	22.7	24,400
10	27.4	45,000	2am	7.7	3,880	5	10.0	6,240	12M	20.9	20,500
12M	29.9	60,000	3	8.1	4,240	7	9.5	5,690	September 28		
September 16			4	10.4	6,680	9	8.2	4,340	3am	18.5	17,100
2am	25.9	36,700	5	11.3	7,710	12M	7.3	3,520	6	16.5	14,300
4	23.0	25,200	7	10.3	6,570	September 26			12N	12.7	9,390
6	19.2	18,100	8	8.8	4,940	2am	7.0	3,250	6pm	9.7	5,910
8	14.4	11,500	10	6.7	2,980	5	7.0	3,250	12M	7.3	3,520
10	12.8	9,510	2pm	5.0	1,710	6	7.2	3,430	September 29		
4pm	10.8	7,120	8	3.8	952	7	9.5	5,690	6am	5.6	2,130
12M	9.5	5,690	12M	3.5	792	8	14.5	11,600	12N	4.8	1,570
September 17			September 20			9	19.3	18,200	6pm	4.5	1,370
3am	9.5	5,690	12N	3.0	549	10	24.0	28,400	September 30		
4	12.7	9,390				11	28.3	50,400	12N	3.8	952

Concho River near Paint Rock, Tex.

Location.- Lat. 31°31', long. 99°57', at Gulf, Colorado & Santa Fe Railway bridge 2 miles northwest of Paint Rock, Concho County.

Drainage area.- 5,532 square miles, of which about 275 square miles is probably noncontributing.

Gage-height record.- Water-stage recorder graph. Sept. 15; graph drawn from one or more daily readings and from flood marks at temporary staff gage 1.6 miles below recorder site Sept. 16-30. Gage heights used to half tenths between 3.6 and 5.8 feet; hundredths below and tenths above these limits Sept. 15 to half tenths between 12.8 and 14.0 feet, hundredths below and tenths above these limits Sept. 16-30.

Stage-discharge relation.- For both gages relation is defined by current-meter measurements below 30,500 second-feet; extended to peak discharge on basis of two slope-area measurements.

Maxima.- 1936: Discharge, 301,000 second-feet 9 p.m. Sept. 17 (gage height, 41.3 feet, from flood marks, recorder site and datum), by slope-area measurement.

1915-35: Discharge, 86,100 second-feet Apr. 27, 1922 (gage height, 27.5 feet, recorder site and datum).

1882-1914: Discharge, 201,000 second-feet August 1882 (gage height, 38.4 feet, recorder site and datum), from 1936 rating curve.

Remarks.- Flow affected by diversions and storage upstream.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			19	25,600	50,780	24	1,480	2,940	29	3,750	7,440
15	52,600	104,300	20	6,070	12,040	25	1,980	3,930	30	1,910	3,790
16	61,900	122,800	21	1,090	2,160	26	22,100	43,830			
17	134,000	265,800	22	922	1,830	27	99,000	196,400			
18	90,500	179,500	23	635	1,260	28	13,100	25,980			
Run-off, in acre-feet, for period Sept. 15-30.											1,025,000

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15		5pm	23.6	27,500		September 20		9pm	26.0	39,700
1am	0.98	2.6	7	23.6	27,500	8am	16.7	7,530	12M	34.2	120,000
4	1.14	9.5	9	24.0	28,800	4pm	14.9	3,550		September 27	
5	4.85	2,130	12M	27.0	46,000	12M	13.8	1,690	1am	35.1	132,000
6	6.70	4,220		September 17			September 21		2	35.6	140,000
7	7.86	6,090	3am	30.0	70,500	8am	13.2	922	3	35.8	144,000
8	9.70	10,100	6	32.4	96,000	12N	13.1	820	4	35.8	144,000
10	13.40	18,900	8	33.0	104,000	4pm	13.2	922	6	35.5	139,000
11	15.00	24,000	11	33.0	104,000	12M	13.6	1,420	9	34.5	124,000
12N	18.00	37,600	3pm	32.8	101,000		September 22		12N	33.0	104,000
2pm	22.90	61,300	5	32.9	102,000	6am	13.6	1,420	2pm	32.6	98,500
4	26.90	82,600	6	35.4	137,000	3pm	12.9	635	3	31.8	88,800
5	29.17	96,000	7	38.6	195,000	5	12.8	550	6	29.1	62,400
6	27.8	87,800	8	41.9	266,000		September 23		9	26.9	45,400
7	30.8	105,000	9	43.4	301,000	12N	12.8	550	12M	24.9	33,300
8	34.2	128,000	10	43.4	301,000	8pm	13.0	725		September 28	
9	35.3	140,000	11	43.0	291,000		September 24		6am	21.2	20,100
10	35.1	137,000	12M	41.6	259,000	6am	13.4	1,150	12N	17.8	10,300
11	34.2	128,000		September 18		12N	13.8	1,690	3pm	16.3	6,590
12M	33.4	121,000	3am	37.3	170,000	3pm	13.9	1,840	6	15.8	5,440
	September 16		6	33.4	109,000		September 25		8	15.6	5,000
1am	33.7	113,000	9	31.0	80,000	1am	13.9	1,840		September 29	
3	34.4	123,000	12N	29.6	66,900	12N	14.0	1,980	5am	15.4	4,580
4	34.4	123,000	6pm	28.0	53,500	12M	14.1	2,140	10	15.2	4,160
5	33.8	114,000	12M	26.2	40,900		September 26		6pm	14.5	2,800
6	32.8	101,000		September 19		2am	14.4	2,630	12M	14.2	2,300
9	29.8	68,700	6am	24.5	31,000	4	15.1	3,950		September 30	
12N	26.9	45,400	12N	22.8	25,000	9	17.5	9,550	5am	14.0	1,980
3pm	24.4	30,600	6pm	21.0	19,400	12N	19.3	14,500	12M	13.8	1,690
4	23.7	27,800	12M	19.2	14,200	6pm	23.1	25,900			

Note.- Gage heights Sept. 16 to 30 from temporary staff gage.

Middle Concho River near Tankersly, Tex.

Location.- Lat.31°22'35", long. 100°36'50", at Twelvemile Bridge, 3 miles northeast of Tankersly, Tom Green County. Zero of gage is 1,919.5 feet above mean sea level.
Drainage area.- 1,280 square miles, of which about 152 square miles is probably non-contributing.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 4.7 and 5.5 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 11,000 second-feet; extended to peak stage on basis of study of flow over Lake Nasworthy Dam.
Maxima.- 1936: Discharge, 35,000 second-feet 10 p.m. Sept. 26 (gage height, 24.2 feet).
1930-35: Discharge, 19,400 second-feet (revised), May 11, 1932 (gage height, 22.45 feet).
1922-29: Stage, 27.2 feet during 1922 (discharge not determined).
Remarks.- Small diversions above station affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			20	64	127	24	44	87	28	1,270	2,520
17	7,650	15,170	21	114	226	25	3,240	6,430	29	600	1,190
18	921	1,830	22	97	192	26	25,600	50,780	30	312	619
19	445	883	23	28	56	27	25,200	49,980			
Run-off, in acre-feet, for period Sept. 17-30.											130,100

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 17		6am	5.39	840	1pm	3.50	114	10pm	24.20	35,000
1am	2.53	9	8	4.89	645	12M	3.12	42		September 27	
2	4.00	265	4pm	3.90	230		September 25		1pm	23.97	33,200
3	8.20	1,870	5	4.05	282	1am	5.70	945	3	23.86	32,300
4	15.20	6,240	7	7.00	1,380	2	7.25	1,450	4	23.58	29,600
5	19.60	9,480	10	8.30	1,920	5	5.35	822	5	22.29	18,600
6	22.05	16,500	12M	8.50	2,020	7	8.08	1,820	6	19.80	9,640
7	23.55	29,600		September 19		10	11.50	3,700	7	16.70	7,290
8	23.75	31,400	1am	8.07	1,820	2pm	14.75	5,960	9	12.38	4,280
9	23.30	26,900	4	5.45	858	4	15.72	6,590	12M	8.86	2,220
10	22.54	20,200	6	4.58	516	6	14.90	6,030		September 28	
11	20.74	10,600	12N	3.90	230	9	9.40	2,490	2am	7.53	1,560
12N	17.40	7,800		September 20		12M	5.24	785	5	6.29	1,160
1pm	13.90	5,340	12N	3.20	52		September 26		7	6.00	1,050
2	11.12	3,460	11pm	3.30	68	3am	4.52	489	9	6.25	1,120
3	8.68	2,120	12M	4.40	430	4	12.60	4,420	12N	6.74	1,280
5	5.81	980		September 21		5	17.95	8,250	2pm	6.85	1,310
7	4.72	565	6am	3.27	63	6	21.00	11,200	3	6.87	1,340
8	4.54	498	7pm	3.00	31	7	23.37	27,800	4	6.85	1,310
9	7.85	1,680	8	4.10	300	8	23.86	32,300	6	6.72	1,280
10	10.84	3,280		September 22		9	24.02	33,200	12M	5.74	945
11	11.27	3,580	12N	3.37	83	10	24.09	34,100		September 29	
12M	9.80	2,710		September 23		2pm	24.09	34,100	4am	5.19	765
	September 18		12N	2.95	28	4	24.01	33,200	8	4.88	645
2am	6.26	1,160		September 24		6	24.06	34,100	12M	4.35	408
4	4.68	557	11am	2.70	15	8	24.15	35,000		September 30	
									12N	4.12	308

Spring Creek near Tankersly, Tex.

Location.- Lat. 31°21'30", long. 100°32'5", 2 3/4 miles above confluence with Middle Concho River and 6 1/2 miles east of Tankersly, Tom Green County. Zero of gage is 1,874.6 feet above mean sea level.
Drainage area.- 734 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 3.6 and 6.0 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 17,000 second-feet; extended to peak stage by logarithmic curve.
Maxima.- 1936: Discharge, 23,900 second-feet 6:30 a.m. Sept. 17 (gage height, 20.3 feet), from rating curve extended above 17,000 second-feet.
1930-35: Discharge, 17,000 second-feet May 10, 1932 (gage height, 17.70 feet).
Remarks.- Small diversions upstream affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			19	225	446	24	54	107	29	110	218
15	5,040	10,000	20	108	214	25	149	296	30	93	184
16	248	492	21	96	190	26	4,950	9,820			
17	6,300	12,500	22	71	141	27	982	1,950			
18	429	851	23	55	109	28	197	391			
Run-off, in acre-feet, for period Sept. 15-30											37,910

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15		5am	17.80	17,300		September 20		1pm	11.56	6,580
1am	2.40	83	6	19.99	23,100	8pm	2.38	80	2	12.90	8,360
2	7.75	2,730	7	20.30	23,900	11	3.04	273	3	13.86	9,850
3	15.20	12,000	8	18.96	20,400		September 21		4	15.19	12,000
4	16.70	14,800	9	17.06	15,600	1am	2.86	215	5	15.38	12,300
5	18.52	19,100	10	12.96	8,500	4	2.58	129	6	15.05	11,600
6	18.70	19,900	11	9.96	4,760	12N	2.36	76	8	14.74	11,100
7	15.40	12,300	12N	7.94	2,800	4pm	2.32	69	9	13.92	9,850
8	11.60	6,580	2pm	6.31	1,720		September 22		10	12.36	7,660
9	10.27	5,080	4	5.19'	1,080	1am	2.33	71	11	10.36	5,190
10	11.14	5,980	5	5.71	1,360	5	2.42	88	12M	9.16	3,940
11	10.65	5,410	6	6.61	1,910	12M	2.27	61		September 27	
12N	8.53	3,300	8	5.46	1,210		September 23		1am	8.12	2,960
2pm	7.30	2,370	10	4.48	765	12N	2.23	55	3	6.66	1,980
4	6.45	1,780	12M	3.93	568		September 24		6	5.49	1,240
6	5.24	1,110		September 18		12N	2.23	55	9	4.76	868
8	5.00	983	3am	3.36	375		September 25		12N	4.29	690
12M	4.10	619	6	3.02	266	2pm	2.23	55	3pm	3.85	536
	September 16		9	2.83	206	4	3.16	311	12M	3.17	314
3am	3.55	436	3pm	2.64	147	5	3.45	404		September 28	
6	3.15	308	4	4.26	672	6	3.39	385	6am	2.92	234
12N	2.75	180	5	5.36	1,160	12M	2.90	228	12N	2.76	184
9pm	2.54	118	7	4.60	805		September 26		12M	2.60	135
	September 17		12M	3.67	470	5am	2.71	168		September 29	
1am	2.97	250		September 19		9	3.61	453	12N	2.51	110
2	5.20	1,080	6am	3.08	286	10	4.51	765		September 30	
3	11.00	5,870	12N	2.79	193	11	8.96	3,760	12N	2.44	93
4	15.17	12,000				12N	9.41	4,140			

North Concho River near Carlsbad, Tex.

<u>Location</u>.- Lat. 31°36', long. 100°40', just above State Sanatorium Dam and 2 miles above Carlsbad, Tom Green County. Zero of gage is 2,000.8 feet above mean sea level.

<u>Drainage area</u>.- 1,529 square miles, of which about 123 square miles is probably non-contributing.

<u>Gage-height record</u>.- Water-stage recorder graph Sept. 15 to 7 a.m. Sept. 17. Graph drawn from occasional staff gage readings, flood marks, and local information 8 a.m. Sept. 17 to Sept. 30. Gage heights used to half tenths between 7.5 and 10.8 feet; hundredths below and tenths above these limits.

<u>Stage-discharge relation</u>.- Defined by current-meter measurements below 7,600 second-feet, extended to peak discharge on basis of 3 slope-area measurements.

<u>Maxima</u>.- 1936: Discharge, 94,600 second-feet 10 a.m. Sept. 26 (gage height, 16.0 feet, from flood marks), by slope-area measurement.
1924-35: Discharge, 55,200 second-feet May 30, 1925 (gage height, 14.45 feet), by slope-area measurement (revised).
1922-23: Stage, 14.0 feet Apr. 1, 1922.

<u>Remarks</u>.- Small reservoir above gage affects low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			19	560	1,100	24	46	91	29	242	480
15	238	472	20	84	167	25	189	375	30	136	270
16	820	1,630	21	971	1,930	26	45,500	90,250			
17	62,900	124,800	22	131	260	27	3,920	7,780			
18	4,170	8,270	23	64	127	28	610	1,210			
Run-off, in acre-feet, for period Sept. 15-30											239,200

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15			September 18			September 21		11am	15.90	91,800
12M	2.17	0	2am	10.95	12,500	8am	4.60	54	12N	15.70	86,200
2am	2.50	0	4	9.95	8,000	9	4.70	73	2pm	14.80	63,600
3	5.80	428	6	9.20	5,410	10	6.00	520	4	13.95	45,600
4	6.84	1,140	8	8.50	3,780	11	8.40	3,570	6	13.10	29,600
6	5.98	510	10	7.90	2,600	12N	8.50	3,780	8	12.10	19,000
8	5.53	321	12N	7.50	1,940	1pm	8.35	3,460	10	11.35	14,500
12N	4.98	144	2pm	7.10	1,410	2	7.95	2,690	12M	10.70	11,200
6	4.44	28	4	6.75	1,050	4	7.15	1,470		September 27	
12M	4.31	10	6	6.50	835	6	6.60	915	2am	10.10	8,600
	September 16		8	6.20	625	10	5.90	472	4	9.60	6,700
2pm	4.18	2	9	6.20	625		September 22		6	9.20	5,410
6	5.00	150	10	8.70	4,210	4am	5.20	210	8	8.85	4,540
7	7.50	1,940	11	9.04	5,000	12N	4.80	96	10	8.50	3,780
8	7.25	1,600	12M	8.60	3,990		September 23		12N	8.20	3,160
10	8.20	3,160		September 19		12N	4.65	64	2pm	7.90	2,600
12M	11.50	15,000	2am	7.20	1,530		September 24		4	7.65	2,170
	September 17		4	6.50	835	12N	4.55	46	6	7.40	1,800
2am	13.75	41,400	6	6.10	570		September 25		8	7.20	1,530
4	14.45	54,400	8	5.80	428	12N	4.50	37	12M	6.85	1,140
6	15.10	70,800	10	5.55	329	8pm	4.60	54		September 28	
8	15.45	78,400	12N	5.35	258	10	5.85	450	6am	6.40	760
10	15.55	83,600	2pm	5.20	210	12M	9.30	5,710	12N	6.05	545
2pm	15.80	89,000	4	5.10	180		September 26		6pm	5.80	428
4	15.60	83,600	6	5.00	150	2am	11.90	17,500	12M	5.60	348
6	15.15	73,200	8	4.90	122	4	13.45	34,000		September 29	
8	14.35	54,400	10pm	4.90	122	6	14.50	56,600	12N	5.30	242
10	13.40	34,000		September 20		8	15.40	78,400		September 30	
12M	12.10	19,000	12N	4.75	84	10	16.00	94,600	12N	4.95	236

Pecan Bayou at Brownwood, Tex.

Location.- Lat. 31°44'10", long. 98°58'30", three-eighths of a mile above city dam, 1 mile north of Brownwood, Brown County. Zero of gage is 1,319.2 feet above mean sea level.

Drainage area.- 1,614 square miles, affected by 140,000 acre-feet of storage in Brownwood Reservoir, 10 miles upstream.

Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 3.1 and 4.6 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements below 38,000 second-feet; extended above to peak discharge reached in 1930.

Maxima.- 1936: Discharge, 19,800 second-feet 4 p.m. Sept. 28 (gage height, 14.26 feet).
1917-18, 1923-35: Discharge, 52,700 second-feet Oct. 14, 1930 (gage height, 16.92 feet), from rating curve extended above 38,000 second-feet. (Flood of July 3, 1932, probably the greatest known, reached a discharge of about 235,000 second-feet as it entered Brownwood Reservoir (computed from rate of storage in reservoir).

Remarks.- Flow regulated by storage in Brownwood Reservoir.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			21	2,250	4,460	27	5,650	11,210	2	1,700	3,370
16	1,700	3,370	22	1,540	3,050	28	15,900	31,540	3	1,200	2,380
17	8,310	16,480	23	1,080	2,140	29	10,700	21,220	4	910	1,800
18	11,500	22,810	24	800	1,590	30	4,270	8,470	5	701	1,390
19	8,380	16,620	25	604	1,200	Oct.					
20	3,660	7,260	26	540	1,070	1	2,500	4,960			
Run-off, in acre-feet, for period Sept. 16 to Oct. 5. 166,400											

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.
September 16		
12M	1.06	23
2am	2.04	572
3	2.89	1,460
4	3.08	1,690
7	3.06	1,660
9	2.86	1,420
12N	2.83	1,390
3pm	2.55	1,070
6	3.10	1,710
9	4.15	3,000
12M	5.01	4,210
September 17		
3am	5.96	5,700
5	6.65	6,440
7	7.50	7,400
9	8.36	8,210
11	9.33	8,930
1pm	10.06	9,610
3	10.25	9,700
4	10.26	9,800
8	10.18	9,700
10	10.27	9,800
12M	10.47	10,000
September 18		
3am	10.92	10,400
6	11.41	11,000
9	11.83	11,500
12N	12.16	12,100
2pm	12.27	12,300
4	12.29	12,300
6	12.26	12,300
8	12.15	12,100

Time	Feet	Sec.ft.
10pm	12.00	11,800
12M	11.77	11,500
September 19		
3am	11.29	10,900
6	10.60	10,100
9	9.71	9,250
12N	8.72	8,450
3pm	7.72	7,590
6	6.76	6,680
9	6.02	5,700
12M	5.51	4,990
September 20		
3am	5.12	4,360
6	4.90	4,060
9	4.72	3,760
12N	4.54	3,550
3pm	4.39	3,340
6	4.25	3,140
9	4.12	2,940
12M	3.96	2,750
September 21		
6am	3.72	2,440
12N	3.53	2,250
6pm	3.36	2,010
12M	3.21	1,830
September 22		
6am	3.07	1,670
12N	2.94	1,520
6pm	2.83	1,390
12M	2.73	1,270
September 23		
12N	2.55	1,070

Time	Feet	Sec.ft.
September 24		
12N	2.29	800
September 25		
12N	2.07	596
September 26		
1pm	1.93	488
12M	2.17	683
September 27		
5am	2.47	984
8	3.34	2,010
10	4.91	4,060
12N	6.50	6,320
2pm	9.00	8,690
4	9.93	9,430
6	10.02	9,520
8	10.02	9,520
10	10.26	9,800
12M	10.80	10,300
September 28		
2am	11.40	11,000
4	12.05	11,800
6	12.71	13,100
9	13.45	15,100
12N	13.94	17,300
3pm	14.23	19,100
4	14.26	19,800
5	14.26	19,800
7	14.18	19,100
9	14.03	17,800
12M	13.64	15,800
September 29		
3am	13.17	14,500
6	12.57	12,900

Time	Feet	Sec.ft.
9am	11.88	11,700
12N	11.00	10,600
3pm	9.96	9,520
6	8.76	8,530
9	7.60	7,500
12M	6.57	6,440
September 30		
3am	5.90	5,570
6	5.45	4,840
9	5.11	4,360
12N	4.85	3,910
3pm	4.72	3,760
6	4.55	3,550
9	4.37	3,270
12M	4.24	3,140
October 1		
6am	3.94	2,750
12N	3.73	2,500
6pm	3.52	2,190
12M	3.36	2,010
October 2		
6am	3.20	1,830
12N	3.05	1,650
6pm	2.93	1,510
12M	2.85	1,410
October 3		
12N	2.64	1,170
October 4		
12N	2.37	880
October 5		
12N	2.18	692

San Saba River at Menard, Tex.

