# Summary of Floods in the United States during 1963

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1830-B

*Prepared in cooperation with Federal, State, and local agencies*

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*By* J. O. ROSTVEDT *and others*

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# CONTENTS

# ILLUSTRATIONS

## TABLES

# FLOODS OF 1963 IN THE UNITED STATES

# SUMMARY OF FLOODS IN THE UNITED STATES DURING 1963

By J. O. Rostvedt and others


## ABSTRACT

This report describes the most outstanding floods in the United States during 1963. The three most destructive floods occurred in March from Alabama to West Virginia and Ohio, in June in Nebraska, and in August in Buffalo, N.Y.

Widespread disastrous floods struck the western slopes of the Appalachian Mountains from Alabama to West Virginia and Ohio as a result of three storms moving over the area during March 4–19. Precipitation during the first storm period, March 4–6, caused some major stream overflows and produced conditions favorable for high runoff from subsequent rainfall. Heavy rainfall on March 11–13 produced record-breaking floods on many streams in Tennessee, Kentucky, Virginia, and West Virginia. Noteworthy floods occurred in the bordering States of Alabama, Georgia, North Carolina, and Ohio. The third storm on March 16–19 was significant because it prolonged the period of flooding and produced high-volume runoff in some areas. Twenty-six lives were lost, and more than 30,000 persons were forced from their homes. Damage to highways, railroads, municipal and private property amounted to approximately $98 million.

Floods of June 24 in small basins in east-central Nebraska were the most severe known in the area. Discharges in many streams greatly exceeded the 50-year flood. Twenty-five cities and villages and more than 600 families suffered property loss. Three lives were lost. Property loss was about $13 million.

On July 29 the most severe rainstorm in 18 years occurred in western New York. On August 7, rains of near-record magnitude again fell over western New York, and record intensities were recorded in Buffalo for 1-, 2-, and 6-hour storms. The resulting floods on Scajaquada Creek were the highest recorded in a short period of record, and flood damage in Buffalo was estimated at $35 million.

In addition to the three floods mentioned above, 21 others of lesser magnitude are considered important enough to be included in this annual summary.


## INTRODUCTION

This report summarizes information on outstanding floods in the United States during 1963. The floods selected were unusual hydrologic events in which large areas were affected, great damage resulted, or record-high discharges or stages occurred and in which sufficient data were available for the preparation of a report.

U.S. Geological Survey Water-Supply Paper 1830–A, "Floods of January–February 1963 in California and Nevada," is a special report that describes floods in that area in detail. The area for which flood reports have been prepared in 1963 is shown in figure 1. The area discussed in the special flood report is indicated by shading, and other areas discussed in this summary chapter are shown by line patterns. The months in which the floods occurred are shown; the map thereby gives both the location and the time distribution of floods during the year.

A flood is any high streamflow which overtops natural or artificial banks of a stream. By popular definition a flood is a newsworthy discharge or stage of extremely high magnitude that inundates large areas and causes much damage or great loss of life. In a hydrologic sense an outstanding flood need not be newsworthy and may be one of which only a few or possibly no persons are aware. An outstanding flood is a rare flood, one which will not often be duplicated at a given site. An unusually rare flood on an unoccupied or nonutilized flood plain would be little noticed by the public, but to the hydrologist it could be an event of great interest.

Floods result from the combined effects of meteorological events and physiographic characteristics of a basin. The principal physiographic features of a basin that affect floodflows are: drainage area, altitude, geology, shape, slope, aspect, and vegetative cover. With the exception of vegetative cover, which varies seasonally, the features are fixed for an area.

Meteorological events causing floods, of which precipitation is the principal one, are variable with respect to place and time. Some meteorological factors influencing floods are: form of the precipitation, whether rain, snow, hail, or sleet; amount and intensity of the precipitation; moisture conditions of the soil antecedent to the flood-producing precipitation; and temperature, which may cause frozen soil or determine the rate of snowmelt.

In general, meteorological conditions determine when and where the floods will be. The combination of the magnitude and intensity of meteorological factors and the effect of inherent physiographic features on runoff determine what the magnitude of a flood will be.