Location.- Lat. 30°55', long. 99°48', 1,000 feet above highway bridge in Menard, Menard County, and half a mile below mouth of Las Moras Creek. Zero of gage is 1,865.05 feet above mean sea level.
Drainage area.- 1,151 square miles.
Gage-height record.- Graph drawn from two or more gage readings daily, observer's estimates of peaks, and flood marks. Gage heights used to half tenths between 3.4 and 4.1 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 17,000 second-feet; extended to peak discharge on basis of slope-area measurement of the peak.
Maxima.- 1936: Discharge, 68,600 second-feet 8 a.m. Sept. 16 (gage height, 21.2 feet, from flood marks) by slope-area measurement.
1915-35: Discharge, 44,600 second-feet Oct. 6, 1930 (gage height, 18.3 feet), from curve extended by slope-area method.
1899-1914: Stage, 23.7 feet, present site and datum, June 5 or 6, 1899 (discharge not determined).
Remarks.- Small diversions above affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			20	255	506	26	2,650	5,260	Oct.		
15	62	123	21	155	307	27	11,500	22,810	1	300	595
16	28,300	56,130	22	103	204	28	3,720	7,380	2	250	496
17	17,700	35,110	23	96	190	29	755	1,500	3	215	426
18	14,700	29,160	24	94	186	30	432	857	4	196	389
19	678	1,340	25	295	585				5	188	373
									6	169	335
Run-off, in acre-feet, for period Sept. 15 to Oct. 6.											164,300

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.
September 15		
12M	2.90	161
September 16		
1am	8.00	5,450
2	13.90	18,200
3	18.00	42,500
4	16.80	34,400
6	18.60	46,800
8	21.20	68,600
9	19.40	53,200
10	14.80	22,700
12N	16.00	29,600
4pm	14.80	22,700
8	13.40	16,000
12M	12.30	11,400
September 17		
1am	12.00	10,300
2	11.80	9,750
4	11.45	9,120
8	10.80	8,380
9	10.80	8,380
10	11.15	8,860
11	11.70	9,550
12N	12.35	11,700
4pm	14.70	22,200
6	16.00	29,500
8	16.60	33,100
12M	16.95	35,700

Time	Feet	Sec.ft.
September 18		
4am	16.95	35,700
6	16.80	34,400
7	16.00	29,500
8	14.70	22,200
9	13.20	14,600
10	11.90	9,750
11	10.20	7,670
12N	9.10	6,600
2pm	8.05	5,130
4	7.75	4,810
6	6.70	3,010
8	6.15	2,150
10	5.75	1,770
12M	5.45	1,520
September 19		
4am	4.90	1,010
8	4.50	720
12N	4.30	600
11pm	4.00	405
September 20		
12N	3.75	225
September 21		
12N	3.65	145
September 22		
12N	3.55	105
September 23		
12N	3.50	96

Time	Feet	Sec.ft.
September 24		
12N	3.45	87
September 25		
6am	3.60	117
4pm	3.90	225
8	4.40	488
12M	5.90	1,440
September 26		
4am	6.70	2,150
9	6.00	1,600
7pm	5.30	1,010
8	6.20	1,770
9	8.20	4,810
10	10.50	7,490
11	12.80	12,500
12M	15.10	23,200
September 27		
1am	16.60	33,100
2	15.35	25,900
4	14.00	18,700
6	12.90	13,800
8	12.00	10,300
9	11.60	9,400
10	11.25	8,860
12N	10.65	8,160
4pm	9.60	7,200
8	8.80	6,400
12M	8.30	5,850

Time	Feet	Sec.ft.
September 28		
4am	7.80	5,130
8	7.50	4,650
12N	7.00	3,760
4pm	6.50	3,010
8	6.05	2,350
12M	5.10	1,520
September 29		
4am	4.35	880
8	4.05	720
12M	3.80	570
September 30		
12N	3.60	432
October 1		
12N	3.40	300
October 2		
12N	3.30	260
October 3		
12N	3.23	215
October 4		
12N	3.19	196
October 5		
12N	3.17	188
October 6		
12N	3.12	169

Note.- Discharge determined by shifting-control method 9 a.m. Sept. 18 to Sept. 26, Sept. 29 to Oct. 6.

San Saba River at San Saba, Tex.

Location.- Lat. 31°12'10", long. 98°42'15", at the San Saba-Chadwick Mill highway bridge three-quarters of a mile northeast of San Saba, San Saba County. Zero of gage is 1,152.4 feet above mean sea level.

Drainage area.- 3,046 square miles.

Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 4.6 and 6.4 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements below 30,000 second-feet; extended above to peak stage.

Maxima.- 1936: Discharge, 45,500 second-feet 7:20 a.m. Sept. 17 (gage height, 36.67 feet), from rating curve extended.

1915-35: Discharge, 57,000 second-feet Apr. 26, 1922 (gage height, 42.1 feet, present site and datum, affected by backwater), from rating curve extended and corrected for backwater.

1899-1914: Stage, 42.6 feet June 6, 1899 (discharge not determined).

Remarks.- Diversions above station for irrigation and municipal use affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			20	2,140	4,240	26	1,570	3,110	Oct.		
15	79	157	21	994	1,970	27	18,600	36,890	1	1,050	2,080
16	1,910	3,790	22	640	1,270	28	17,000	33,720	2	808	1,600
17	33,900	67,240	23	433	859	29	4,580	9,080	3	649	1,290
18	20,000	39,670	24	354	702	30	1,670	3,310	4	565	1,120
19	13,500	26,780	25	303	601				5	502	996
									6	474	940
Run-off, in acre-feet, for period Sept. 15 to Oct. 6											241,400

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15			September 18			September 23			September 28	
8am	3.36	39	3am	30.60	17,000	12N	6.15	433	4am	32.93	26,800
3pm	3.67	81	4	30.38	16,100		September 24		6	32.20	23,500
6	4.10	143	5	30.23	15,300	12N	5.68	354	9	31.19	19,100
11	4.17	154	6	30.22	15,300		September 25		10	30.84	17,400
12M	4.49	202	7	30.31	15,700	4pm	5.42	303	11	30.40	15,700
	September 16		10	30.87	18,200	6	5.50	320	12N	29.98	14,200
2am	5.60	388	2pm	31.20	19,500		September 26		1pm	29.53	12,900
3	6.56	586	5	31.86	22,600	2am	5.36	312	2	29.08	11,900
4	7.77	854	8	32.50	25,400	4	5.53	346	3	28.62	11,200
5	8.92	1,120	9	32.57	25,800	5	7.00	628	4	28.20	10,600
6	9.58	1,310	10	32.58	25,800	6	9.26	1,180	5	27.77	10,100
7	10.06	1,450	12M	32.47	25,400	7	11.46	1,790	6	27.40	9,700
8	10.36	1,530		September 19		8	13.03	2,290	8	26.78	9,140
9	10.48	1,560	3am	32.15	24,000	9	14.02	2,650	12M	25.63	8,150
10	10.44	1,530	6	31.50	20,800	10	14.50	2,830		September 29	
11	10.18	1,480	9	30.38	16,100	11	14.58	2,870	6am	22.52	6,060
1pm	9.16	1,200	12N	28.50	11,200	12N	14.34	2,760	12N	18.36	4,330
3	7.56	808	3pm	26.02	8,550	2pm	13.26	2,400	6pm	15.17	3,100
5	6.45	544	6	23.14	6,460	4	11.67	1,850	12N	13.02	2,290
6	7.66	831	9	20.22	5,150	6	10.34	1,450		September 30	
7	10.20	1,480	12M	17.54	4,060	8	9.77	1,310	6am	11.76	1,850
8	13.96	2,720		September 20		9	9.72	1,280	12N	11.02	1,620
9	18.00	4,250	3am	15.30	3,210	10	9.76	1,310	6pm	10.37	1,450
10	21.60	5,740	6	13.70	2,610		September 27		12M	9.80	1,280
11	25.20	7,910	9	12.48	2,190	1am	9.92	1,390		October 1	
12M	28.40	11,000	12N	11.58	1,890	2	10.03	1,420	6am	9.38	1,150
	September 17		3pm	10.97	1,700	4	11.60	1,890	12N	9.00	1,050
1am	31.40	20,400	6	10.45	1,530	6	13.50	2,540	6pm	8.64	950
2	33.26	29,200	9	10.00	1,420	8	16.40	3,630	12M	8.35	900
4	35.47	39,700	12M	9.54	1,280	10	20.90	5,450		October 2	
5	36.14	42,600		September 21		12N	27.90	10,300	12N	7.97	785
6	36.53	44,500	6am	8.80	1,100	1pm	31.00	18,600		October 3	
7	36.67	45,500	12N	8.30	975	2	32.83	26,800	12N	7.37	649
8	36.64	45,000	6pm	7.88	877	3	33.80	31,600		October 4	
9	36.47	44,500	12M	7.50	785	4	34.46	34,900	12N	6.94	565
12N	35.63	40,200		September 22		6	35.09	37,800		October 5	
3pm	34.50	34,900	6am	7.13	693	8	35.53	39,700	12N	6.68	502
6	33.25	28,700	12N	6.86	649	9	35.56	40,200		October 6	
9	32.33	24,400	6pm	6.63	586	10	35.43	39,200	12N	6.50	460
12M	31.48	20,800	12M	6.43	544	12M	34.80	36,400			

Note.- Discharge determined by shifting-control method Sept. 23-26, 28 to Oct. 6.

North Llano River near Junction, Tex.

Location.- Lat. 30°30', long. 99°47', 500 feet above remains of old Wilson Dam and 3 miles northwest of Junction, Kimble County. Zero of gage is 1,699.9 feet above mean sea level.

Drainage area.- 914 square miles.

Gage-height record.- Graph drawn from staff-gage readings and elevations of stakes set at water surface by observer and engineer, flood marks, and local information.

Stage-discharge relation.- Poorly defined. Publication of discharge withheld until further discharge measurements are made. Peak discharge for 1936 determined by slope-area measurement.

Maxima.- 1936: Discharge, 94,800 second-feet midnight Sept. 15-16 (gage height, 24.9 feet, from flood marks).
1915-35: Stage, 20.9 feet Oct. 6, 1930 (discharge not determined).
1875-1914: Stage, about 22.9 feet in 1889.

Remarks.- Diversions for irrigation materially reduce low-water flow but do not affect flood flow.

Gage height, in feet, at indicated time, 1936

Time	Feet	Time	Feet	Time	Feet
September 15		10 a.m.	10.30	12M	7.80
1 p.m.	1.35	11	10.35	September 18	
8	1.25	12N	9.40	3 a.m.	6.80
9	7.75	2 p.m.	8.00	6	5.90
10	14.60	4	7.15	9	5.20
11	21.80	5	12.00	12N	4.55
12M	24.90	8	10.45	3 p.m.	4.00
September 16		12M	8.65	6	3.50
1 a.m.	20.70	September 17		9	3.15
2	17.90	3 a.m.	7.55	12M	2.85
3	20.50	6	6.65	September 19	
4	16.75	9	5.85	3 a.m.	2.60
5	13.70	12N	5.20	6	2.45
6	11.75	3 p.m.	4.60	12N	2.30
7	10.40	6	4.10	12M	2.10
8	9.35	10	3.60		
9	8.70	11	8.00		

Llano River near Junction, Tex.

Location.- Lat. 30°30', long. 99°44', 100 feet north of Kerrville-Junction road, 3 miles below confluence of North Llano and South Llano Rivers, and 3½ miles east of Junction, Kimble County.

Drainage area.- 1,762 square miles.

Gage-height record.- Water-stage recorder graph except 3:30 a.m. Sept. 16 to 1 p.m. Sept. 17, when it was determined from a graph drawn from flood marks and local information. Gage heights used to half tenths between 3.5 and 5.4 feet; hundredths below and tenths above these limits.

Stage-discharge relation.- Defined by current-meter measurements below 35,000 second-feet; extended to peak discharge on basis of four slope-area measurements.

Maxima.- 1936: Discharge, 158,000 second-feet 3:30 a.m. Sept. 16 (gage height, 32.2 feet, from flood marks), by slope-area measurement.

1915-1935: Discharge, 319,000 second-feet June 14, 1935 (gage height, 43.3 feet, from flood marks), by slope-area measurement.

1889-1936: Discharge and stage, that of June 14, 1935.

Remarks.- Small diversions and storage above station affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			20	940	1,860	26	967	1,920	Oct.		
15	4,160	8,250	21	718	1,420	27	4,440	8,810	1	600	1,190
16	59,700	118,400	22	600	1,190	28	3,450	6,840	2	539	1,070
17	14,400	28,560	23	512	1,020	29	1,070	2,120	3	498	988
18	7,390	14,660	24	465	922	30	710	1,410	4	458	908
19	1,830	3,630	25	3,500	6,940				5	426	845
									6	406	805
Run-off, in acre-feet, for period Sept. 15 to Oct. 6.											213,800

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15		6am	10.50	15,200		September 23		5pm	8.30	9,660
12M	1.40	49	9	9.00	11,300	12N	2.38	519	6	7.90	8,790
5pm	1.60	98	10	9.90	13,500		September 24		9	6.68	6,350
6	6.20	5,380	12N	8.50	10,100	12N	2.30	465		September 28	
7	12.10	19,800	2pm	7.60	8,160	12M	2.27	446	1am	7.35	7,750
8	13.25	23,300	3	8.85	10,800		September 25		3	6.80	6,550
9	10.80	16,000	4	9.42	12,300	1am	8.25	9,440	6	5.70	4,480
10	8.30	9,660	6	9.08	11,500	2	9.00	11,300	12N	4.48	2,750
11	9.90	13,500	8	8.90	11,100	3	8.50	10,100	12M	3.42	1,500
12M	10.70	15,800	10	9.16	11,800	4	7.50	7,950		September 29	
	September 16		11	9.04	11,300	6	5.40	4,000	12N	2.98	1,020
1am	12.35	20,700	12M	9.30	12,000	8	4.50	2,750		September 30	
2	16.60	35,800		September 18		10	4.35	2,570	12N	2.65	710
3	24.00	80,200	2am	10.75	16,000	12	4.30	2,510		October 1	
4	32.20	158,000	4	10.00	13,800	3pm	4.12	2,270	12N	2.50	600
5	29.30	126,000	6	8.80	10,800	8	3.42	1,500		October 2	
7	31.70	153,000	10	7.05	6,950	10	3.96	2,090	12N	2.41	539
8	27.20	106,000	3pm	5.66	4,480	12M	3.51	1,590		October 3	
9	23.00	72,500	12M	4.50	2,750		September 26		12N	2.35	498
10	20.40	54,900		September 19		6am	3.22	1,280		October 4	
11	17.90	41,400	6am	4.00	2,150	12N	2.87	910	12N	2.29	458
12N	16.20	34,100	12N	3.59	1,700	9pm	2.60	670		October 5	
1pm	15.80	32,600		September 20			September 27		12N	2.24	426
4	16.30	34,500	12N	2.94	980	3am	2.53	621		October 6	
7	15.60	31,800		September 21		6	2.66	718	12N	2.21	406
11	17.60	40,100	12N	2.66	718	9	3.25	1,320			
12M	16.60	35,800		September 22		12N	6.00	5,000			
	September 17		12N	2.50	600	3pm	8.20	9,440			
3am	13.00	22,600				4	8.48	10,100			

Llano River near Castell, Tex.

Location.- Lat. 30°43', long. 98°53', 4 miles above mouth of Hickory Creek and 6 miles east of Castell, Llano County.
Drainage area.- 3,514 square miles.
Gage-height record.- Graph drawn from two or more staff-gage readings daily and flood marks. Gage heights used to half tenths between 1.5 and 4.4 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 10,000 second-feet; extended to peak stage on basis of one float and one slope-area measurement.
Maxima.- 1936: Discharge, 153,000 second-feet 3 p.m. Sept. 16 (gage height, 22.9 feet, from flood marks), by slope-area measurement.
1923-35: Discharge, 388,000 second-feet June 14, 1935 (gage height, 37.0 feet, from flood marks), by slope-area measurement.
1889-1922: Stage, 28.4 feet in 1889 (discharge not determined).
Remarks.- Small diversions above station affect low flow only.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			20	2,580	5,120	26	3,720	7,380	Oct.		
15	15,200	30,150	21	1,540	3,050	27	56,600	112,300	1	1,280	2,540
16	93,000	184,500	22	1,340	2,660	28	5,210	10,330	2	1,100	2,180
17	46,000	91,240	23	1,040	2,060	29	2,400	4,760	3	945	1,870
18	14,100	27,970	24	710	1,410	30	1,610	3,190	4	860	1,710
19	4,730	9,380	25	1,380	2,740				5	780	1,550
									6	740	1,470
Run-off, in acre-feet, for period Sept. 15 to Oct. 6											509,600

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 15		9pm	20.90	126,000		September 23		4pm	19.80	112,000
12M	1.85	216	12M	19.30	106,000	12N	3.50	990	5	17.40	83,500
6am	2.95	590		September 17			September 24		6	10.60	23,300
9	4.00	1,610	3am	17.30	82,400	12N	3.15	710	8	8.40	12,600
12N	5.85	5,070	9	13.50	44,800	12M	2.95	590	12M	7.30	9,100
3pm	9.10	15,500	3pm	11.85	31,100		September 25			September 28	
6	11.85	31,100	12M	10.35	22,200	9am	3.20	740	6am	6.35	6,550
8	13.20	42,200		September 18		3pm	3.85	1,400	6pm	5.30	3,930
9	13.60	45,700	12N	8.70	13,800	9	4.75	2,940		September 29	
10	13.70	46,500	12M	7.05	8,200		September 26		12N	4.55	2,580
11	13.60	45,700		September 19		3am	5.20	3,720		September 30	
12M	13.00	40,500	12N	5.40	4,140	8	5.35	4,140	12N	4.00	1,610
	September 16		12M	4.95	3,300	3pm	5.20	3,720		October 1	
2am	10.30	21,600		September 20		9	4.90	3,120	12N	3.75	1,280
4	9.80	19,000	8am	4.90	3,120	12M	5.50	4,350		October 2	
6	9.80	19,000	12N	4.75	2,940		September 27		2pm	3.60	1,100
7	10.90	25,000	6pm	4.25	1,990	2am	7.00	8,200		October 3	
8	14.20	51,000	12M	4.10	1,760	4	9.00	15,000	12N	3.44	945
10	18.20	92,600		September 21		6	12.00	32,500		October 4	
12N	21.30	131,000	12N	3.90	1,470	8	15.80	66,500	12N	3.36	860
2pm	22.80	151,000	12M	3.80	1,340	10	20.00	114,000		October 5	
3	22.90	153,000		September 22		11	21.30	131,000	12N	3.27	780
4	22.85	151,000	12N	3.80	1,340	12N	21.60	135,000		October 6	
6	22.50	147,000	12M	3.80	1,340	2pm	21.45	133,000	12N	3.18	740

Pedernales River near Spicewood, Tex.

Location.- Lat. 30°25'15", long. 98°4'50", in Travis County, 5.4 miles above confluence with Colorado River and 8 miles southeast of Spicewood, Burnet County. Zero of gage is 624.8 feet above mean sea level.
Drainage area.- 1,294 square miles.
Gage-height record.- Graph drawn from two or more gage readings daily. Gage heights used to half tenths between 1.6 and 2.8 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 3,500 second-feet; extended to peak discharge by one slope-area measurement and 3 slope-area computations.
Maxima.- 1936: Discharge, 85,300 second-feet 8 p.m. Sept. 27 (gage height, 28.4 feet, from graph based on gage readings).
1923-35: Discharge, 155,000 second-feet May 28, 1929 (gage height, 40.4 feet, from flood marks), by slope-area measurement.
1869-1922: Stage, about the same height as in 1929, occurred in 1869.
Remarks.- No regulation or diversions.