Many different and variable factors form innumerable combinations to produce floods of all degrees of severity. If there are two floods with equal peak discharges from different-size drainage basins and if both sites are assumed to have similar runoff and climatologic characteristics, the one from the smaller drainage basin would be the rarer or the more outstanding flood. Also, if two floods have equal discharges from equal drainage basins, the rarer flood would be that at the site

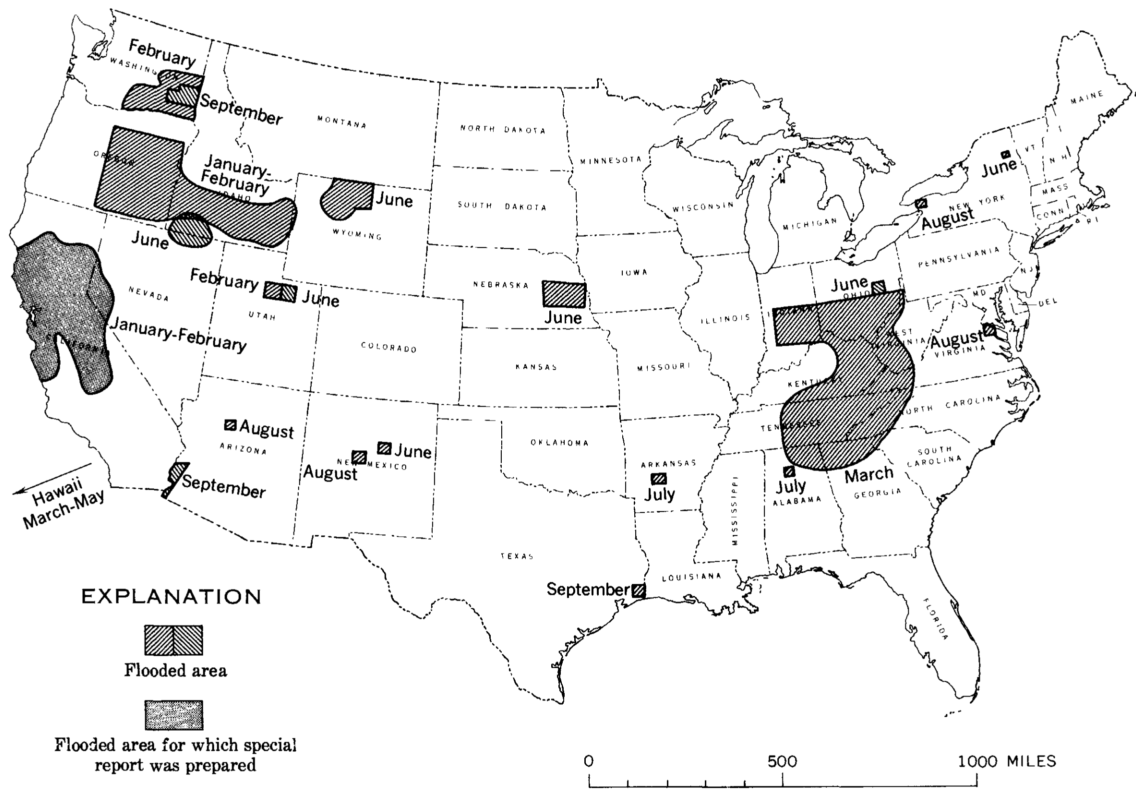


FIGURE 1.—Areas and months of occurrences of outstanding floods in 1963 in the conterminous United States and Hawaii.

having geographic and climatologic characteristics that normally produce the smaller flood peak.

The severity and prevalence of floods are not wholly determined by the absolute values of the contributing factors—amount and intensity of rainfall, peak discharge in cubic feet per second, volume of runoff, ratio of runoff to rainfall, and many others—but are greatly influenced by the ratio of these values to values under normal conditions.

Losses from floods in the United States during 1963 ($176 million) were more than twice the losses in 1962 ($75 million) and slightly more than in 1961 ($154 million), and they were the highest since 1958, when the total was $218 million. The 1963 losses were about 50 percent of the national average of $350 million, based on the 10-year-period 1951–60, adjusted to the 1960 price index.

Total loss of life due to floods in 1963 was 39 compared with 19 in 1962 and 52 in 1961 and was half the national annual average of 78 lives lost during the 39-year period, 1925–63.

Many flood reports give the amount of rainfall and the duration of the storm producing the rain. Recurrence intervals of the flood-producing storms can be determined from the U.S. Weather Bureau (1961) or from a simplified set of isopluvial maps and charts in a report by Rostvedt (1965).

Continuing investigation of surface-water resources in the areas covered by this report is performed by the U.S. Geological Survey in cooperation with State agencies, the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, and other Federal or local agencies. Some data were obtained from U.S. Weather Bureau publications. Collection of data, computations, and some of the text were made by the district offices in whose district the floods occurred.

## DETERMINATION OF FLOOD STAGES AND DISCHARGES

Data concerning peak stages and discharges at discharge stations in this report are those that are obtained and compiled in regular procedures of surface-water investigation by the U.S. Geological Survey.