Mean discharge, in second-feet, and run-off, in acre-feet, 1936

Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.	Day	Sec.ft.	Ac.ft.
Sept.			20	620	1,230	27	39,100	77,550	3	665	1,320
14	445	883	21	538	1,070	28	19,600	38,880	4	578	1,150
15	23,100	45,820	22	439	871	29	1,660	3,290	5	538	1,070
16	34,700	68,830	23	439	871	30	1,020	2,020	6	498	988
17	4,360	8,650	24	386	766	Oct.					
18	2,460	4,880	25	336	666	1	860	1,710			
19	1,020	2,020	26	304	603	2	760	1,510			
Run-off, in acre-feet, for period Sept. 14 to Oct. 6 266,600											

Gage height, in feet, and discharge, in second-feet, at indicated time, 1936

Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.	Time	Feet	Sec.ft.
	September 14		12N	19.9	42,800		September 20		4am	21.0	47,900
1am	0.8	29	2pm	18.0	34,500	12N	3.0	620	6	17.5	32,400
9	0.9	37	4	16.5	28,200		September 21		8	13.8	17,800
12N	1.2	78	6	15.6	24,600	12N	2.8	538	10	11.3	10,300
2pm	1.8	204	8	14.7	21,000		September 22		12N	9.8	7,400
4	2.5	420	10	13.6	17,100	12N	2.6	458	2pm	8.7	5,830
6	3.2	710	12M	12.2	12,800		September 23		4	7.8	4,660
8	4.1	1,190		September 17		12N	2.5	420	6	7.1	3,820
10	4.7	1,590	2am	11.0	9,550		September 24		12M	6.0	2,660
12M	5.2	1,970	4	9.4	6,800	12N	2.4	386		September 29	
	September 15		6	8.4	5,440		September 25		8am	5.1	1,890
4am	6.1	2,760	8	7.7	4,540	12N	2.2	320	5pm	4.5	1,450
6	6.7	3,370	12N	6.9	3,590		September 26			September 30	
8	8.6	5,700	4	6.2	2,860	12N	2.1	289	8am	4.0	1,130
9	16.0	26,200	8	5.6	2,300		September 27		5pm	3.7	965
10	20.5	45,600	10	5.5	2,210	2am	2.6	458		October 1	
12N	20.8	47,000	12M	5.7	2,390	4	4.0	1,130	12N	3.5	860
2pm	20.0	43,300		September 18		6	7.0	3,700		October 2	
4	17.5	32,400	2am	6.6	3,260	8	11.3	10,300	12N	3.3	760
6	16.4	27,800	4	7.1	3,820	10	14.5	20,300		October 3	
8	16.2	27,000	6	6.7	3,370	12N	18.0	34,500	12N	3.1	665
10	16.4	27,800	8	6.2	2,860	2pm	21.2	48,800		October 4	
12M	17.2	31,100	12N	5.7	2,390	4	24.5	64,800	12N	2.9	578
	September 16		4pm	5.3	2,050	6	27.5	80,400		October 5	
2am	19.6	41,500	8	4.9	1,740	8	28.4	85,300	12N	2.8	538
4	20.8	47,000	12M	4.5	1,450	10	27.8	82,600		October 6	
6	19.9	42,800		September 19		12M	26.5	75,200	12N	2.7	498
8	19.4	40,600	12N	3.7	965		September 28				
10	21.6	50,700				2am	24.0	62,300			

Trinity River at Dallas, Tex.

Location.- Lat. 32°47', long. 96°48', at Commerce Street viaduct in Dallas, Dallas County. Zero of gage is 368.05 feet above mean sea level.
Drainage area.- 6,001 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 10.8 and 14.5 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 75,300 second-feet; extended to peak discharge.
Maxima.- 1936: Discharge, 25,900 second-feet 2 p.m. Sept. 28 (gage height, 35.15 feet).
1903-35: Discharge, 76,700 second-feet May 20, 1935 (gage height, 42.10 feet).
1840-1902: Discharge observed, 184,000 second-feet, from rating curve extended logarithmically, May 26, 1908 (gage height, 52.6 feet, U. S. Weather Bureau).
Remarks.- Flow at present partly regulated by several reservoirs upstream with combined storage capacity of 741,000 acre-feet.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
Sept. 16	127	Sept. 26	206	Oct. 6	3,170
17	157	27	4,440	7	3,020
18	313	28	22,800	8	3,070
19	372	29	21,900	9	2,970
20	210	30	19,600	10	2,920
21	151	Oct. 1	14,800	11	2,870
22	104	2	6,110	12	2,870
23	95	3	6,390	13	2,870
24	118	4	4,260	14	2,720
25	124	5	3,440	15	2,470

Trinity River near Oakwood, Tex.

Location.- Lat. 31°39', long. 95°47', at Palestine-Oakwood highway bridge 1½ miles above International-Great Northern Railroad bridge and 6 miles northeast of Oakwood, Leon County. Zero of gage is 175.03 feet above mean sea level.
Drainage area.- 12,840 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenthe between 3.3 and 7.1 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements throughout.
Maxima.- 1936: Discharge, 41,400 second-feet 10 p.m. Oct. 4 (gage height, 43.6 feet).
1904-35: Stage, about 52.2 feet, at present site, June 4, 1908 (discharge not determined).
Remarks.- Small diversions above for municipal use. Flow partly regulated by reservoirs above Dallas with combined storage capacity of 741,000 acre-feet.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
Sept. 16	110	Sept. 26	298	Oct. 6	35,400
17	110	27	254	7	30,800
18	106	28	651	8	26,800
19	125	29	5,580	9	24,200
20	169	30	9,570	10	22,500
21	212	Oct. 1	12,400	11	21,000
22	311	2	15,200	12	19,300
23	430	3	23,100	13	16,600
24	406	4	39,600	14	12,000
25	344	5	39,600	15	7,000

Brazos River near Palo Pinto, Tex.

Location.- Lat. 32°51'45", long. 98°18'10", at Palo Pinto-Graford highway bridge, 300 feet below Dark Valley Creek and 6½ miles north of Palo Pinto, Palo Pinto County. Zero of gage is 831.19 feet above mean sea level.
Drainage area.- 22,760 square miles, of which about 9,240 square miles is probably non-contributing.
Gage-height record.- Water-stage recorder graph except Sept. 23-30, for which period there is no record. Gage heights used to half tenths between 2.6 and 6.6 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 31,600 second-feet, extended logarithmically to peak discharge.
Maxima.- 1936: Maximum discharge and stage not determined.
1934-35: Discharge, 64,900 second-feet May 20, 1935 (gage height, 15.60 feet, from flood marks).
1876-1933: Maximum stage observed by local residents, about 24 feet in June 1930 (discharge not determined). A somewhat higher stage in 1876 is indicated by profiles by the Corps of Engineers, U. S. Army.
Remarks.- No large diversions above station. Mean daily discharge Sept. 23-30, 1936, estimated by comparison with discharge at stations above and below and by study of rainfall records.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
Sept. 15	0	Sept. 25	22,000	Oct. 5	5,060
16	8,720	26	12,400	6	1,840
17	36,100	27	26,000	7	1,150
18	22,900	28	44,000	8	1,060
19	13,500	29	43,600	9	848
20	10,200	30	32,000	10	714
21	5,890	Oct. 1	16,000	11	603
22	11,000	2	10,000	12	540
23	18,000	3	7,600	13	494
24	28,000	4	5,600	14	436

Clear Fork of Brazos River near Crystal Falls, Tex.

Location.- Lat. 32°54', long. 98°50', at Texas Co.'s pumping plant 2½ miles below Hubbard Creek and 3¼ miles northeast of Crystal Falls, Stephens County.
Drainage area.- 5,658 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 4.2 and 5.6 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 17,800 second-feet; extended to peak discharge.
Maxima:- 1936: Discharge, 20,000 second-feet 2 a.m. Sept. 29 (gage height, 26.60 feet).
1921-35: Discharge, 22,700 second-feet Sept. 8, 1932 (gage height, 28.10 feet, present site and datum).
1900-20: Stage, about 34.0 feet, present site and datum (discharge not determined).
Remarks.- Low flow regulated by dams upstream.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
Sept. 15	0	Sept. 25	955	Oct. 5	244
16	1,070	26	1,560	6	207
17	8,530	27	8,810	7	171
18	7,800	28	17,200	8	140
19	2,390	29	16,800	9	125
20	2,750	30	12,400	10	113
21	3,130	Oct. 1	5,490	11	102
22	1,470	2	2,010	12	88
23	898	3	896	13	78
24	470	4	332	14	71

Guadalupe River near Spring Branch, Tex.

Location.- Lat. 29°52', long. 98°23', at New Braunfels-Blanco highway bridge 4 miles southeast of Spring Branch, Comal County. Zero of gage is 947.37 feet above mean sea level.
Drainage area.- 1,432 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 4.7 and 5.0 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 70,000 second-feet; extended above.
Maxima.- 1936: Discharge, 48,600 second-feet 7:30 a.m. Sept. 28 (gage height, 33.45 feet).
1922-35: Discharge, 121,000 second-feet 2 a.m. July 3, 1932 (gage height, 42.10 feet).
1900-21: Stage, 45 to 50 feet in 1900 (discharge not determined).
Remarks.- Small diversions and regulation upstream affect low flow only.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
Sept. 14	274	Sept. 24	1,100	Oct. 4	1,850
15	18,400	25	950	5	1,680
16	23,700	26	980	6	1,580
17	10,500	27	11,000	7	1,580
18	3,670	28	32,000	8	1,460
19	2,210	29	4,940	9	1,330
20	1,850	30	3,240	10	1,180
21	1,630	Oct. 1	2,620	11	1,100
22	1,610	2	2,210	12	1,020
23	1,300	3	1,970	13	950

Nueces River at Laguna, Tex.

Location.- Lat. 29°26', long. 100°0', half a mile below Sycamore Creek and 1 mile northeast of Laguna, Uvalde County.
Drainage area.- 764 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 4.4 and 7.6 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 40,000 second-feet; extended to peak discharge on basis of one float and one slope-area measurement.
Maxima.- 1936: Discharge, 114,000 second-feet 12:30 p.m. Sept. 16 (gage height, 21.30 feet).
1924-36: Discharge, 213,000 second-feet, by slope-area measurement, June 14, 1935 (gage height, 26.0 feet, from flood marks).
1903-23: Discharge observed, 226,000 second-feet Sept. 21, 1923 (gage height, 26.5 feet).
Stage, about 29 feet in June 1913 (discharge not determined).
Remarks.- No diversions or regulation.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
Sept. 14	82	Sept. 24	602	Oct. 4	559
15	22,900	25	559	5	530
16	26,400	26	538	6	509
17	3,890	27	1,980	7	516
18	1,900	28	1,600	8	480
19	1,320	29	1,020	9	445
20	1,030	30	810	10	424
21	866	Oct. 1	711	11	403
22	755	2	638	12	384
23	674	3	588	13	370

Frio River at Concan, Tex.

Location.- Lat. 29°29', long. 99°42', half a mile below Concan post office, Uvalde County.
Drainage area.- 485 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 3.1 and 4.2 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 440 second-feet; extended to peak discharge on basis of two slope-area measurements.
Maxima.- 1936: Discharge about 103,000 second-feet 10:30 a.m. Sept. 16 (gage height, 30.6 feet, from flood marks).
1924-35: Discharge, 162,000 second-feet, by slope-area measurement, July 1, 1932 (gage height, 34.44 feet, from flood marks).
1913-23: Stage from flood marks, 28.8 feet, Sept. 18, 1923 (discharge not determined).
Remarks.- No diversions or regulation.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
Sept. 14	97	Sept. 24	318	Oct. 4	564
15	701	25	318	5	532
16	13,100	26	376	6	506
17	1,010	27	6,050	7	525
18	876	28	1,370	8	480
19	622	29	980	9	440
20	486	30	811	10	414
21	440	Oct. 1	707	11	388
22	388	2	642	12	376
23	362	3	596	13	356

Devils River near Juno, Tex.

Location.- Lat. 29°58', long. 101°9', 500 feet below Walter Baker ranch house, 2 miles above mouth of Phillips Creek, and 13½ miles southwest of Juno, Val Verde County.
Drainage area.- 2,733 square miles.
Gage-height record.- Water-stage recorder graph. Gage heights used to half tenths between 4.5 and 9.1 feet; hundredths below and tenths above these limits.
Stage-discharge relation.- Defined by current-meter measurements below 4,500 second-feet; extended to peak discharge on basis of three float and two slope-area measurements.
Maxima.- 1936: Discharge, 38,300 second-feet 8:30 a.m. Sept. 17 (gage height, 14.88 feet).
1925-36: Discharge, 370,000 second-feet, by slope-area measurement, Sept. 1, 1932 (gage height, 31.3 feet, from flood marks).
1882-1924: Stage, 22.1 feet about Sept. 1, 1916.
Remarks.- No regulation or diversions.

Mean discharge, in second-feet, 1936

Day	Second-feet	Day	Second-feet	Day	Second-feet
Sept. 14	117	Sept. 24	158	Oct. 4	175
15	275	25	153	5	169
16	10,800	26	3,740	6	166
17	20,900	27	15,900	7	160
18	14,200	28	2,170	8	158
19	1,640	29	792	9	158
20	507	30	362	10	155
21	258	Oct. 1	225	11	155
22	191	2	198	12	151
23	169	3	185	13	151

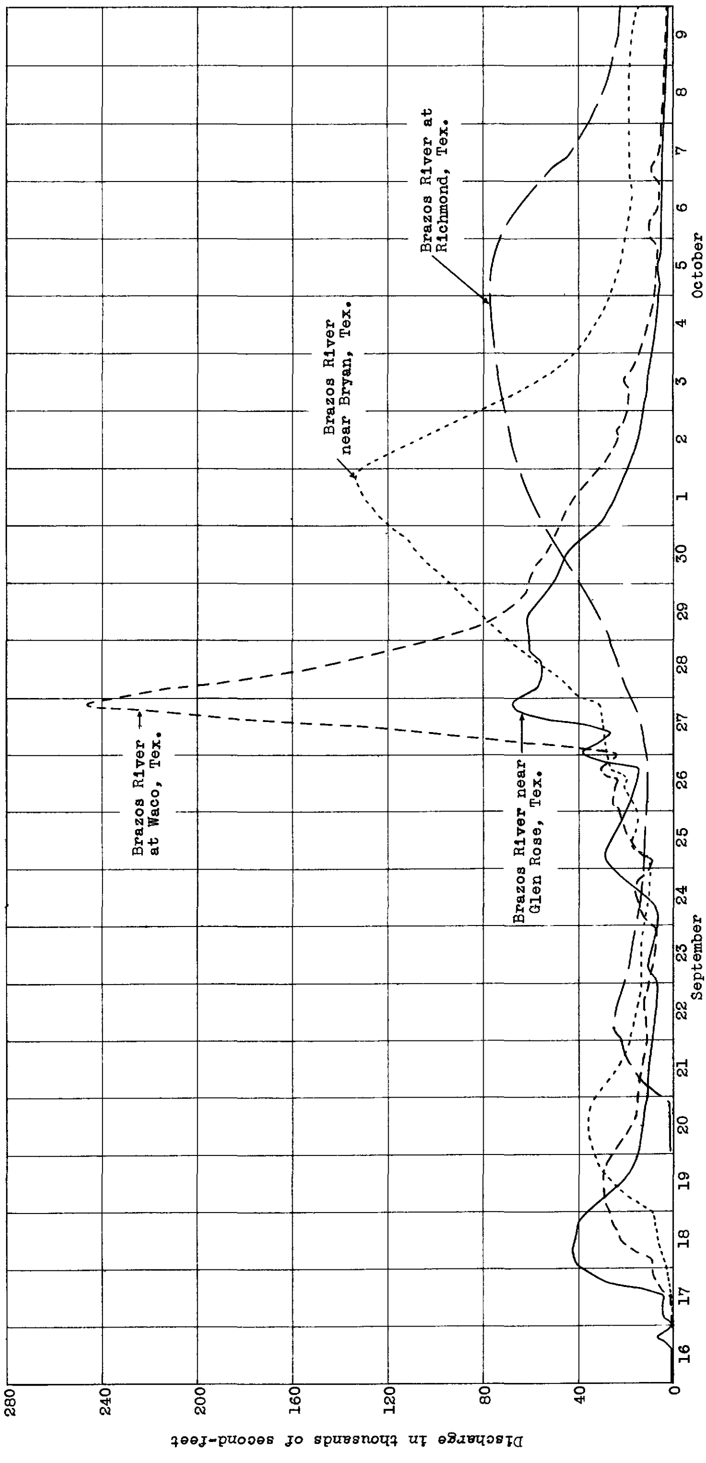

Figure 23.--Hydrographs of discharge at river-measurement stations on the Brazos River, September 16 to October 9, 1936.

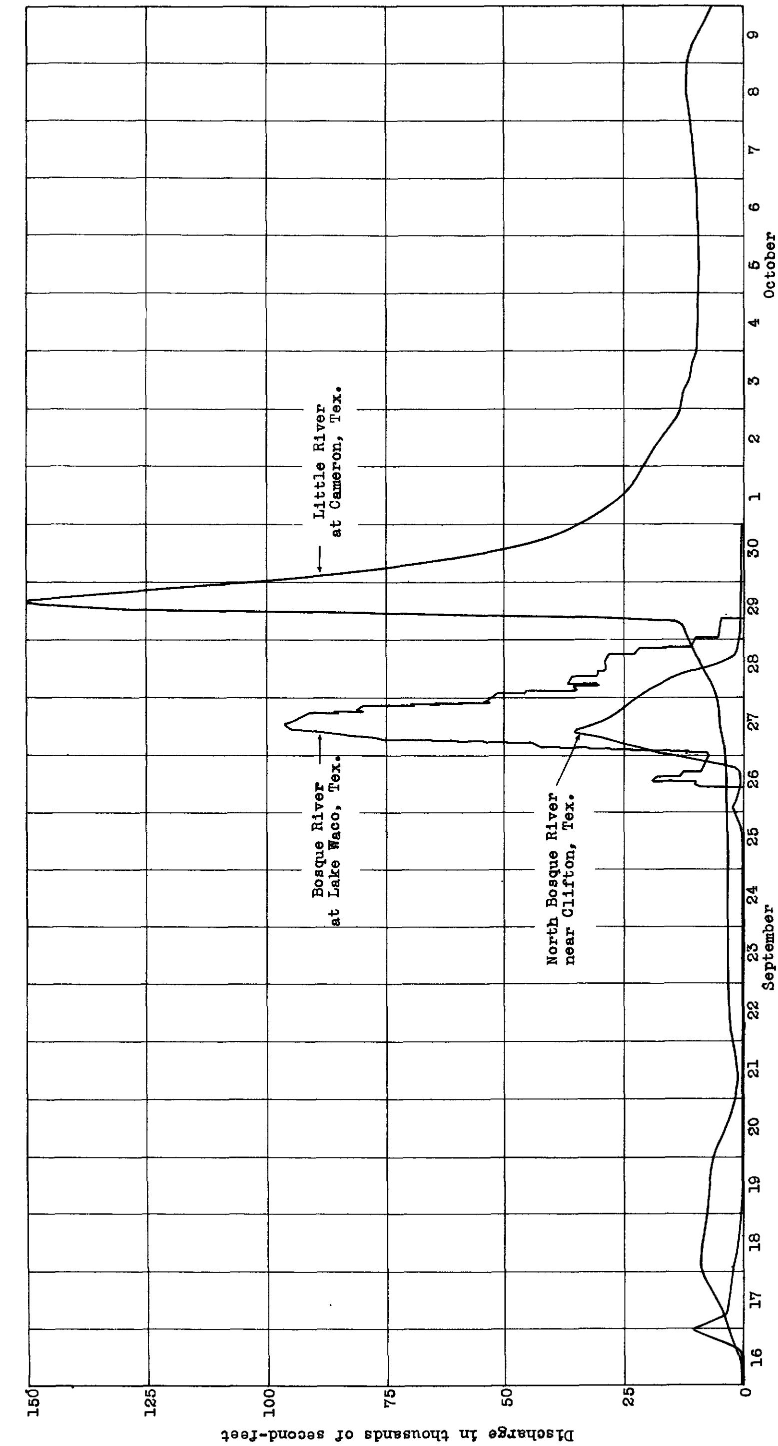

Figure 24.--Hydrographs of discharge at river-measurement stations on tributaries to the Brazos River, September 16 to October 9, 1936.

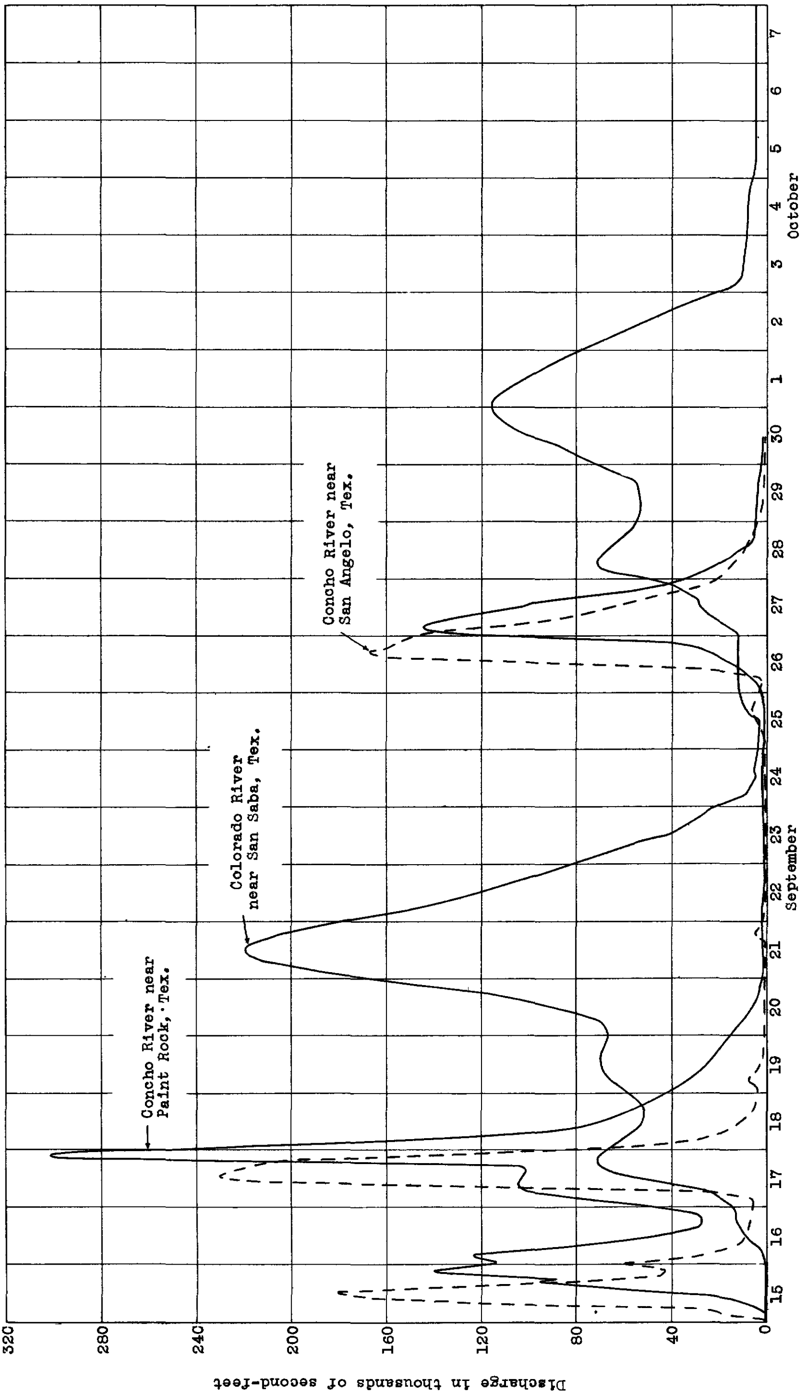

Figure 25.--Hydrographs of discharge at river-measurement stations on the Concho and upper Colorado Rivers, September 15 to October 7, 1936.

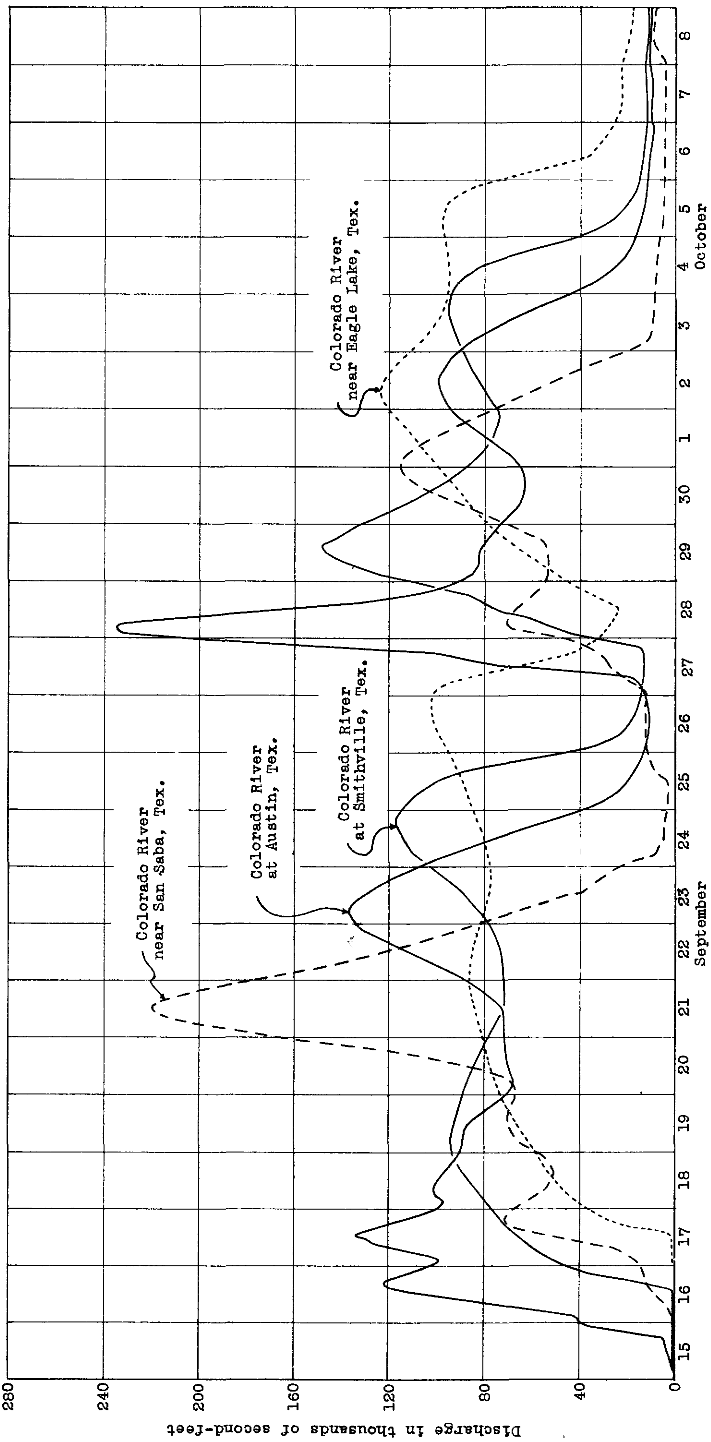

Figure 26.--Hydrographs of discharge at river-measurement stations on the lower Colorado River, September 15 to October 8, 1936.

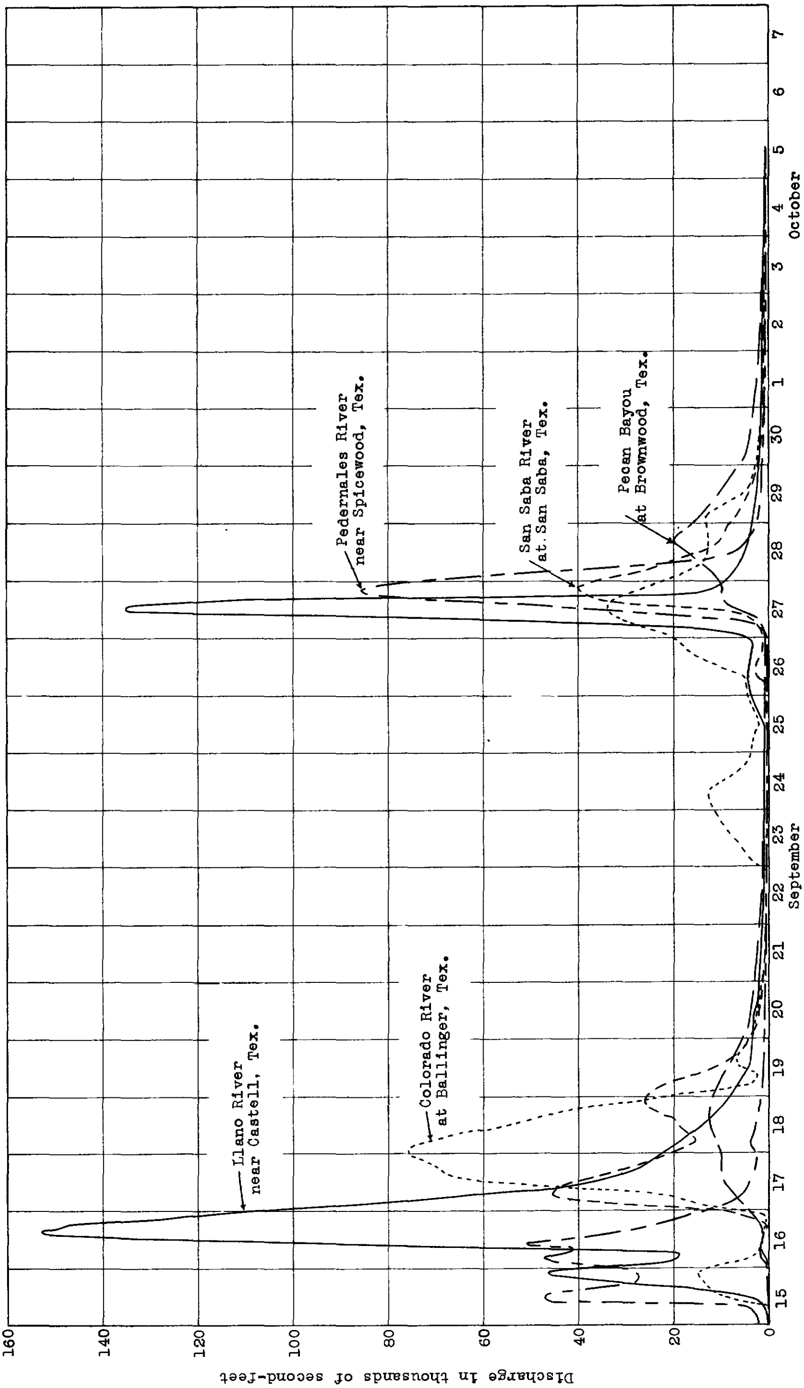

Figure 27.--Hydrographs of discharge at river-measurement stations on tributaries to the Colorado River, September 15 to October 5, 1936.

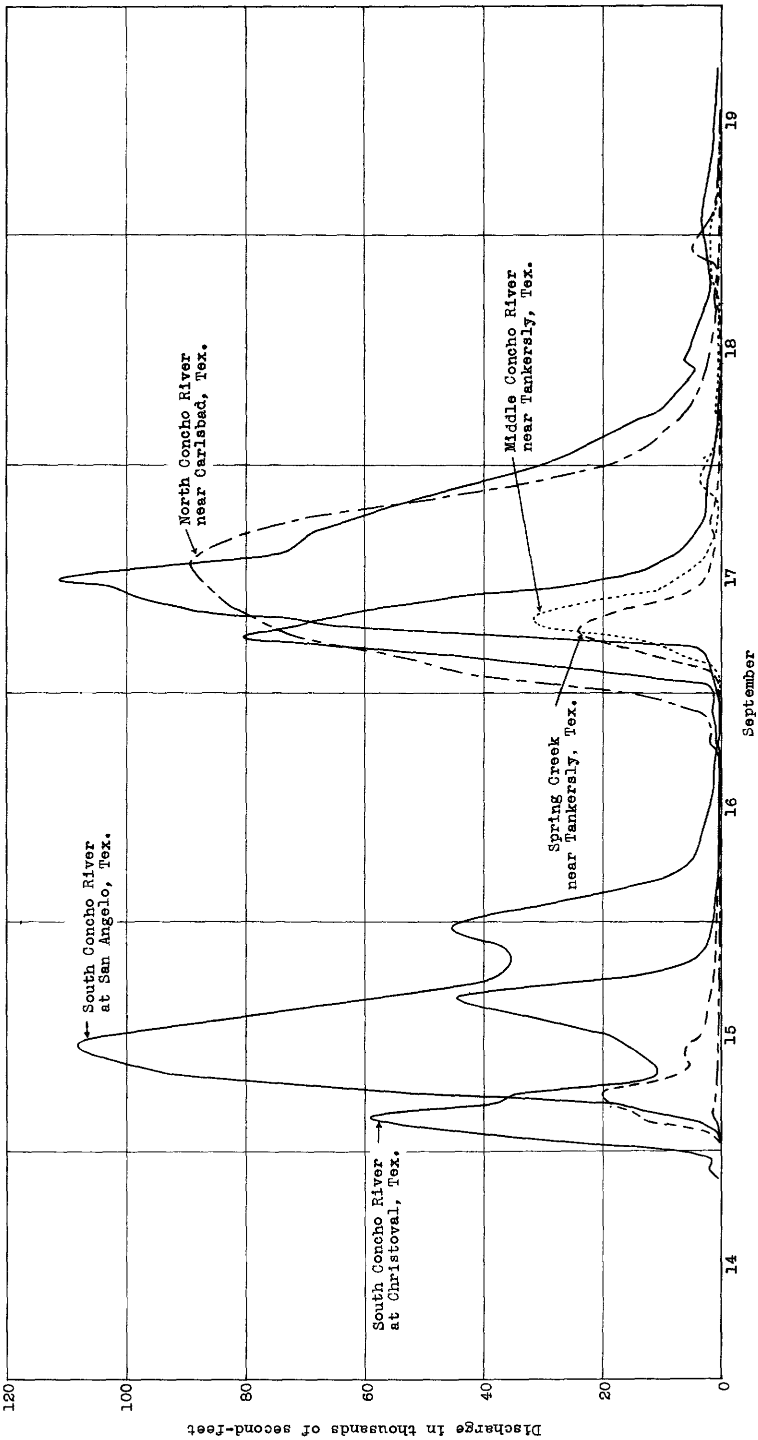

Figure 28.--Hydrographs of discharge at river-measurement stations on tributaries to the Concho River, September 14-19, 1936.

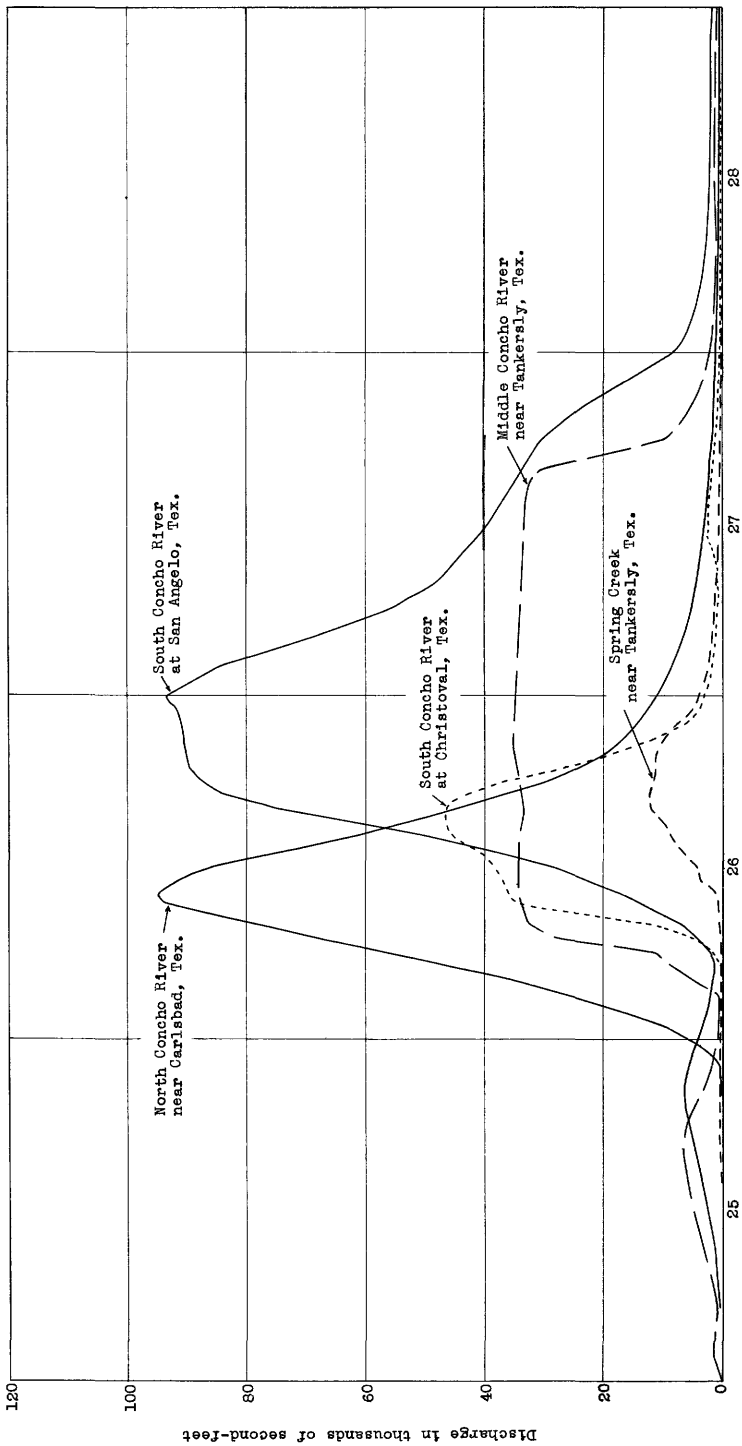

Figure 29.--Hydrographs of discharge at river-measurement stations on tributaries to the Concho River, September 25-28, 1936.

PREVIOUS FLOODS

At least 1,150 lives have been lost and damages exceeding $130,000,000 have been caused by floods following excessive rains in Texas in the 45 years preceding 1934, according to information given by R. L. Lowry, Jr., on page 20 in Texas Reclamation Department Bulletin 25, Excessive rainfall in Texas. In this bulletin Mr. Lowry has presented the results of a study of 33 major storms that occurred during the period 1891 to 1933.

The following information on floods prior to 1891 is compiled from "The climatic conditions of Texas, especially with reference to temperature and rainfall: 52d Cong., 1st sess., 1891-92, S. Ex. Doc., vol. 2, appendix 6, pp. 110-116:

General.--August 14, 1880.--Extremely heavy rains rendered all streams impassable between San Antonio and the Rio Grande; at Fort McKavett the water rose 10 feet in 10 minutes.

August 17, 1880.--The Pecos was impassable, and the bridge at Horsehead Crossing was swept away.

September 1880.--Heavy rains in western Texas caused floods. Near Mason the Comanche overflowed for the first time in memory and carried off stock. At Uvalde the Frio rose higher than ever before; the town of Frio was inundated and much damage wrought.

May 1884.--The rains of the 20th and 21st were the heaviest ever known in Texas and productive of great losses to agriculture. Travel on all railways in the eastern part of the State was suspended on account of washouts and destroyed bridges. The northeastern counties had not been so inundated for many years. The San Jacinto washed away the eastern approach to the Bremond Bridge and flooded the country, drowning much stock. The Trinity River, at Fort Worth, overflowed on the 21st a mile on either side and rose higher than had been known since 1866. Chambers Creek, at Corsicana, on the 23d was a mile and a half wide. About the 10th the Rio Grande began to rise at El Paso, reached an unprecedented height, caused great loss of life and property. The flood reached Brownsville on the 26th, when the Texas bank began to give way. The rains of the 20th and 21st alone were estimated to have damaged railroad property $2,000,000, and the combined losses of the farmers and railroad companies were placed at $5,000,000.

<u>Trinity River Basin</u>.--February 3, 1881. At Grapeland rain was reported as having fallen incessantly for several days, and watercourses rose higher than had been known in twenty years.

February 12, 1881. From Dallas it was reported that rain had been almost incessant throughout eastern and northern Texas for a week, flooding the entire country; Trinity River overflowed and 20 miles of the Texas & Pacific Railroad was washed away; the rivers were higher than ever since the great floods of 1852 and 1866.

April 22, 1881. At Huntsville occurred the heaviest rain ever known; surrounding country flooded.