The usual method of determining stream discharges at gaging stations is the application of a stage-discharge relation to a known stage. The relation at a station is usually defined by current-meter measurements through as much of the range of stage as possible. If the peak discharge at a station is above the range of the computed stage-discharge relation, short extensions may be made to the graph of relation by logarithmic extrapolation, by velocity-area studies, or by use of other measurable hydraulic factors.

Peak discharges that are greatly above the range of the stage-discharge relation at gaging stations and peak discharges at miscellaneous sites are generally determined by indirect measurements. During major floods, adverse conditions often make it impossible to obtain current-meter measurements at some sites. Peak discharges can be measured after the flood has subsided by indirect methods based on detailed surveys of selected channel reaches. A general description of indirect methods is given by Corbett and others (1943), and more detailed descriptions with illustrated examples are reported by Johnson (1936) and Dalrymple (1937, 1939).

## EXPLANATION OF DATA

The floods described herein are in chronological order. Because the characteristics and the amount of information differ for each flood, no consistent form is used to report the events.

The data include a description of the storm, the flood, and the flood damage; a map of the flood area showing the location of flood-determination points and, for some storms, the location of precipitation stations or isohyets; rainfall amounts and intensities; and flood-peak stages and discharges of the streams affected.

When considerable rainfall data are available, they are presented in tabular form and show daily or storm totals. When sufficient data are available to determine the pattern and distribution of rainfall, an isohyetal map may be shown.

A summary table of peak stages and discharges is given for each flood unless the number of stations in the report is small, and then the information is included in the text description. In the summary table the first column under maximum floods shows the period of known floods prior to the 1963 floods. This period does not necessarily correspond to that in which continuous records of discharge were obtained, but the period may extend back to an earlier date. More than one period of known floods are shown for some stations. A period is shown whenever it can be associated with a maximum stage, even though the corresponding discharge may not be known. If the discharge is unknown for the maximum stage, a second period of floods is given in which maximums of both discharge and stage are known.

The second column under maximum floods shows the year, within the period of known floods, in which the maximum stage or discharge occurred. The third column gives the date of the peak stage or discharge of the 1963 flood.

The last column gives the recurrence interval for the 1963 peak discharge. The recurrence interval is the average interval, in years, in which a flood of a given magnitude (the 1963 peak) will be equaled or exceeded once as an annual maximum. A flood having a recurrence interval of 20 years can be expected to occur, on the average, once in 20 years, or it is one that has a 5-percent chance of occurring in any year. The recurrence intervals in the tables were obtained from U.S. Geological Survey reports on flood magnitude and frequency. In nearly all flood-frequency reports used, the data that are available limit the determination of recurrence intervals to 50 years. In a few reports the limit is less than 50 years. The severity of a flood whose recurrence interval exceeds the limit of determination is expressed as the ratio of its peak discharge to the discharge of the flood that has a recurrence interval equal to the limits of determination.

## SUMMARY OF FLOODS OF 1963

### FLOODS OF JANUARY–FEBRUARY IN CALIFORNIA AND NEVADA

Flood-producing rains were associated with two warm frontal systems that crossed California and Nevada from the west on January 30 and 31. Most of the precipitation fell during a 72-hour period between January 29 and February 1. Three-day precipitation totals of more than 20 inches were recorded at several places in the Sierra Nevada and along the coast of California near Monterey Bay. The largest storm total was 27.15 inches at Westfall Ranger Station in the Sierra National Forest, Calif. The storm that produced the flood ended a record-breaking 42-day winter drought in the area.

The floods of January–February in California and Nevada (fig. 2) produced the greatest peak discharges in the history of recorded streamflow in some areas of the Sierra Nevada, of which those in the American River basin were the most notable. The peak discharge of 121,000 cfs (cubic feet per second) on the Middle Fork American River near Auburn, Calif., for which records have been kept since 1911, exceeded not only the previous maximum of 79,000 cfs of the devastating floods of 1955 but also exceeded all peaks since the great deluge of December 1861–January 1862. Maximum peaks of record occurred in several other central Sierra Nevada River basins, including those of the Carson, Truckee, Stanislaus, Feather, and Yuba Rivers. Loss of 10 lives was attributed to the storm and floods, and damage amounted to $18.5 million.