April 28, 1884. The rain at Dallas was so heavy as to reverse the current in Trinity River, a phenomenon once before observed 25 years ago.

April 20, 1885. A destructive flood occurred at Gainesville, and the waters of Pecan Creek rose 2 feet higher than in the great flood of 1857.

June 3, 1889. The wheat crop near Denton was damaged by heavy rain; the water gathered in floods, exceeding the highest remembered.

July 3, 1889. Heavy rain at Fort Worth, caused a flood higher than any since 1866; all the valley was 6 feet under water; the loss to the railroads was estimated at $1,500,000; Dallas was flooded.

San Jacinto River Basin.--August 29, 1887. Buffalo Bayou became a raging torrent and carried houses and bridges away; a family of 9 was drowned before they could escape; in all 11 deaths by drowning were reported.

Brazos River Basin.--April 22, 1879. All highway bridges within a radius of 30 miles from Corsicana were swept away by floods; railroad trains were abandoned on the Texas Central for 36 hours.

May 27, 1885. A remarkably heavy rain fell at Valley Mills. The most destructive flood ever known at Waco occurred. The Brazos River rose 2 feet above highest water mark and submerged the cotton plantations. After it had fallen 7 feet there yet remained 150 houses submerged; 17 bridges were washed away.

May 31, 1885. The Brazos at Calvert rose 5 feet above highest flood mark, and thousands of acres under cultivation were flooded.

Colorado River Basin.--May 27-30, 1880. Very heavy rains caused floods of destructive character.--Coleman City,--Colorado River rose 30 feet. San Saba, high flood, 2 persons drowned and much property swept away.

August 23, 1882. Rain fell in torrents at Concho, flooding the South Concho River to a height of 45 feet above its usual level; houses were swept away and people drowned. The town of Ben Ficklin was completely washed away with the exception of the courthouse and jail. The town of San Angeles was also inundated. It was estimated that 50 people were drowned and from 10,000 to 15,000 head of stock lost; the damage to property amounted to more than $150,000.

Rio Grande Basin.--May 27-30, 1880. Brackettville, severest storm ever known, all the city except a portion on two hills inundated, water 8 feet deep on the main street, buildings washed away and more than 20 persons reported drowned.

November 1881. From Brackettville, Brownsville, and Matamoras come reports that the Rio Grande was higher than at any time since 1848; the floods were most disastrous.

June 1884. Extensive and disastrous floods continued along the Rio Grande, providing great losses to farmers and stockmen. The loss to railways was estimated at $1,000,000. At El Paso the street-railway bridge was carried away on the 9th. Between that city and Fort Quitman all the valleys were flooded.

July 10, 1889. Heavier rain than for years fell at Del Rio; Sencas Creek overflowed, and the Rio Grande was over a mile wide.

Upper Colorado River floods

The following information concerning flood peaks on the upper Colorado River at places other than discharge-measurement stations was obtained mostly from local residents:

At Robert Lee Mr. Vastal stated that the flood of 1922 reached a stage 5 or 6 feet higher than that of 1936. Mr. Allen stated the river was 1 or 2 feet higher in 1906 and 1922 than in 1936.

Six miles below Robert Lee, at the site of a former river-measurement station, the peak stage of the flood of September 17, 1936, was found by levels to be 26 feet (former gage datum). Two floods are reported to have reached stages of 28 or 29 feet since 1883.

Near Bronte J. B. McCutcheon furnished the following information relative to stages reached during previous floods at the site of a former river-measurement station: 1896, 2 feet higher than in 1936; 1908, same as in 1896; 1913, 2 feet lower than in 1896; 1919 or 1922, lower than in 1913; 1925, lower than in 1919 or 1922. By levels to high-water marks it was determined that the flood of September 17, 1936, reached a stage of 27.3 feet, former gage datum.

Near Milburn, at the former river-measurement station, the flood of September 19, 1936, reached a maximum stage of 60.3 feet, gage datum. R. L. Mauldin, who lives about 4 miles above the former gaging station, gave the following information: He moved to the country in 1897; the flood of 1882 was much lower than in September 1936; the flood of 1906, the highest known up to that time, was 8 feet lower than the flood of 1936; the flood of October 1930 was 5 or 6 feet lower than that of 1906.

Near Regency, about 16 miles above the mouth of Pecan Bayou, Mr. Young, who moved to the country in 1857, is reported to have stated that the Colorado River was higher in September 1936 than ever before and that the second highest stage occurred in 1906.

Near Tow, at the former river-measurement station on the Colorado River, the peak stage reached during the flood of September 21, 1936, was determined by levels to be 27.90 feet, gage datum. The highest previous stage known, 28.4 feet, occurred in April 1900.

Plate 10, B is a view looking west from the top of the Runnels County courthouse, showing the town of Ballinger, flooded by the Colorado River and Elm Creek in August 1906. The Colorado River flows from right to left in the background of the picture.

Concho River floods

The following information regarding floods in the Concho River Basin which occurred prior to the establishment of river-measurement stations in 1915, has been taken essentially from a paper entitled "Floods in Concho River Basin" compiled in May 1925 by A. G. Fiedler of the United States Geological Survey.

Flood of 1853: The earliest flood of any considerable size of which we have any definite knowledge occurred in 1853. From a study of precipitation records it would seem that this rise occurred in June 1853. It is reported that the flood of this year reached an altitude of about 1,852 feet above mean sea level, which corresponds to a depth of about 6 feet at the site of the present courthouse in San Angelo. Reliable evidence supporting the occurrence of a flood of such unprecedented height is rather scant, but several old residents report having seen the remains of a 4-foot pecan tree lying a short distance north of San Angelo upon what at that time was an open prairie. The general vicinity of the point where this old tree lay was visited in April 1925, and after a reconnaissance of the country it seemed very probable that a big rise upon the North Concho River could have deposited this tree at the place where it is reported to have lain for so many years. The existence of this log is the only evidence that would tend to confirm the occurrence of the flood of 1853. However, such a flood height is not impossible should the peak of a rise on both the North Concho River and the South Concho River arrive at their junction at the same time. This assumption is partly verified by the fact that there is reliable information concerning all large floods since 1882, and at no time have the peaks of any floods on both forks arrived at their junction at the same time. In considering the height that floods upon only one fork of the river have attained it is not improbable that a combination of floods upon both streams could produce a condition such as is reported to have occurred in 1853.

A. LOOKING ACROSS SOUTH CONCHO RIVER FROM LEFT BANK.
Lone Wolf Bridge over main channel shown in right center of picture.

B. LOOKING ACROSS NORTH CONCHO RIVER FROM LEFT BANK AT OAKES STREET.

FLOOD OF AUGUST 1906 AT SAN ANGELO.

A. LOOKING ACROSS RIVER FROM LEFT BANK AT ABOUT PEAK OF FLOOD.

B. TREES DAMAGED BY FLOOD.
Many beautiful cypress trees were destroyed.

GUADALUPE RIVER AT KERNVILLE, FLOOD OF JULY 1, 1932.

THE TOM GREEN TIMES

VOL. 3. SAN ANGELA, TOM GREEN CO, TEXAS, SATURDAY, AUGUST 26, 1882 NO. 19.

TERRIFIC FLOOD!

GREAT DESTRUCTION OF LIFE.

Thousands of Dollars Lost in the Seething Waters.

BEN FICKLIN ALMOST WHOLLY RUINED AND SAN ANGELA PARTIALLY INUNDATED.

SOME PARTICULARS OF THE DISASTER.

A great affliction has fallen upon our country, and it is our duty to chronicle the details of a calamity, whose general results and special incidents bring sorrow and loss to all.

At 8:30 p. m., on Wednesday evening the 23d inst, a cloud gathered in the west and promised rain, and at 9 o'clock it came in torrents for more than an hour. Then the moon shone out clear and indicated that the storm was exhausted. Many were attracted by its brilliancy and turned in for the night with no thought of further wet weather. But at eleven rain began a second time and the thunder, which pealed across the skies, made sleep impossible. The frequent flashes of lightning blinded those who ventured to look out, and the ceaseless roar of water from roofs and gutters made old Texans anxious for to-morrow and what to-morrow would reveal. All night it continued its impetuous fall, and when day arose there were no signs of change. By the early light the Middle Concho was seen to be 30 feet above its level, and rising with great rapidity. The rain poured, it seemed to have come for all time, nor was it till eleven on Thursday morning one might reasonably hope for fair weather. At noon the blue sky appeared, the clouds drew off, and the telegraph office register (at Fort Concho) measured a rainfall of 5 85 inches, full one inch more than the average fall of rain in this section for an entire year.

Anxious parties were out all the morning watching the river, which quickly rose above the banks, and made immense currents on the plains two and three hundred yards beyond. It was filled with drift, and every conceivable species of property. Chairs, goods, trunks, boxes, and furniture of all kinds made their appearance. Hundreds of sheep floated down the torrent, and roofs of houses, quantities of planks, sills and doors dashed against the very tops of the tallest trees which skirt the banks of the stream. It was certain, not only that immense loss of property was entailed, but that life itself was endangered by so terrific a rise, and what made the situation more distressing was the absolute inability to rescue property or extend aid to any sufferers. There was no boat at hand, and it is doubtful if any boat could have lived in so headlong a current. The largest trees, measuring from two to four feet in diameter were torn up by the roots, and hurried along as if mere toys in the fierce element. The river reached its highest point at about 4 o'clock Thursday evening, and, by the estimate of experienced men, it measured a height of at least 45 feet above its ordinary bed. Such a rise has not been known to the oldest dweller on the frontier, and Heaven grant such another will not be seen by this generation. A little after 4 it began to recede; by 7 it had fallen 2¾ feet, and all during the night it continued to go down. When the morning of Friday, the 25th, broke, it showed a decrease of 20 feet, though it is yet an angry current, which will hardly be fordable until Sunday.

We are at a loss where to turn in our attempt to speak of the effects of this immense storm. Perhaps the greatest interest of the community is excited over the unhappy fate of the family.

At the Old Stage Station, between this town and Ben Ficklin. Unfortunately this place is situated on a small eminence between the river and the cliffs, about 300 yards from the latter, whose base is skirted by a deep ravine. Escape from such a position is extremely difficult, since in any direction a horse would swim long before the house is endangered. Mrs. M J. Metcalfe and her family of five, Mrs Kate Arden and two children, Mr. B. Taylor and daughter, Mr. Frank Lerch, who was luckily absent, and Mr S C. Robertson and wife, of San Angela, reside at the station. Early in the morning they discovered that their houses were surrounded and the water was making rapidly toward them. Mr C D. Foote appreciating the danger, drove from Ben Ficklin to the station, and brought off Mrs. Arden and her two children, Miss Taylor, Misses Fannie and Amelia Metcalfe, and the two sons of Sheriff Spears. Mrs Metcalfe, thinking the water had reached its highest point, declined to leave, and her daughter, Miss Zemula, resolved to remain with her, saying: "My place is with mother." But the waters rising, induced Mr Robertson to drive his wife to a place of safety, which he did with some difficulty. He then returned to aid Mrs. Metcalfe and others at the station, whom he induced to enter the hack. They started, but the horses balked, and no progress was possible. At Mrs Metcalfe's suggestion they turned, and by means of a ladder, climbed upon the roof of her dwelling. In this position Mr. Terrell Harris and Kerby Smith, a colored man, who had nobly resolved to rescue the unfortunate party and had left Ben Ficklin in a frail boat for that purpose, observed and passed them. Upon that roof were Mrs Metcalfe and her daughter Miss Zemula, Mr S. C Robertson; Mr Blake Taylor, Sr.; George Robinson, chainbearer for Mr. Lerch; Anselmo, a Mexican; and Red Evans, a negro cook. The heavy boat, half full of water, capsized within ten feet of the house. It occupants, Harris and Smith, made desperately for a grove of pecan trees, a place on the tallest of which they luckily secured. Nearly at the same time the roof with its living freight broke in two, the ladies clinging to one half and the five men to the other half. The screams of George Robinson were distinctly heard and the actions of all seen by Harris and Smith from the tree tops. Mr Taylor lost his hold on the roof in a few seconds and was swept beyond human aid. The ladies bore down upon the pecan clump and were engulphed

Screaming as They Disappeared

beneath the drift which had rapidly accumulated within a few feet of Harris. Mr S C Robertson was shaken from the roof, but caught a tree and held on through as terrible a day and night as any one ever endured. Once the wreck of a house knocked him from his position, but he swam with that until he secured another. All of the party on the roof but this gentleman were lost. On Friday morning, at about 6 o'clock, Judge Joseph Spence espied Mr. Robertson in his tree and took steps to rescue him. An hour later Captain Rose, U S A, found and relieved Harris and Smith. They were bruised and sore from contact with the drift and from their super-human exertions. The station is itself an utter ruin. All the houses and walls have disappeared in a current before which stone walls melted like snow in June.

Ben Ficklin,

our county seat, is almost wholly destroyed. The water rose to a height of 15 feet upon the court house, which with the jail and Mr Elliot's residence alone remains upon the flat. The majority of its inhabitants have lost everything. The stone buildings of Jno Engel and William L. Wahrmund the frame or adobe houses of Pollock Wishert & Brown, Holtz, Sanderson and Halfin, together with Foote's office are swept away, and all their contents are lost as far as we are able to judge. Further we are unable to report, since communication is impossible. Provisions were forwarded to Ben Ficklin from this place and the post, but could not be sent across the river. The people, however, have enough to last until supplies reach them.

At San Angela

the scene was exciting in the extreme. The North Concho was not affected save by the backwater. But for this circumstance our town would have perished. Yet the backwater frightened all and ruined many sending the still element into our streets, and rising forty feet above the river bed. The whole bottom was covered, and exhibited a large inland basin, four hundred yards wide. At its highest point it circled around the Nimitz coral, stretched away in a constantly expanding line until it embraced G. W. Westbrook's residence, sunk Keyser's saloon to the eaves lapped the back of the Great Western Livery Stable, and becoming holder it swept by Patton & Lungkwitz's tin shop, and rose more than two feet above the first gallery of the Concho House. All adobe houses touched by the water are ruined. The livery stable has lost its back wall, the tin shop is dismantled and its roof was uplifted by a number of props, as the walls disappeared. The Concho House, lately built at a cost of $11,000, yet stands, but is wholly unfit for further use. The adobes where the water reached them dissolved as by the touch of magic. Immediately doors crashed in, windows gave way and plaster and portions of walls fell in. It is a question of time only when the entire building will go to the ground. Most of the furniture was saved. Mrs. Frary's home, east of the hotel, is destroyed, while those of Mr. E E. Deaton, Dave Kearse, Bob Fairbanks, Frank Lungkwitz, Tom Brown and W. B. Cain, are abandoned and ruined, while not a Mexican habitation on the river is left. The store and house of W. S Veck escaped all injury, but his stable, lately built, entirely collapsed. The loss to our city will probably reach $50,000, a low estimate. But the

Country Around

has suffered terribly, and the loss of life has been very great. Hundreds of carcasses of sheep and other stock are scattered over the prairies, wagons, blankets, clothing and all sorts of furniture strew the banks, while the baser sort of Mexicans are pilfering. We confess we are unable to estimate the losses in this county; all sorts of rumors prevail, and our citizens are endeavoring to find the remains of all the unfortunates who drowned. D Carter went at 12 o'clock, Friday, about eight miles above Ben Ficklin and learned that a Mexican lost his wife and five children just opposite that town. Twenty persons are missing from Mr. W S. Kelley's ranch, on Spring Creek, and ten from Tankersley's. Three at Mr David McCarthy's, who is now in California, are lost, and all his sheep are gone. Dr Owens and child, living on Levy's ranch, are drowned, and his wife was taken from a tree on Friday morning at the same place. Mrs. H. K Mathis was swept from her home with a child in her arms.

Mother and Child

were hurled upon a drift and separated, the latter sinking, the former clinging to a tree, from which she was taken Friday morning. The body of the infant has been recovered, and we learn that the remains of Miss Zemula Metcalfe have been found. The body of Red Evans, the station cook, was discovered near the Post lime kiln. Parties were searching the banks all Friday for the drowned, and will continue the search. Not fewer than one hundred lives were lost in this county. The telegraph wires east are broken. As we go to press the citizens are organizing search and relief parties, our citizens have responded liberally, and have opened their houses and purses to the suffering.

Notes of the Flood.

Mr. Terrell Harris, who made the heroic attempt to save the Metcalfe family, says that when his boat capsized that he was caught under it, that he raised it off, got on top and pulled off his boots as a preparation for life and death struggle. Such presence of mind is truly remarkable.

Mr. S C. Robertson appeared on our streets yesterday evening looking haggard and bruised. He received the congratulations of his friends.

Judge Spence and Mr. A. G. Nason were detained at the Post by the merest accident. Had they gone to the station where they designed to pass the night, it is probable they would have been lost.

David Welsh, on Main Concho, lost his thoroughbred bucks, for which he had recently paid $700.

Mr. C E. Hicks estimates the injury to his stables at from three to five thousand dollars.

Following are the names of a few of the lost:

Mrs. Metcalfe and daughter, Zemula, Mr. B. Taylor, Geo Robinson, infant son of H. K. Mathis, Anselmo, (a Mexican, Red Evans, and five Mexicans opposite Ben Ficklin.

Our report closes as we go to press. Such sickening details and horrid suspicions of death we do not often meet in life. Our reporter is out hunting up the news, and our next issue we will give full particulars of the disaster. As it is we feel a relief in closing the initial chapter of so terrible a calamity.

The Latest.

Mr Charles Lackey, wife and children are reported drowned.

The body of Mrs Metcalfe has been found, sixteen miles below, at the mouth of Crow's Nest.

From Ben Ficklin we learn that the records are destroyed, and the court house is injured to such an extent that it will probably fall.

Mr. Stonehouse and family, at the head of Spring Creek, are reported lost.

The bodies of three women were found in the road by Mr Van Flores, above Ben Ficklin, who failed to recognize the remains.

The body of young George Robinson, one of the station victims, was found this afternoon and brought to town on horseback by a Mexican.

The body of the Mexican woman, drowned opposite Ben Ficklin, was also recovered to-day.

The funeral of Mrs Metcalfe was held to-day at Ben Ficklin.

Figure 30.--Excerpt from the Tom Green Times of San Angelo, August 26, 1882, giving an account of the Ben Ficklin flood on the Concho River in August 1882.

The Ben Ficklin Flood of 1882: The prominence given to the Ben Ficklin flood of 1882 in the local history of San Angelo and vicinity is not because it was the largest flood within the memory of present inhabitants, for the flood of August 1906 is known to have reached a height about 1 foot higher, but because of the loss of life and the complete destruction of the town of Ben Ficklin, the county seat of Tom Green County. The storm centered over the Middle and South Concho River drainage basins and left the North Concho comparatively unaffected. According to local reports the North Concho River rose about 10 feet, which corresponds to a discharge of about 15,000 second-feet at San Angelo. The precipitation for August 1882 at San Angelo was 14.03 inches; the mean August precipitation is 2.89 inches. A vivid account of the Ben Ficklin flood of 1882 is given by the Tom Green Times of August 26, 1882. (See fig. 30.)

May 1884: Little is known concerning the flood of May 1884, for, coming so closely upon the destructive flood of 1882, it received very little mention in old records. The precipitation for May at San Angelo was recorded as 13.50 inches, compared with a mean May precipitation of 3.02 inches. The flood of this year affected only the Middle and South Concho River drainage basins.

October 1896: No definite high-water points are available for the rise of October 1896. Precipitation records indicate that this flood was not of unusual magnitude.

April 1900: On April 6, 1900, a combined rise of both the North and South Concho Rivers occurred. It is estimated that the South Concho River rise reached a stage of about 45 feet, while the North Concho reached a peak stage of at least 15 feet. According to the best information obtainable the flood on the South Concho reached a stage about equal to that of 1882.

August 1906: The flood of August 1906, is the largest which has occurred in the history of San Angelo. The rise of 1853 as reported was considerably greater, but information and evidence supporting it is rather scant. Information that is considered reliable indicates that the flood of this year was from 12 to 18 inches higher than the destructive flood of 1882. No loss of life is recorded for this rise, and property damage was estimated at $250,000, not including damage to land. After the flood of 1882 Ben Ficklin was never rebuilt, but the town was moved to the present site of San Angelo, which is upon considerably higher ground. In this way extensive damage during the 1906 flood was avoided. Precipitation records within the Concho drainage basin are lacking for the early floods, but a comparison with monthly records at surrounding stations shows that while the monthly precipitation for the month of the 1906 flood is not quite as great as that of the flood of 1882, yet the storm which caused the rise was of greater intensity and was practically centered over the drainage area. Records indicate at least a 7-inch precipitation over the South Concho drainage basin during a period of less than 2 days. Much information upon which the foregoing summary is based was furnished by C. B. Metcalf, James Hinde, Clint Johnson, M. L. Mertz, Mr. Weaver, Mrs. W. S. Deck, and Pat Dooley of San Angelo. Numerous persons furnished general information.

At San Angelo the 1906 flood was higher than the Ben Ficklin flood, but at Paint Rock the latter was about 1 foot higher than the former. Plate 11, A, shows a view, taken from the left bank, of the Lone Wolf bridge across the South Concho River at about the peak of the flood of August 1906. This bridge is about 1 mile above the confluence of the

South and North Concho Rivers and is the site of the present gaging station on the South Concho River at San Angelo.

Plate 11, B, is a view, taken from the left bank, of the old Oakes Street bridge across the North Concho River in San Angelo, probably just after the peak of the flood of August 1906. The flood in the North Concho River was caused mostly by backwater from the South Concho River.

Floods of September 1921

Water-Supply Paper 488, "The floods in central Texas in September 1921", by C. E. Ellsworth, describes the floods of September 1921 in the Brazos, Colorado, and Guadalupe River Basins, especially those on the Little River and at San Antonio. This report also gives an account of the general features of the flood of 1913 as described in an article by B. Bunnemeyer of the United States Weather Bureau at Houston.* Many valuable data on previous floods in the Brazos, Colorado, and Guadalupe Rivers Basins are also included in the above-mentioned water-supply paper.

Floods of May 1929

Heavy precipitation during the later part of May 1929, centering over a fairly small area in Hays County, caused floods of unusual magnitude on the Pedernales River and on Miller, Barton, and Onion Creeks in the Colorado River Basin and on the San Marcos and Blanco Rivers in the Guadalupe River Basin.

Excessive precipitation also fell in Tyler, Bell, and La Salle Counties, but no special investigations were made in those areas. A slope-area determination of discharge was made of the flood of May 31 on the San Jacinto River near Humble; during this flood the highest stage known at this gaging station occurred. The greatest discharge that has been determined at the river-measurement station on the Brazos River at Richmond occurred on June 6.

Miscellaneous precipitation data, supplementing the records of the United States Weather Bureau, were obtained in the flood areas as follows:

At Jasper Brown's house, on Barton Creek, about 3 miles above Barton Springs, a bucket 10 inches high was filled to overflowing during Monday night, May 27.

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* Bunnemeyer, B., The December flood of Texas: Eng. News, vol. 71, no. 21, pp. 1116-1121, May 21, 1914.

At Burnett's ranch on the Blanco River, Monday night May 27, a bucket 7.8 inches high was filled to overflowing, and the total rainfall was probably 9 inches or more. The next day the bucket was filled within 3 inches of the top. The total rainfall for the 2 days was about 14 inches.

Driftwood: Several residents said the total rainfall was at least 15 inches Monday night, May 27, and Tuesday, May 28.

Dripping Springs: C. H. Buckley measured 8 inches of rainfall from Monday night, May 27, to Tuesday night.

Fischer Store: May 24, 0.60 inch
25-26, 1.00 inch
27-28, 8.00 inches
29, 1.40 inches

Henley: A 15-inch bucket was filled to overflowing. The total rainfall was probably nearly 20 inches.

Johnson City: Mr. Stubbs said he measured 13 inches of rain from Monday night, May 27, to Tuesday night.

Kyle: Rainfall record furnished by Mr. Sion:
May 23-24, 2.66 inches
25, 1.43 inches
28, 6.90 inches
29, .98 inch
30, .04 inch
31, .22 inch

Spring Branch: C. E. Crist, at Blanco, said he was at Spring Branch Monday and Tuesday and that the rainfall Monday night was half an inch and by Tuesday night the total rainfall was 3½ inches.

In table 10 are listed the maximum discharges determined for various stations experiencing unusual discharges in these floods. All measurements of discharge of the floods of May 1929, made at miscellaneous stations, have been published in Water-Supply Paper 688, pp. 126-127, under "Miscellaneous discharge measurements."

Table 10.--Maximum discharge at places experiencing unusual floods in May and June 1929

Stream	Lat.	Long.	Drainage area (sq.mi.)	Maximum discharge		
				Date	Sec.-ft.	Sec.-ft. per sq. mi.
Colorado River Basin						
Colorado River at Austin (a)	30°16'	97°45'	26,350	May 29, 12:20am	132,000	5.0
Colorado River at Columbus (b)	29 42	96 33	29,000	June 1, 5am	110,000	3.8
Pedernales River at Stonewall (b)	30 13	98 39	647	May 28, 11:30am	38,100	58.9
Pedernales River near Spicewood (a)	30 25	98 5	1,294	May 28, 3pm	155,000	120
Miller Creek near Johnson City	30 12	98 18	56.3	May 28	22,900	407
Little Barton Creek near Bee Cave	30 18	97 58	6.3	May 28	2,450	389
Barton Creek near Riley	30 15	97 49	114	May 28	39,400	346
Onion Creek near Dripping Springs	30 10	98 6	54.8	May 28	21,900	400
Onion Creek near Buda	30 5	97 51	151	May 28	53,200	352
Onion Creek near Del Valle (b)	30 11	97 42	337	May 28, 6:15pm	76,000	225

a Gaging station at which systematic records of stage and discharge are kept.

b Gaging station discontinued since 1929.

Table 10.--Maximum discharge at places experiencing unusual floods in May and June 1929--Continued

Stream	Lat.	Long.	Drainage area (sq.mi.)	Maximum discharge		
				Date	Sec.-ft.	Sec.-ft. per sq. mi.
Guadalupe River Basin						
Guadalupe River at New Braunfels (a)	29°43'	98° 7	1,666	May 30, 5am	19,700	11.8
Guadalupe River below Cuero (b)	29 3	97 18	5,073	May 30, 8-11pm	101,000	19.9
San Marcos River at Ottine (a)	29 36	97 35	1,249	May 29, 5am	202,000	162
Blanco River near Blanco	30 6	98 26	92.2	May 28	43,500	472
Blanco River at Wimberly (a)	29 59	98 4	378	May 28	113,000	299
Blanco River near San Marcos	29 56	97 54	429	May 28	139,000	324
Plum Creek near Lockhart (b)	29 52	97 37	184	May 28, 6pm	25,200	137

a Gaging station at which systematic records of stage and discharge are kept.
b Gaging station discontinued since 1929.

Floods of July 1932

The following description of the floods of July 1932 is given in the United States Weather Bureau "Climatological data: Texas section" for July 1932:

Torrential rains over the upper watersheds of the Nueces and Guadalupe Rivers from June 30 to July 2 caused destructive floods along both rivers and their tributaries; 7 persons being drowned and property losses being conservatively estimated to exceed half a million dollars. Minor floods occurred in the Trinity and Sulphur Rivers with no losses. The Colorado carried a large volume of water but remained under flood at all points. Crests of the floods were reached in Kerr, Kendall, Real, Bandera, Uvalde, and Medina Counties on the 1st and 2d.

In the Colorado River Basin there was one unusual storm which centered near Coleman, where a rainfall of 9.40 inches on July 1-2 caused record-breaking floods on Jim Ned Creek and Pecan Bayou near Brownwood. Lake Brownwood, by storing the flood waters of Pecan Bayou, doubtless prevented great damage in the city of Brownwood. The flood, which was the greatest known, reached a discharge of about 235,000 second-feet into the lake. The reservoir, which was empty at 7 a.m. July 3, was filled by 8 a.m. July 4, to its capacity of 140,000 acre-feet. During this time all sluice gates were open and the discharge through the gates reached a maximum of about 12,000 second-feet.

The Guadalupe, Medina, Frio, and Nueces Rivers all head in a small area in the corner of Kerr, Real, and Bandera Counties. Over an area of more than 1,000 square miles on or adjacent to the headwaters of these rivers the rainfall was from 20 to 35 inches from June 30 to July 3. Floods of unusual magnitude occurred in each of these river basins.

A very heavy rain fell over the upper Guadalupe River Basin, west of Kerrville, from June 30 to July 2. This rain amounted to over 35 inches in about 36 hours at the State Fish Hatchery above Ingram. Record-breaking stages were experienced on all streams above Kerrville, and on the Guadalupe River to a point below Spring Branch. Along the streams in the hills above Kerrville are many summer homes, resorts, and camps for boys and girls. Most of these places were damaged by the floods, many of them being almost completely destroyed. There was much apprehension for the safety of the people in these camps, especially for the younger boys and girls, but fortunately all were safe. The fact that the flood occurred in the day rather than at night no doubt accounts for no loss of life in the camps. Plate 12, A, shows a view of the Guadalupe River at Kerrville at about the peak of the flood and plate 12, B, a view at about the same locality after the flood had receded.

In the Medina River above Medina Lake a flood occurred greater than had been known before. The area drained by this stream is not thickly inhabitated, and the peak discharges per square mile of drainage area were much lower than in the Guadalupe River Basin. No great amount of damage was done along this stream.

The floods in the Frio River, which is tributary to the Nueces River, were the highest known. Considerable damage was done to property along the streams in the upper reaches of the Frio River and its tributaries. In its lower reaches, where the river flows through the relatively flat Coastal Plain, wide areas were overflowed, inundating several small towns and many farms and rural homes. The town of Three Rivers, at the junction of the Frio and Atascosa Rivers with the Nueces River, was inundated with the exception of the Murrary Hill section and the highway.

The flood in the Nueces River was unusually high only below the mouth of the Frio River at Three Rivers. Many acres of farm land were submerged with damage to cotton and corn crops.

Precipitation

Table 11 presents rainfall data from United States Weather Bureau and miscellaneous observation stations in the flood areas. Figure 31 is an isohyetal map showing the distribution of the total rainfall for the period June 30-July 3, 1936, based on data presented in table 11.

Table 11.--Rainfall for period June 30 to July 3, 1932

U.S. Weather Bureau station	Latitude	Longitude	Inches
Brazos River Basin:			
Abilene	32°27'	99°43'	3.80
Comanche	31 54	98 36	1.27
Dublin	32 05	98 20	1.68
Eastland	32 24	98 48	2.00
Hamilton	31 43	98 07	1.31
Hico	31 59	98 01	1.55
Lampasas	31 04	98 10	.80
Putnam	32 23	99 12	1.00
Colorado River Basin:			
Austin	30 16	97 44	.26
Brownwood	31 43	98 59	1.20
Coleman	31 50	99 25	9.40
Fairland	30 39	98 17	.41
Fort McKavett	30 50	100 06	3.86
Junction	30 29	99 45	5.50
Llano	30 45	98 40	2.05
Marble Falls	30 34	98 17	.46
Menard	30 55	99 47	3.11
Morris Ranch	30 13	99 04	6.89
Mud	30 25	98 01	.22
Paint Rock	31 30	99 55	2.60
Rochelle	31 14	99 12	6.28
San Angelo	31 28	100 26	.60
Winters	31 59	99 58	1.71
Guadalupe River Basin:			
Blanco	30 05	98 25	2.49
Kerrville	30 01	99 07	7.92
New Braunfels	29 42	98 07	1.38
Nixon	29 17	97 46	.17
San Marcos	29 53	97 58	.57
Seguin	29 34	97 58	.48
San Antonio River Basin:			
Boerne	29 47	98 44	3.02
Karnes City	28 52	97 54	.28
Rio Medina	29 26	98 52	6.15
San Antonio	29 25	98 31	4.91
Nueces River Basin:			
Big Wells	28 34	99 34	1.31
Carrizo Springs	28 32	99 51	4.69
Cotulla	28 26	99 14	1.11
Dilley	28 40	99 10	1.39
Fowlerton	28 28	98 49	1.05
George West	28 20	98 07	.15
Hondo	29 20	99 08	10.65
La Pryor	28 56	99 51	15.22
Montell	29 32	100 01	8.74
Pearsall	28 53	99 06	1.94
Rocksprings	30 01	100 12	3.10
Sabinal	29 19	99 28	19.25
Uvalde	29 13	99 48	20.28
Rio Grande River Basin:			
Del Rio	29 22	100 53	.45
Eagle Pass	28 43	100 30	.71
Laredo	27 30	99 30	1.09
Substation 14	30 26	100 41	1.49

Miscellaneous rainfall data, June 30 to July 3, 1932. (Unless otherwise noted, rain fell on July 1 and 2.)

Llano River Basin:

Junction, 8 miles east at Phillips Ranch. John Phillips measured 6 inches in can.

Live Oak Ranch, at head of Johnson Fork of Llano River. Robert Real measured 10.5 inches in standard-type gage.

Mason. Harry Bierschwale measured 3.14 inches July 1 and 3.41 inches July 2. Rainfall for July 3 was 0.35 inch.

Guadalupe River Basin:

Comfort. Rain measured by Walter Brinkman, from 10 p.m. Thursday June 30 to Friday morning, 3.5 inches, and from 10 p.m. June 30 to noon July 2, 5.95 inches.

Hunt. Ed Driver measured 26 inches in rock tank. Measured 23 inches and estimates 3 inches leaked out.

Hunt, 9 miles west of, on North Fork of Guadalupe River. W. H. Furr measured 14.75 inches in gas drum on south side of house and 10 to 15 feet away.

Hunt, 16 miles southwest of, on South Fork of Guadalupe River. H. R. Colbath measured 16 inches in standard rain gage.

Kerrville, 20 miles northwest of. George Dudderstaat estimated total rain of 18 to 20 inches from goldfish pond, which ran over.

Mountain Home, 6 miles west of, 5 miles east of Live Oak ranch, and at head of Johnson Creek. Gus Sproul measured 6 inches in small jar and 12 inches in 3-gallon crock, total 18 inches.

Mountain Home, 6 miles northwest. Alfred Knott measured 20 inches of rain in 50-gallon oil barrel. Mr. Knott stated that slow rain fell from 9 p.m. Thursday, June 30, to 2 p.m. Friday; heavy rain from 2 p.m. to 5:30 p.m. Friday, intermittent showers from 5:30 to 10 p.m., then heavy rain until 4 a.m. Saturday, July 2.

Mountain Home, 8½ miles northwest of and 2½ miles northeast of. Alfred Knott, Ferdinand Tatsch reported 18.5 inches at his ranch.

State Fish Hatchery, on Johnson Creek above Ingram. E. C. Brady, superintendent, and Guy Colhert, assistant, measured 35.56 inches in each of two fish cans sitting in rear end of light truck. (Opening in can 8 inches in diameter, can below opening 12 3/4 inches in diameter, straight sides; measured 14 inches in can.) Mr. Brady stated: "General slow rain on Thursday night, with no wash. Friday slow rain until noon, then began to rain hard, with diminished intensity Friday about sundown. Began to rain hard early Saturday morning. Creek reached highest point about 3 a.m. Saturday.

Medina River Basin:

Bandera, 2 miles out Kerrville road. J. S. Short measured 14 inches in 9-inch coffee can.

Lima, at Phillips ranch. Measured 13.8 inches (June 30, 0.86 inches; July 1-2, 12.95 inches) in standard-type gage (small tube only, mounted on high post).

Medina. Whit Parson measured 14 inches in can used only as rain gage.

Vanderpool, 12 miles north of, at head of Medina River. At Humble Pipe Line Co.'s station C, 33.5 inches was measured in a garbage can; 22.5 inches was measured in the can when first emptied at 3 p.m. Friday, July 1. On Saturday morning, after rain had stopped, 11 inches more had accumulated in the can.

Frio River Basin:

Batesville. J. B. Britten is reported to have measured 12 inches.

Batesville, 10 miles east of. R. G. Treves is reported to have measured 15 inches.

Divot. 1 to 2 inches is reported to have fallen.

Leakey. Ed. C. Taylor measured 16 inches in can.

Leakey, 2 miles south of. J. R. Hillman is reported to have measured 15 inches in jar.

Leakey, 2 miles west of. E. W. Laird measured 15 inches in can.

Leakey, 3.5 miles east of. Ross Hoover measured 16 inches in can.

Rio Frio, 1 mile northwest of. Dr. Cavender is reported by Mr. Dunlap to have measured more than 24 inches from observed catch in water tank.

Rio Frio, 4 miles southeast of. George Hoover measured 20 inches in can.

Tarpley. C. G. Leighton measured 12.6 inches July 1 and 2. He stated that rain began Thursday night, June 30, about 11 p.m.; not much rain during Friday afternoon, with heaviest rain Saturday morning.

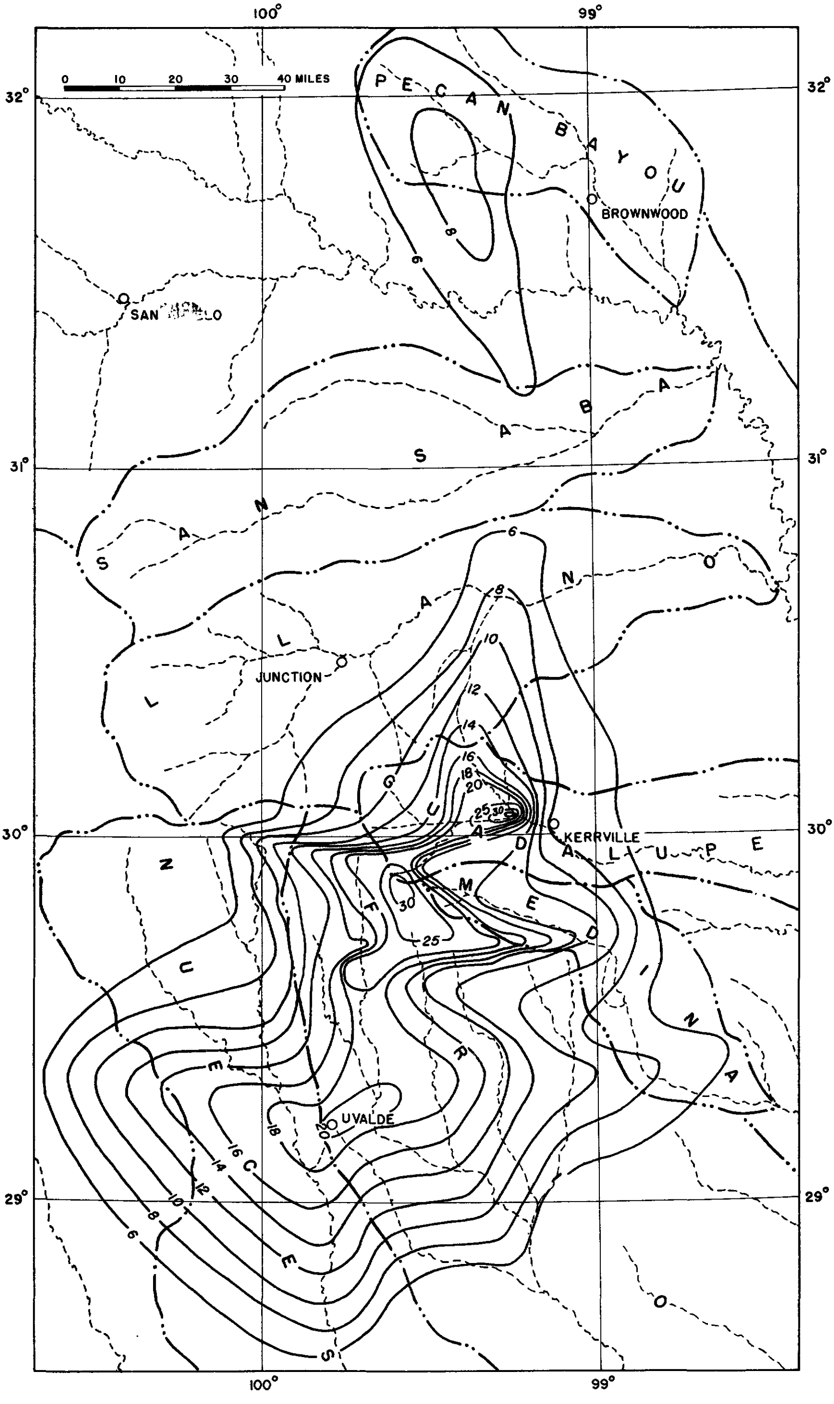


Figure 31.--Isohyetal map of part of Texas showing total rainfall, in inches, observed June 30 to July 3, 1932.