These floods are fully described in U.S. Geological Survey Water-Supply Paper 1830–A, "Floods of January–February 1963 in California and Nevada" (Young and Harris, 1966). They present a general description of the storm precipitation, the floods, the flood damage, and the regulation of floodflow by storage reservoirs. Maximum stages and discharges for the 1963 flood and for the period of station record

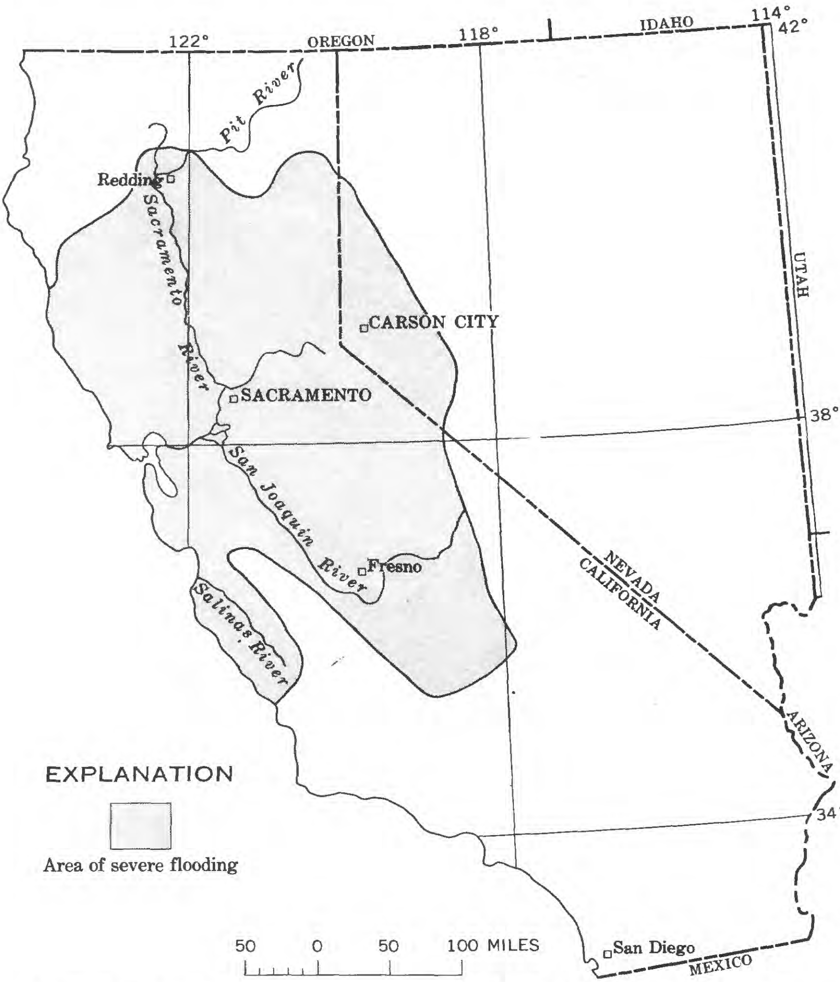


FIGURE 2.—Flood area for January–February in California and Nevada.

at 623 continuous-record gaging stations, crest-stage stations, miscellaneous sites, and reservoir stations are listed in a summary table. Station descriptions are given for all stations listed in the summary table. A table of daily mean discharges for January and February 1963 and a table of stages and discharges at selected intervals during most of the days of floodflow are given for each continuous-record gaging station.

## FLOODS OF JANUARY–FEBRUARY IN SOUTHERN IDAHO

By C. A. Thomas

Record-breaking flood peaks occurred in February in southern Idaho. Peak discharges on many streams exceeded the exceptional rates of the February 1962 flood, and a considerable number had recurrence intervals of more than 50 years. The area affected is shown in figure 3.

The floods resulted from above-freezing temperatures and prolonged light-to-moderate rainfall on light snow cover on ground that was frozen to considerable depths. These conditions were similar to those causing the February 1962 floods. The 1962 floods may have increased the efficiency of the contributing drainage systems and thus aggravated the 1963 flooding in some areas.