Table 12.--Maximum discharge at places experiencing unusual floods in July, 1932

Stream	Lat.	Long.	Drainage area in sq. mi.	Maximum discharge		
				Time	Sec.-ft.	Sec.-ft. per sq. mi.
Llano River Basin						
East Fork of James River at Old Noxville	30°22'	99°24'	60.8	July 1,1:30pm	105,000	1,730
James River near Mason	30 35	99 19	336	July 2,4am	85,900	256
Guadalupe River Basin						
North Fork of Guadalupe River near Hunt	30 3	99 27	110	July 1,2pm	108,000	982
Guadalupe River near Ingram	30 3	99 15	336	July 1	206,000	613
Guadalupe River at Kerrville	30 1	99 8	570	July 1,5pm	196,000	334
Guadalupe River near Comfort (a)	29 57	98 56	916	July 1,8-9pm	182,000	199
Guadalupe River near Spring Branch (b)	29 52	98 23	1,432	July 3,2am	121,000	84.5
Guadalupe River at New Braunfels (b)	29 43	98 7	1,666	July 3	95,200	57.2
Guadalupe River below Cuero (b)	29 3	97 18	5,073	July 8,1:30pm	17,500	3.4
Bear Creek near Hunt	30 4	99 26	50.3	July 1	17,200	342
South Fork of Guadalupe River near Hunt	29 58	99 26	65.3	July 1 (c)	84,300	1,290
Johnson Creek near Ingram	30 3	99 14	111	July 2,1-3am	138,000	1,240
Medina River Basin						
North Fork of Medina River at Lima	29 50	99 20	54.0	July 1,1pm	40,200	744
Medina River near Medina	29 46	99 11	235	July 1	47,600	203
Medina River near Pipe Creek (a)	29 42	98 58	412	July 1	64,000	155
Frio River Basin						
Frio River at Rio Frio	29 39	99 44	371	July 1,3-4pm	128,000	345
Frio River at Concan (b)	29 29	99 42	485	July 1	162,000	334
Frio River near Uvalde	29 6	99 30	840	July 2	148,000	176
Frio River near Derby (b)	28 44	99 9	3,493	July 4,2am	230,000	65.8
Frio River near Los Angeles	28 35	98 57	3,732	July 4-5	204,000	54.7
Frio River at Calliham (b)	28 30	98 21	5,491	July 6,11:30 pm	109,000	19.8
East Fork of Frio River near Leakey	29 49	99 40	75.0	July 1,12N	89,500	1,190
Dry Frio River near Reagan Wells	29 31	99 49	120	July 1	30,700	256
Sabinal River at Vanderpool	29 46	99 32	45.7	July 2	52,300	1,140
Sabinal River at Sabinal	29 20	99 29	258	July 2,12N-3pm	71,700	278
Hondo Creek near Hondo	29 21	99 3	400	July 2	74,800	187
Seco Creek near D'Hanis	29 26	99 17	169	July 2,12N	35,800	212
Leona River near Divot	28 47	99 15	565	July 4,2-3am	49,300	87.3

a Gaging station discontinued since 1932.
b Gaging station at which is kept systematic records of stage and discharge.

Table 13.--Mean daily discharge, in second-feet, and total run-off, in acre-feet, for June 30 to July 31, 1932

Day	Pecan Bayou at Brownwood	Llano River near Castell	Guadalupe River near Spring Branch	Medina River near Pipe Creek	Nueces River near Uvalde	Nueces River at Cotulla	Frio River at Concan	Frio River at Derby
	River-measurement station							
June 30	304	40	67	24	7.8	0	62	0
July 1	178	64	67	†15,100	12,300	0	41,200	0
2	354		28,500	†16,000	44,300	0	8,140	2,190
3	4,250	*19,400	62,800	† 5,020	9,840	0	2,320	75,700
4	12,400		6,800	† 3,020	3,200	185	1,470	135,000
5	14,800	1,700	2,270	† 2,140	1,500	1,400	1,140	36,500
6	14,500	928	1,560	† 1,610	834	8,080	1,010	9,420
7	13,600	692	1,400	† 1,260	600	25,800	980	4,260
8	12,900	532	1,140	† 991	520	27,600	818	3,170
9	12,100	439	945	† 785	445	19,300	733	2,270
10	11,400	360	820	† 686	427	12,000	668	1,530
11	10,500	314	752	† 545	416	7,150	622	1,030
12	8,940	280	685	† 500		3,450	584	805
13	766	251	640	456		1,620	551	730
14	586	222	618	403		991	518	635
15	546	202	577	362		642	492	550
16	498	186	546	333		480	466	480
17	436	173	530	† 297		408		420
18		160	502		*275	360		376
19		151	510			326		328
	*115			* 266			*378	
20		140	568			304		290
21	.5	134	454			270		254
22	2,490	126	434	† 235		248		224
23	242	120	406	† 226		218		198
24	63	116	386			198	301	175
25	6.5	112	362		89	178	284	155
26	55	105	346		83	158	267	132
27	92		332	* 194	80	140	258	112
28	40		317		78	123	244	95
29	37	*92	283		73	107	234	81
30	32		272	† 162	70	94	230	68
31	15		250	† 155	63	87	221	57
Acre-feet	243,000	131,000	230,000	104,000	156,000	222,000	132,000	550,000

* Estimated
† Partly estimated or interpolated.

Tarpley, 8 miles northwest of. 22 inches at Lucius Hicks ranch.
Utopia, 1 mile north of. Mrs. L. D. Bounds measured 10 inches from June 30 to noon July 1 and 4 inches from noon July 1 to 7 p.m. July 2. Total rain 14 inches.
Vanderpool, 1 mile west of. J. J. Leighton reported that O. M. Clayton measured 29 inches in can.
Vanderpool, 2 miles east of. J. J. Leighton reported that R. H. Ryan measured 17 inches in water trough.
Vanderpool, 3.5 miles north of. O. T. Moore measured 30 inches in a barrel.
Vanderpool, 5 miles north of. W. E. Hatley measured 29 inches in oil barrel.
Vanderpool, about 8 miles north of, 4½ miles from Hunt-Leaky road toward Vanderpool, at Bonnie Hills ranch. This ranch is in the Frio River drainage basin near the head of the South Fork of Guadalupe River. Adam Wilson, Jr., measured 25 inches in large stone tank, which overflowed.
Yancy. Storekeeper stated that about 8 inches fell in that vicinity, as measured by various residents.

Flood discharge

In addition to measurements made at regular river-measurement stations, slope-area determinations of discharge were made at twenty other places. The results of the determinations of maximum discharges together with other pertinent data, are given in table 12. All measurements of discharge during the July floods made at places other than regular river-measurement stations have been published in Water-Supply Paper 733, pp. 175, 176, under "Miscellaneous discharge measurements".

There were no river-measurement stations on the headwaters of streams experiencing unusual floods. Table 13 shows records of mean daily discharge and run-off in acre-feet for the flood period at river-measurement stations within the flood areas.

Rio Grande floods of September 1932

Record-breaking floods occurred in the Rio Grande Basin in the first part of September 1932. The highest stages of record occurred on the Rio Grande below Del Rio, on the lower reaches of the Pecos and Devils Rivers, and on smaller streams. The peak discharges given in table 14 are taken from data for these floods published by the International Boundary Commission, United States and Mexico, in Water Bulletin 2, "Flow of the Rio Grande and tributary contributions" for 1932.

Major floods of 1935

There were three major flood periods in Texas in 1935--the May flood on Seco Creek, in the Nueces River Basin; the June floods in the Colorado and Nueces River Basins; and the December flood on Buffalo Bayou and tributaries at Houston. On Seco Creek and the West Nueces River the maximum discharges per square mile of area drained exceeded any rates known to be recorded from areas of comparable size.

A paper entitled "Major Texas floods of 1935", now being prepared, will give detailed information of these floods.

Flood-discharge records

Table 14, "Records of maximum floods in Texas", shows the peak stages and discharges that have occurred at gaging stations and other points on streams over the entire State. The peak stages, and the discharges where known are given for other unusual floods, for comparison. The table also gives the period of record, drainage area, and peak discharge per square mile.

Except as otherwise noted discharge figures are taken from published reports of the United States Geological Survey or have been computed from unpublished data in the files of the Geological Survey or the Texas Board of Water Engineers at Austin. Many of the records of stage have been obtained from the United States Weather Bureau reports.

The period of record as given includes for many points years prior to the beginning of systematic records. The earlier records are generally based on information obtained from local residents and believed to be reliable.

In many parts of the State topographic maps are not available for an accurate determination of the drainage areas. The drainage areas given represent the best measurements that could be made from available sources, which include topographic maps of the United States Geological Survey and Texas Reclamation Department, maps of the United States Army, of Soil Surveys of the United States Department of Agriculture, county road maps, and airplane pictures. All noncontributing areas above the Cap Rock are excluded from the areas given.

The reference number given to each determination may be used to locate the place of determination on the map shown in figure 32. The latitude and longitude of each place of determination are given to define the place more closely.

Figure 33 is a chart in which discharges in second-feet per square mile for the determinations of maximum discharges shown in table 14 have been plotted against the corresponding drainage areas. In any study of these determinations and in the comparison of one with another consideration should be given to the type of area drained above the point of measurement. The physical characteristics of a river basin that affect flood flow, such as topography, soil, vegetable cover, and channel conditions, may differ greatly in neighboring areas.

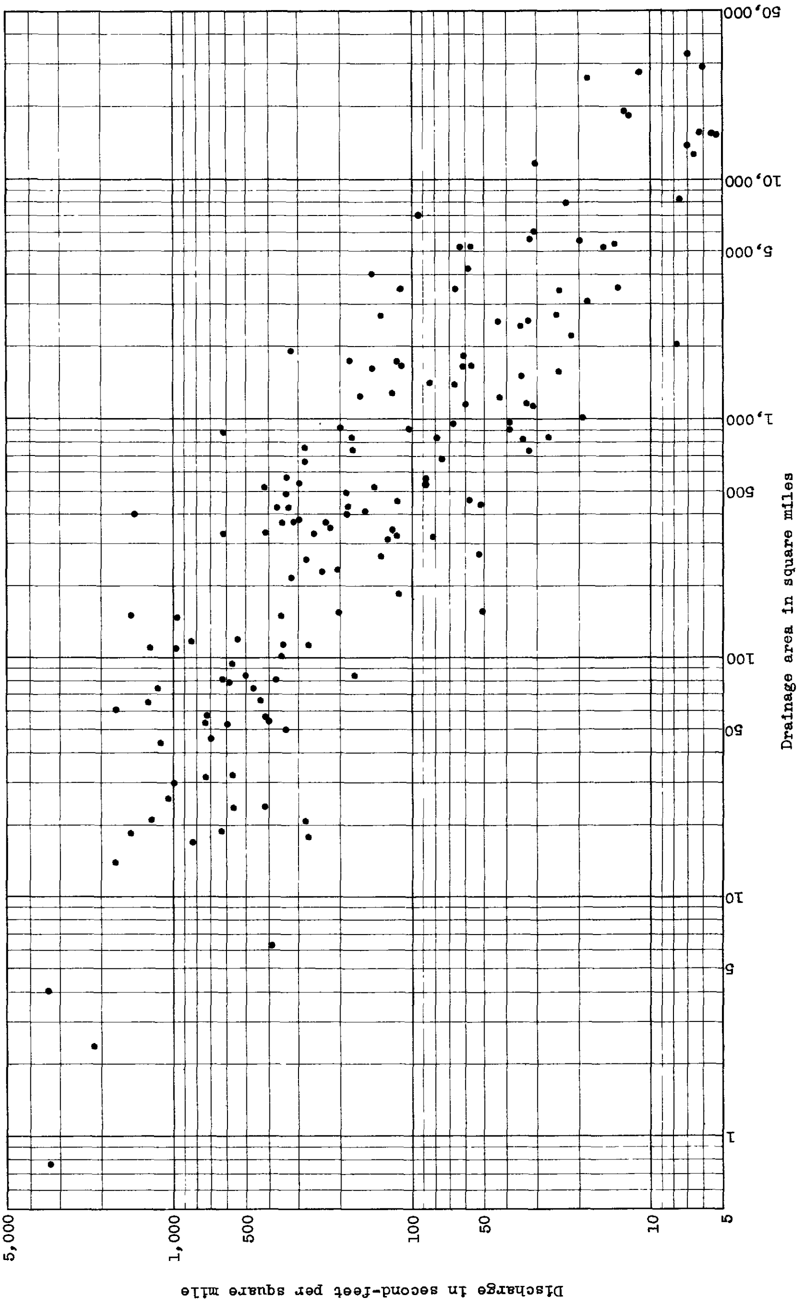
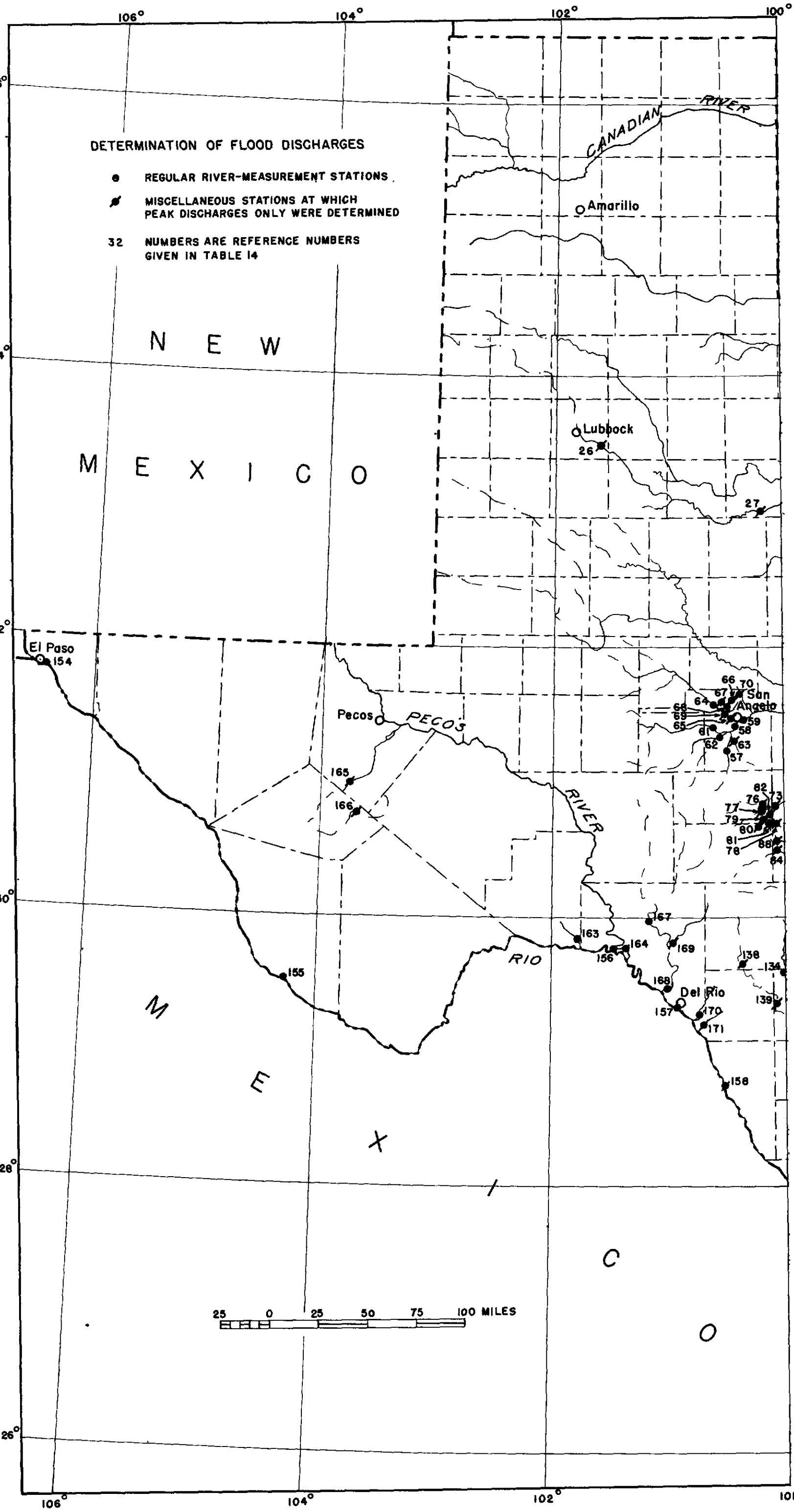


Figure 32.--Chart showing the maximum discharges, in second-feet per square mile, determined for various drainage areas as given in table 14.


DETERMINATION OF FLOOD DISCHARGES
REGULAR RIVER-MEASUREMENT STATIONS
MISCELLANEOUS STATIONS AT WHICH PEAK DISCHARGES ONLY WERE DETERMINED
32 NUMBERS ARE REFERENCE NUMBERS GIVEN IN TABLE 14
NEW MEXICO
MEXICO
CANADIAN RIVER
PECOS RIVER
RIO
Amarillo
Lubbock
El Paso
Pecos
San Angelo
Del Rio
25 0 25 50 75 100 MILES

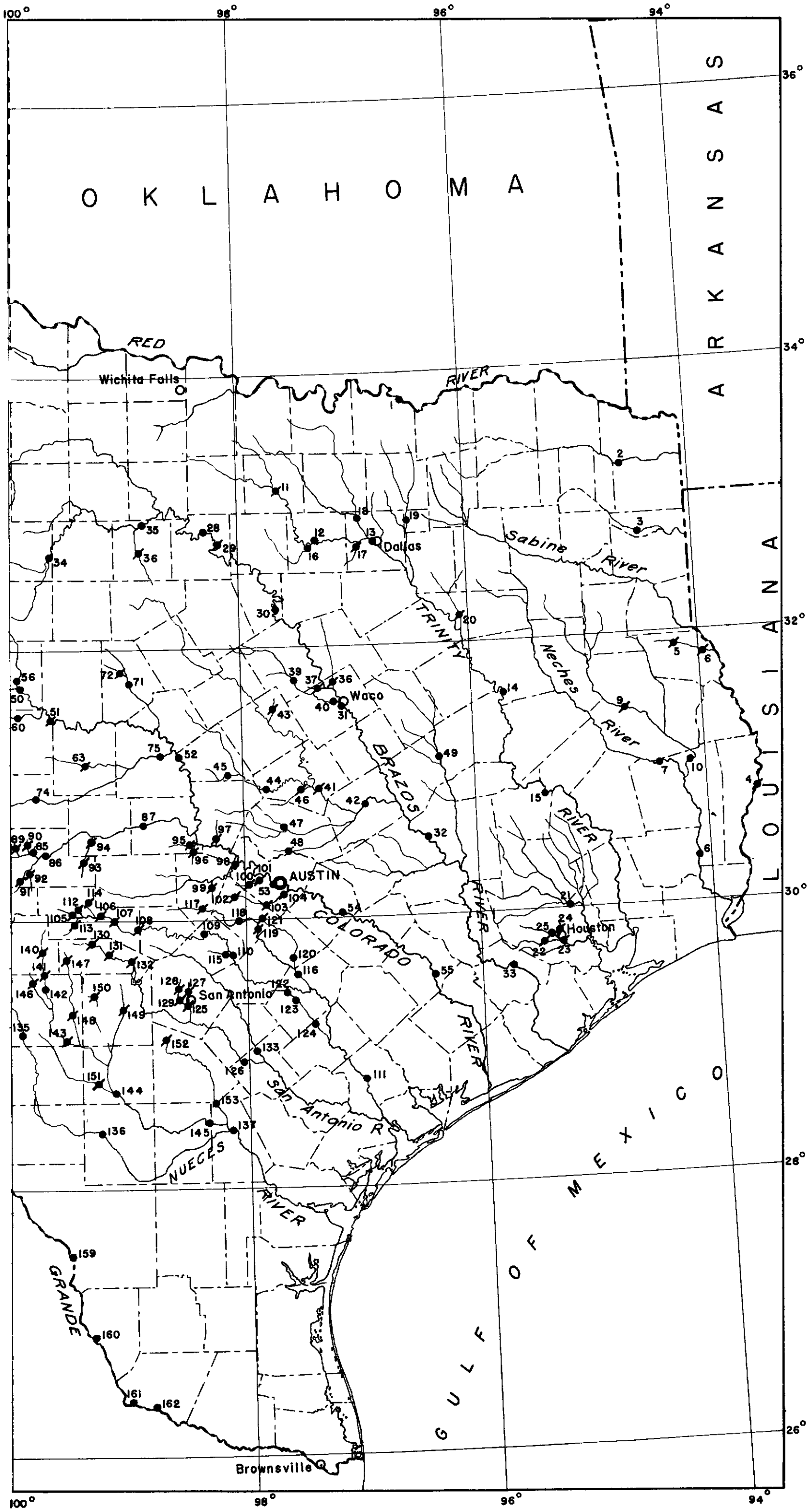

OKLAHOMA
ARKANSAS
LOUISIANA
GULF OF MEXICO
RED RIVER
Wichita Falls
Dallas
Waco
AUSTIN
Houston
San Antonio
Brownsville
Sabine River
Neches River
TRINITY RIVER
BRAZOS RIVER
COLORADO RIVER
San Antonio R.
NUECES RIVER
GRANDE
100°
98°
96°
94°
36°
34°
32°
30°
28°
26°

Table 14.--Records of major floods in Texas

No. on map (fig. 33)	Stream and place of determination	Latitude	Longitude	Drainage area in square miles	Period of record	Peak stage and discharge				Remarks
						Date	Stage in feet	Discharge		
								Sec.-ft.	Sec.-ft. per sq. mi.	
	Red River Basin									
1	Red River near Denison	33°49'	96°32'	32,840	1906-1936	May 26,1908 May 21,1935	35.5 23.95	- 201,000	- 6.12	Discharge from extension of rating curve.
2	Sulphur River near Darden	33 15	94 37	2,754	1909-1936	May 19,1930	32.8	67,200	24.4	Discharge from well-defined rating curve.
3	Cypress Creek near Jefferson	32 45	94 29	848	-	May 20,1930	25.37	22,600	26.7	Discharge from extension of rating curve. Greatest flood known to local residents.
	Sabine River Basin									
4	Sabine River near Bon Wier	30 45	93 37	8,323	1884-1936	May 1884 Aug.2,1933	26 23.04	- 63,000	- 7.57	Discharge from well-defined rating curve.
5	Flat Fork Creek near Center	31 54	94 13	58	-	July 24,1933	-	42,200	728	Discharge by slope-area method.
6	Tenaha Creek near Joaquin	31 50	93 57	374	-	July 24,1933	-	117,000	313	Do.
	Neches River Basin									
7	Neches River near Rockland	31 2	94 24	3,539	1884-1936	May 1884 May 22,1935	34.9 28.9	- 48,500	- 13.7	Discharge from extension of rating curve.
8	Neches River at Evadale	30 21	94 5	7,908	1884-1936	May 1884	26.2	175,000	22.1	Do.
9	Angelina River near Lufkin	31 27	94 44	1,575	1908-1936	May 1908 Feb.24,1932	25.4 18.26	38,200	24.3	Discharge from well-defined rating curve.
10	Angelina River at Horger	31 1	94 10	3,435	-	Aug. 1915	39.5	82,000	23.9	Discharge from extension of rating curve. Greatest flood known to local residents.
	Trinity River Basin									
11	West Fork of Trinity River at Bridgeport	33 12	97 46	1,010	1908-1936	June 8,1915	28.9	19,500	19.3	Discharge from extension of rating curve.
12	West Fork of Trinity River at Fort Worth	32 46	97 20	2,431	-	Apr.25,1922	23.95	85,000	35.0	Discharge by slope-area method. Record furnished by City Engineer of Fort Worth. Greatest flood known to local residents.
13	Trinity River at Dallas	32 47	96 48	6,001	1840-1936	May 26,1908	52.6	184,000	30.7	Discharge from extension of rating curve.
14	Trinity River near Oakwood	31 39	95 47	12,840	1904-1936	June 4,1908 May 23,1930	52.2 46.8	- 84,400	- 6.57	Discharge from well-defined rating curve.