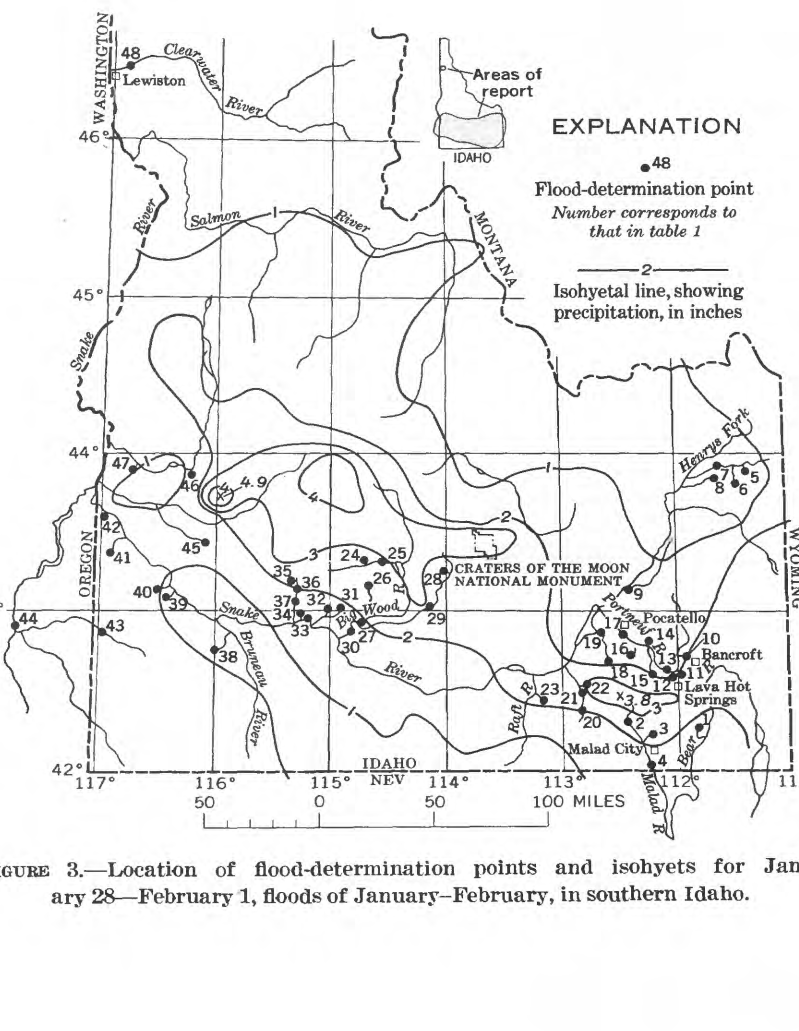


FIGURE 3.—Location of flood-determination points and isohyets for January 28—February 1, floods of January–February, in southern Idaho.

Runoff rates were highest from streams draining areas of flatlands or rolling hills at low altitudes and were only moderate from high mountainous basins, some of which showed no significant rise in discharge.

Total damage in Idaho was estimated at more than $3½ million. This is considerably less than for the 1962 flood. Flooding in 1963 was more scattered than for the preceding year, and less population and lower concentration of industrial and other development in the flooded areas resulted in less total damage.

Floods were highest of record in many basins in the southern part of the State. Peak discharges on many streams are listed in table 1. Discharges were determined from rating curves that were extended when practicable, from indirect measurements, and from direct measurements at or near the peaks for the points shown in figure 3.

The weather conditions at Craters of the Moon National Monument, antecedent to and during the flood period, were typical of the conditions that contributed to the high runoff rates and are illustrated in figure 4. Temperatures during December and January were 4° to 7° F below normal in southern Idaho. Precipitation for about 5 weeks prior to January 28 was also far below normal, less than 50 percent of normal at most weather stations. The topsoil was therefore fairly dry and loose, but underneath this the soil was frozen to considerable depth. Light snow fell on January 10–18 at many points and accumulated to depths of a few inches. More snow fell on January 29–31 and increased the depth to 6 to 18 inches in the flood areas. Temperatures rose, and on January 31, the precipitation changed to rain. Intensity was moderate to heavy and ranged from 0.02 to 0.39 inches per hour. In many areas, all the snow was melted.

Some noticeable differences from the floods of 1962 were evident. Because the ground surface was not glazed before the 1963 flood as it had been in 1962, the rapid runoff severely eroded the loose topsoil, especially from agricultural lands. Sediment movement was much greater than in 1962. Runoff from lava beds of the Snake River Plain was extremely low because the lava beds were not glazed with ice as they had been in 1962. More precipitation occurred during, or immediately before, the flood than in 1962. The isohyetal lines, January 28–February 1, 1963, in figure 3 show that more than 3 inches of precipitation was recorded at several points in southern Idaho. The volume of runoff is believed to be less than in 1962 in most basins because of the absence of ice-glazed surfaces.

The peak flow in Devil Creek near Malad City (station 3), in Bear River basin, was three times the previous maximum peak in 25 years of record. Damage was confined to roads and farmland.

The most outstanding flood-discharge rate observed in Henrys Fork basin was 96 cfs per square mile from 14.1 sq mi in Milk Creek near Tetonia (station 5). This rate is unusually high for winter floods in Idaho. Principal damage from flooding in Henrys Fork basin was caused by ice jams. In some small areas the losses exceeded those of 1962. Roads, homes, potato storage pits, farm improvements, and lands were affected by the flooding water.

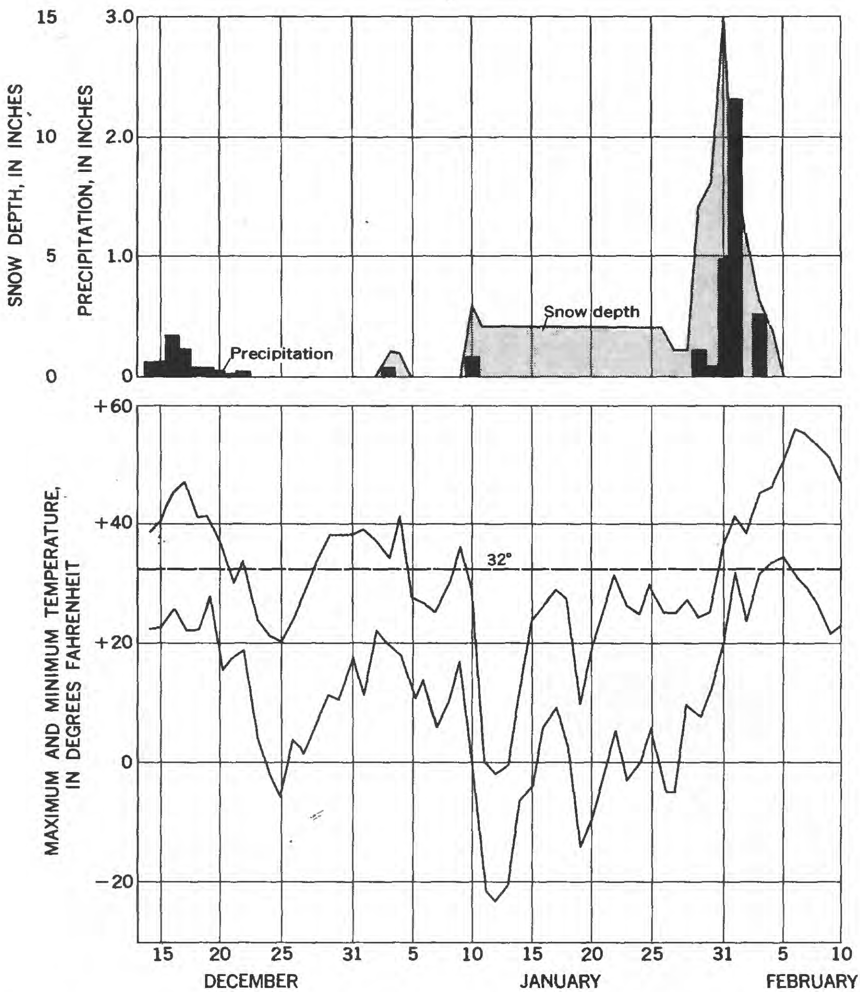


FIGURE 4.—Weather conditions for December 1962–February 1963 at Craters of the Moon National Monument, Idaho.

TABLE 1.—*Flood stages and discharges, January–February, in southern Idaho*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to Jan. 1963: Period | Year | January–February, 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Bear River basin** | | | | | | | |
| 1 | Battle Creek tributary near Treasureton, Idaho | 4.5 | 1961–62 | 1962 | | 11.17 | 81 | |
| | | | | | Feb. 1 | 12.06 | 98 | 15 |
| 2 | Little Malad River above Elkhorn Reservoir, near Malad City, Idaho | 120 | 1911–13, 1931–32, 1940–62 | 1962 | | 4.85 | 1,450 | |
| | | | | | Jan. 31 | 4.41 | 1,100 | 25 |
| 3 | Devil Creek, 7.8 miles north of Malad City, Idaho | 15 | 1938–61 | 1961 | | | [1] 194 | |
| | | | | | Feb. 1 | | 585 | 50 |
| 4 | Malad River at Woodruff, Idaho | 485 | 1938–62 | 1962 | | 8.93 | 2,530 | |
| | | | | | Feb. 2 | 5.02 | 243 | 2 |
| | **Henrys Fork basin** | | | | | | | |
| 5 | Milk Creek near Tetonia, Idaho | 14.1 | 1962 | 1962 | | 7.72 | 179 | |
| | | | | | Feb. 1 | 9.13 | 1,350 | 50 |
| 6 | Canyon Creek at State Highway 33 near Clementsville, Idaho | 76 | 1962 | 1962 | | | 814 | |
| | | | | | Feb. 1 | | 636 | 25 |
| 7 | Teton River near St. Anthony, Idaho | 890 | 1890–93, 1903–09, 1920–62 | 1962 | | 9.36 | 11,000 | |
| | | | | | Feb. 3 | 8.70 | 7,280 | 25 |
| 8 | Moody Creek at railroad crossing, 0.4 mile south of Moody, Idaho | 88 | 1962 | 1962 | | | [2] 2,700 | |
| | | | | | Feb. 1 | | 1,040 | 25 |
| | **Blackfoot River basin** | | | | | | | |
| 9 | Blackfoot River near Blackfoot, Idaho | 1,295 | 1913–62 | 1962 | | 7.68 | 1,710 | |
| | | | | | Feb. 3 | | [3] 1,100 | 50 |
| | **Portneuf River basin** | | | | | | | |
| 10 | Portneuf River tributary, 1 mile northwest of Bancroft, Idaho | 130 | 1962 | 1962 | | | 473 | |
| | | | | | Feb. 1 | | 574 | 50 |
| 11 | Fish Creek, 2.5 miles east of Lava Hot Springs, Idaho | 20.1 | 1962 | 1962 | | | [4] 54 | |
| | | | | | Feb. 1 | | 1,360 | 50 |
| 12 | Dempsey Creek, 1 mile west of Lava Hot Springs, Idaho | 42 | | | Feb. 1 | | 400 | |
| 13 | Portneuf River at Topaz, Idaho | 570 | 1913–15, 1919–62 | 1962 | | 7.83 | [5] 6,140 | |
| | | | | | Feb. 1 | 8.22 | [5] 7,120 | 50 |
| 14 | Rapid Creek, 1.5 miles from U.S. Highway 91 at Inkom, Idaho | 57.2 | | | Feb. 1 | | 526 | |
| 15 | Marsh Creek near McCammon, Idaho | 355 | 1954–62 | 1962 | | 13.25 | [6] 1,120 | |
| | | | | | Feb. 1 | 9.31 | [6] 643 | 30 |
| 16 | East Fork Mink Creek near Pocatello, Idaho | 14.7 | 1962 | | Feb. 1 | 6.39 | 49 | |
| 17 | Portneuf River at Pocatello, Idaho | 1,250 | 1897–99, 1911–62 | 1962 | | 11.35 | [7] 2,990 | |
| | | | | | Feb. 2 | 10.07 | [7] 2,510 | 30 |