15	Trinity River at Riverside	30 52	95 24	15,500	1903-1936	June 11,1908	49.7	86,600	5.59	Discharge from extension of rating curve.
16	Clear Fork of Trinity River at Fort Worth	32 44	97 21	522	-	Apr.25,1922	27.5	74,300	142	Discharge by slope-area method. Record furnished by City Engineer of Fort Worth. Greatest flood known to local residents.
17	Mountain Creek near Grand Prairie	32 43	96 58	267	1923-1936	Dec.17,1928	21.41	35,900	134	Discharge by slope-area method.
18	Elm Fork of Trinity River near Carrollton	32 58	96 57	2,535	1909-1935	May 19,1935	13.0	82,100	32.4	Discharge from well-defined rating curve.
19	East Fork of Trinity River near Rockwall	32 55	96 30	831	1922-1936	Apr. 1922	25	-	-	
						June 16,1935	23.39	64,800	78.0	Discharge by slope-area method.
20	Cedar Creek near Trinidad	32 13	96 5	910	1927-1936	Sept.29,1936	-	35,400	38.9	Do.
	San Jacinto River Basin									
21	San Jacinto River near Humble	30 2	95 16	1,811	-	May 31,1929	33.0	111,000	61.3	Discharge by slope-area method. Greatest flood known to local residents.
22	Buffalo Bayou at Galveston, Harrisburg & San Antonio Railway bridge, Houston	29 45	95 27	319	1855-1936	Dec.9,1935	-	40,030	125	Record furnished by M. J. McCall, Engineer for Harris County.
23	Buffalo Bayou at Lockwood Street bridge, Houston	29 45	95 19	458	1855-1936	Dec.9,1935	-	52,750	115	Do.
24	Little Whiteoak Bayou at Sylvester Street bridge, Houston	29 49	95 23	18.1	1855-1935	Dec.9,1935	-	4,950	273	Do.
25	Whiteoak Bayou at Missouri-Kansas-Texas Railroad bridge, Houston	29 47	95 23	85.3	1855-1936	Dec.9,1935	-	14,750	173	Do.
	Brazos River Basin									
26	Double Mountain Fork of Brazos River near Slaton	33 27	101 33	-	1891-1936	Sept.21,1936	-	1,070	-	Discharge by slope-area method.
27	Double Mountain Fork of Brazos River near Aspermont	33 1	100 11	1,510	1886-1936	Oct.15,1926	18.14	52,000	34.4	Do.
28	Brazos River near Palo Pinto	32 52	98 18	13,520	1876-1936	1876	-	-	-	Stage slightly above 24 feet. Information from Corps of Engineers, U. S. Army.
						June 1930	24	-	-	
						May 20,1935	15.60	64,900	-	Discharge from extension of rating curve.
29	Brazos River near Mineral Wells	32 47	98 12	13,860	1876-1936	1876	-	245,000 to 300,000	-	Discharge estimated by Corps of Engineers, U. S. Army Mineral Wells.
						June 16,1930	28.43	95,600	6.90	Discharge from well-defined rating curve.
30	Brazos River near Glen Rose	32 16	97 42	15,600	-	May 8or9,1922	30	-	-	Greatest flood known to local residents.
						May 18,1935	23.68	97,600	6.26	Discharge from extension of rating curve.

Table 14.—Records of major floods in Texas—Continued

No. on map (fig. 33)	Stream and place of determination	Latitude	Longitude	Drainage area in square miles	Period of record	Peak stage and discharge: Date	Stage in feet	Discharge: Sec.-ft.	Discharge: Sec.-ft. per sq. mi.	Remarks
	Brazos River Basin—Continued									
31	Brazos River at Waco	31°34'	97° 8	19,260	1854-1936	Sept.27,1936	40.9	246,000	12.8	Discharge from well-defined rating curve.
32	Brazos River near Bryan	30 37	96 29	29,190	1899-1936	Dec.3,1913 May 22,1935	54.0 42.3	- 139,000	- 4.76	Do.
33	Brazos River at Richmond	29 35	95 45	34,810	1899-1936	Dec. 1913 June 6,1929	45.4 40.6	- 120,000	- 3.16	Discharge from extension of rating curve.
34	Clear Fork of Brazos River at Nugent	32 41	99 40	2,220	1876-1936	- - 1876 Sept.8,1932	30 27.05	- 47,000	- 21.2	Measurement by C. T. Bartlett, Consulting Engineer, San Antonio, Texas. Discharge from extension of rating curve.
35	Clear Fork of Brazos River near Crystal Falls	32 54	98 50	5,658	1900-1936	- Sept.8,1932	34.0 28.10	- 22,700	- 4.01	Discharge from extension of rating curve.
36	Gonzales Creek at Breckenridge	32 46	98 54	157	-	Sept.21,1924	-	7,960	50.7	Discharge by slope-area method. Greatest flood known to local residents.
37	Childress Creek near China Springs	31 43	97 20	79	-	Sept.26 or 27 1936	-	47,000	595	Do.
38	Aquilla Creek near Gholson	31 44	97 12	372	-	Sept.27,1936	-	84,500	227	Do.
39	North Bosque River near Clifton	31 48	97 35	974	1887-1936	May 9,1922 May 18,1935	25 21.3	- 38,300	- 39.3	Discharge from well-defined rating curve.
40	Bosque River at Lake Waco dam	31 34	97 12	1,660	-	Sept.27,1936	-	96,000	57.8	Determined from rating of spillway of dam.
41	Little River near Little River	30 59	97 24	5,240	-	Sept.10,1921	-	331,000	63.2	Discharge by slope-area method. Greatest flood known to local residents.
42	Little River near Cameron	30 50	96 57	7,034	1852-1936	Sept.10,1921	53.2	647,000	92.0	Discharge by slope-area method.
43	Sevenmile Draw at Ames	31 31	97 47	2.4	-	Sept.26,1936	-	5,140	2,140	Discharge by slope-area method. Greatest flood known to local residents.
44	Lampasas River at Youngsport	30 57	97 43	1,242	1873-1936	Sept. 1873 Sept.28,1936	44.2 33.5	- 53,200	- 42.8	Discharge from extension of rating curve.
45	Sulphur Creek near Lampasas	31 4	98 8	112	1873-1936	1873 Sept.27,1936	- -	- 30,400	- 271	Flood of 1873 about 2.5 feet higher than in 1936 Discharge by slope-area method.

46	Salado Creek near Salado	30 58	97 30	148	-	Sept.10,1921	-	143,000	966	Discharge by slope-area method. Greatest flood known to local residents.
47	San Gabriel River near Georgetown	30 40	97 38	431	-	Sept.10,1921	39.36	160,000	371	Do.
48	Brushy Creek at Round Rock	30 31	97 40	74.7	-	Sept.10,1921	-	34,500	462	Do.
49	Navasota River near Easterly	31 10	96 18	949	1900-1936	1900	24	63,400	66.8	Discharge from extension of rating curve.
	Colorado River Basin									
50	Colorado River at Ballinger	31 44	99 56	5,340	1906-1936	Sept.18,1936	28.6	75,400	14.1	Discharge from well-defined rating curve.
51	Colorado River near Stacy	31 31	99 40	11,660	-	Sept.18,1936	-	356,000	30.5	Discharge by slope-area method. Greatest flood known to local residents.
52	Colorado River near San Saba	31 13	98 34	18,800	1900-1936	Sept.25,1900	57.5	234,000	12.4	Discharge from extension of rating curve.
						Sept.21,1936	56.7	219,000	11.7	Discharge by slope-area method.
53	Colorado River at Austin	30 16	97 45	26,350	1843-1936	July 1869	43.0	-	-	
						June 15,1935	42.0	481,000	18.3	Discharge from well-defined rating curve.
54	Colorado River at Smithville	30 1	97 10	27,850	-	Dec. 1913	47.4	-	-	
						June 16,1935	42.5	305,000	11.0	Discharge by slope-area method.
55	Colorado River at Eagle Lake	29 35	96 25	29,140	-	Dec. 1913	32.0	-	-	
						June 19,1935	29.45	177,000	6.07	Discharge from well-defined rating curve.
56	Elm Creek at Ballinger	31 45	99 57	458	1906-1936	Sept.3,1935	10.3	26,100	57.0	Discharge from extension of rating curve.
57	South Concho River at Christoval	31 13	100 30	434	1882-1936	Aug.6,1906	23	-	-	
						Sept.17,1936	20.5	80,100	185	Discharge by slope-area method.
58	South Concho River at San Angelo	31 27	100 26	2,535	1854-1936	Aug.6,1906	29.7	-	-	
						Sept.17,1936	23.4	111,000	43.8	Do.
59	Concho River near San Angelo	31 27	100 25	4,217	1854-1936	Aug.6,1906	47.5	246,000	58.3	Do.
						Sept.17,1936	46.6	230,000	54.5	Do.
60	Concho River near Paint Rock	31 31	99 57	5,257	1882-1936	Sept.17,1936	41.3	301,000	57.3	Do.
61	Middle Concho River near Tankersly	31 23	100 37	1,128	-	1922	27.2	-	-	Greatest flood known to local residents.
						Sept.26,1936	24.2	35,000	31.0	Determined from rating of spillway of dam.
62	Spring Creek near Tankersly	31 22	100 32	734	-	Sept.17,1936	20.3	23,900	32.6	Discharge from well-defined rating curve.
63	Pecan Creek near San Angelo	31 19	100 27	81	-	Sept.15,1936	-	30,500	377	Discharge by slope-area method. Greatest flood known to local residents.

Table 14.--Records of major floods in Texas--Continued

No. on map (fig 33)	Stream and place of determination	Latitude	Longitude	Drainage area in square miles	Period of record	Peak stage and discharge: Date	Stage in feet	Discharge: Sec.-ft.	Discharge: Sec.-ft. per sq. mi.	Remarks
	Colorado River Basin--Continued									
64	North Concho River near Carlsbad	$31°36'$	$100°40'$	1,406	-	Sept.17,1936	15.8	89,000	-	Discharge by slope-area method. Greatest flood known to local residents.
						Sept.26,1936	16.0	94,600	67.3	Discharge by slope-area method.
65	North Concho River at San Angelo	31 27	100 26	1,675	1854-1936	Sept.17,1936	39.9	184,000	110	Do.
66	East Fork of Grape Creek near Carlsbad	31 39	100 34	32	-	Sept.17,1936	-	23,500	734	Discharge by slope-area method. Greatest flood known to local residents
67	West Fork of Grape Creek near Carlsbad	31 40	100 35	17	-	Sept.17,1936	-	14,200	836	Do.
68	Grape Creek near Carlsbad	31 38	100 34	53	-	Sept.17,1936	-	31,800	600	Do.
69	Dry Creek near San Angelo	31 40	100 29	14	-	Sept.17,1936	-	24,600	1,760	Do.
70	Red Bank Creek near San Angelo	31 41	100 26	.76	-	Sept.17,1936	-	2,490	3,280	Do.
71	Pecan Bayou near Brownwood	31 44	98 58	1,614	-	July 3,1932	-	235,000	146	Determined from storage in reservoir. Greatest flood known to local residents.
72	Jim Ned Creek near Brownwood	31 48	99 2	668	-	July 3,1932	-	187,000	280	Discharge by slope-area method. Greatest flood known to local residents.
73	San Saba River near Fort McKavett	30 52	100 1	688	1899-1936	Sept.16,1936	-	50,700	73.7	Discharge by slope-area method.
74	San Saba River at Menard	30 55	99 48	1,151	1899-1936	June 1899 Sept.16,1936	23.7 21.2	- 68,600	- 59.6	Do.
75	San Saba River at San Saba	31 12	98 42	3,046	1899-1936	June 6,1899 Apr.26,1922	42.6 42.1	- 57,000	- 18.7	Discharge from extension of rating curve.
76	North Valley Prong of San Saba River near Fort McKavett	30 51	100 8	328	-	Sept.16,1936	-	38,800	118	Discharge by slope-area method.
77	Middle Valley Prong of San Saba River near Fort McKavett	30 50	100 8	188	1920-1936	Sept.16,1936	-	20,900	111	Do.

78	East Fork of Terrett Draw above Coal Kiln Draw near Fort McKavett	30 41	100 11	19	-	Sept.16,1936	-	12,100	637	Discharge by slope-area method. Greatest flood known to local residents.
79	East Fork of Terrett Draw below Coal Kiln Draw near Fort McKavett	30 43	100 10	33	-	Sept.16,1936	-	18,700	567	Do.
80	West Fork of Terrett Draw near Fort McKavett	30 45	100 10	21	-	Sept.15 or 16 1936	-	5,880	280	Discharge by slope-area method. Higher stages known to have occurred.
81	Colston Draw near Fort McKavett	30 47	100 7	24	-	Sept.16,1936	-	10,000	417	Do.
82	Terrett Draw near Fort McKavett	30 50	100 7	103	1899-1936	Sept.16,1936	-	35,800	348	Discharge by slope-area method.
83	Brady Creek at Brady	31 9	99 20	554	-	Oct.6,1930	-	48,400	87.4	Do.
84	North Llano River near Roosevelt	30 30	100 3	443	-	Sept.16,1936	-	22,600	51.0	Higher stages known to have occurred.
85	North Llano River near Junction	30 30	99 47	914	1875-1936	Sept.16,1936	24.9	94,800	104	Discharge by slope-area method.
86	Llano River near Junction	30 30	99 44	1,762	1889-1936	June 14,1935	43.3	319,000	181	Do.
87	Llano River near Castell	30 43	98 53	3,514	1889-1936	June 14,1935	37.0	388,000	110	Do.
88	West Fork of Copperas Creek near Roosevelt	30 33	100 3	81	1879-1936	Sept.16,1936	-	50,400	622	Do.
89	Copperas Creek near Roosevelt	30 31	100 0	118	-	Sept.15 or 16 1936	-	98,900	838	Discharge by slope-area method. Greatest flood known to local residents.
90	Bear Creek near Junction	30 32	99 50	155	-	Sept.16,1936	-	31,300	202	Discharge by slope-area method. Higher stages known to have occurred.
91	South Llano River near Telegraph	30 15	99 57	540	-	June 14,1935	-	160,000	296	Discharge by slope-area method. Greatest flood known to local residents.
92	Paint Creek near Telegraph	30 18	99 53	218	1923-1936	June 14,1935	-	69,300	318	Discharge by slope-area method.
93	East Fork of James River at Old Noxville	30 22	99 24	60.8	1915-1936	July 1,1932	-	105,000	1,730	Do.
94	James River near Mason	30 35	99 19	336	-	July 2,1932	-	85,900	256	Do.
95	Sandy Creek near Marble Falls	30 34	98 28	344	1886-1936	Sept.15,1936	-	41,500	121	Do.
96	Walnut Creek near Marble Falls	30 32	98 27	24	-	Sept.15,1936	-	13,600	567	Do.
97	Hamilton Creek near Marble Falls	30 38	98 14	67	1885-1936	Sept.26,1936	-	29,100	435	Do.
98	Pedernales River near Spicewood	30 25	98 5	1,294	1869-1936	May 28,1929	40.4	155,000	120	Do.
99	Miller Creek near Johnson City	30 12	98 18	56.3	-	May 28,1929	-	22,900	407	Do.

Table 14.—Records of major floods in Texas—Continued

No. on map (fig. 33)	Stream and place of determination	Latitude	Longitude	Drainage area in square miles	Period of record	Peak stage and discharge: Date	Stage in feet	Discharge: Sec.-ft.	Sec.-ft. per sq. mi.	Remarks
	Nueces River Basin									
134	Nueces River at Laguna	29°26'	100° 0'	764	1903-1936	1913	29	-	-	
						Sept.21,1923	26.5	226,000	296	Slightly higher stage occurred in 1903.
						June 14,1935	26.0	213,000	-	Discharge by slope-area method.
135	Nueces River near Uvalde	29 11	99 54	1,930	-	June 14,1935	36.9	616,000	319	Do. Greatest flood known to local residents.
136	Nueces River at Cotulla	28 26	99 16	5,260	-	June 18,1935	32.4	82,600	15.7	Discharge by slope-area method. Greatest flood known to local residents.
137	Nueces River near Three Rivers	28 26	98 11	15,600	-	Sept.18,1919	46.0	85,000	5.45	Discharge from extension of rating curve. Greatest flood known to local residents.
138	West Nueces River near Brackettville	29 44	100 24	402	-	June 14,1935	-	580,000	1,440	Discharge by slope-area method. Greatest flood known to local residents.
139	West Nueces River near Cline	29 20	100 6	880	-	June 14,1935	-	536,000	609	Do.
140	East Fork of Frio River near Leakey	29 49	99 40	75.0	1872-1936	July 1,1932	-	89,500	1,190	Discharge by slope-area method.
141	Frio River at Rio Frio	29 39	99 44	371	-	July 1,1932	-	128,000	345	Do. Greatest flood known to local residents.
142	Frio River at Concan	29 29	99 42	485	-	July 1,1932	34.44	162,000	334	Discharge by slope-area method. Greatest flood known to local residents.
143	Frio River near Uvalde	29 6	99 30	840	-	July 2,1932	-	148,000	176	Do.
144	Frio River near Derby	28 44	99 9	3,493	-	July 4,1932	29.45	230,000	65.8	Do.
145	Frio River at Calliham	28 30	98 21	5,491	-	July 6,1932	39.2	109,000	19.8	Do.
146	Dry Frio River near Reagan Wells	29 31	99 49	120	-	June 14,1935	-	64,700	539	Do.
147	Sabinal River at Vanderpool	29 46	99 32	45.7	1903-1936	July 2,1932	-	52,300	1,140	Discharge by slope-area method.

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