See footnotes at end of table.

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TABLE 1.—*Flood stages and discharges, January–February, in southern Idaho*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to Jan. 1963 — Period | Prior to Jan. 1963 — Year | January–February, 1963 | Gage height (feet) | Discharge — Cfs | Discharge — Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Bannock Creek basin** | | | | | | | |
| 18 | Bannock Creek near Pocatello, Idaho | 230 | 1955–58, 1962 | 1962 | | 10.6 | 4,130 | |
| | | | | | Feb. 1 | 10.8 | 4,600 | 50 |
| 19 | Bannock Creek at U.S. Highway 30 near Pocatello, Idaho | 413 | 1962 | 1962 | | | 4,010 | |
| | | | | | Feb. 1 | | 3,930 | 30 |
| | **Rock Creek basin** | | | | | | | |
| 20 | Rock Creek. 2.5 miles north of Roy, Idaho | 96 | 1962 | 1962 | | | 1,770 | |
| | | | | | Feb. 1 | | 1,470 | |
| 21 | Rock Creek, 1.9 miles above former gage site and 4.6 miles southeast of Rockland, Idaho | 156 | 1955–60 [8], 1962 [9] | 1962 | | | 2,120 | |
| | | | | | Feb. 1 | | 5,100 | |
| 22 | East Fork Rock Creek, 4.5 miles east of Rockland, Idaho | 13.7 | 1960–62 | 1962 | | 1.80 | 26 | |
| | | | | | Feb. 1 | 2.25 | 39 | |
| | **Raft River basin** | | | | | | | |
| 23 | Heglar Canyon tributary near Rockland, Idaho | 7.72 | 1958,1962 | 1958 | | 17.7 | 1,930 | |
| | | | | | Feb. 1 | 12.25 | 233 | 50 |
| | **Big Wood River basin** | | | | | | | |
| 24 | Deer Creek near Fairfield, Idaho | 13.2 | 1961–62 | 1962 | | 3.73 | 69 | |
| | | | | | Feb. 3 | [10] 4.20 | 71 | |
| 25 | Camas Creek near Blaine, Idaho | 648 | 1912–21, 1923–62 | 1943 | | 15.45 | [7] 9,780 | |
| | | | | | Feb. 3 | 16.2 | [7] 9,200 | 25 |
| 26 | Schooler Creek near Gooding, Idaho | 2.22 | 1961–62 | 1962 | | 3.83 | 35 | |
| | | | | | Feb. 1 | 5.90 | 68 | |
| 27 | Big Wood River at Gooding, Idaho | 2,190 | 1896, 1898–99, 1921–48 | 1896 | | 9.6 | 5,940 | |
| | | | | | Feb. 1 | 11.6 | [11] 6,300 | 50 |
| 28 | Silver Creek near Picabo, Idaho | 88 | 1920–62 | 1955 | | 3.70 | 357 | |
| | | | | | Feb. 4 | | 757 | 50 |
| 29 | Jim Byrnes Slough, 1 mile east of Richfield, Idaho | ([12]) | 1962 | 1962 | | | 1,520 | |
| | | | | | Feb. 1 | | 1,000 | |
| 30 | Big Wood River near Gooding, Idaho | 2,990 | 1916–62 | 1952 | | 10.67 | 6,500 | |
| | | | | | Feb. 1 | 11.89 | [1'] 8,440 | 50 |

See footnotes at end of table.

TABLE 1.—*Flood stages and discharges, January–February, in southern Idaho*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to Jan. 1963: Period | Prior to Jan. 1963: Year | January–February, 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Clover Creek basin** | | | | | | | |
| 31 | Clover Creek, 6 miles upstream from Calf Creek near Bliss, Idaho | 71.2 | | | Feb. 1 | | 5,680 | 50 |
| 32 | Calf Creek, 1.1 miles above confluence with Clover Creek near Bliss, Idaho | 39.4 | | | Feb. 1 | | 4,150 | 25 |
| | **Snake River Main Stem** | | | | | | | |
| 33 | Snake River near King Hill, Idaho | 35,800 | 1909–62 | 1918 | | 16.3 | [6] 47,200 | |
| | | | | | Feb. 2 | 10.96 | [7] 23,200 | |
| | **King Hill Creek basin** | | | | | | | |
| 34 | King Hill Creek near King Hill, Idaho | 78.9 | 1913, 1938–41 | 1940 | | 7.20 | 763 | |
| | | | | | Feb. 1 | | 2,320 | 25 |
| | **Little Canyon Creek basin** | | | | | | | |
| 35 | Burns Gulch near Glenns Ferry, Idaho | 0.76 | | (13) | | 6.72 | 16 | |
| | | | | | Feb. 1 | 7.73 | 22 | |
| 36 | Little Canyon Creek at Stout Crossing near Glenns Ferry, Idaho | 14.2 | 1961–62 | 1962 | | 11.02 | 65 | |
| | | | | | Feb. 1 | 12.33 | 196 | |
| 37 | Little Canyon Creek at Berry Ranch near Glenns Ferry, Idaho | 26.9 | 1960–62 | 1962 | | 3.22 | 181 | |
| | | | | | Feb. 1 | 4.60 | 519 | |
| | **Bruneau River basin** | | | | | | | |
| 38 | Wickahoney Creek, 1000 ft upstream from former gage near Bruneau, Idaho | 253 | 1939–49 | 1943 | | 12.4 | 2,100 | |
| | | | | | Feb. 1 | 7.73 | 1,720 | |
| | **Fossil Creek basin** | | | | | | | |
| 39 | Fossil Creek near Oreana, Idaho | 19.7 | 1961–62 | 1961 | | 16.2 | 100 | |
| | | | | | Jan. 31 | 15.45 | 84 | |
| | **Sinker Creek basin** | | | | | | | |
| 40 | Sinker Creek 6.5 miles southeast of Murphy, Idaho | 74 | 1962 | 1962 | | 13.15 | 774 | |
| | | | | | Feb. 1 | 7.97 | 400 | |

See footnotes at end of table.

TABLE 1.—*Flood stages and discharges, January–February, in southern Idaho*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to Jan. 1963, Period | Prior to Jan. 1963, Year | January–February, 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Squaw Creek basin** | | | | | | | |
| 41 | Little Squaw Creek tributary near Marsing, Idaho | 1.81 | 1961–62 | 1961 | | 6.55 | 7.8 | |
| | | | | | Jan. 31 | 10.78 | 93 | |
| | **Sucker Creek basin** | | | | | | | |
| 42 | Sucker Creek, 0.5 mile downstream from former gage near Homedale, Idaho | 413 | 1903–09 | 1905 | | 7.30 | 2,500 | |
| | | | | | Feb. 1 | | 13,000 | 50 |
| | **Owyhee River basin** | | | | | | | |
| 43 | Jordan Creek above Lone Tree Creek, near Jordan Valley, Oreg | 440 | 1945–52, 1955–62 | 1952 | | [14] 5.57 | 3,250 | |
| | | | | | Feb. 1 | 8.41 | 3,110 | 30 |
| 44 | Owyhee River near Rome, Oreg | 8,000 | 1949–62 | 1952 | | 15.36 | [15] 27,800 | |
| | | | | | Feb. 1 | 14.20 | 24,100 | 40 |
| | **Boise River basin** | | | | | | | |
| 45 | Bryans Run near Boise, Idaho | 7.03 | 1961–62 | 1962 | | 11.01 | 116 | |
| | | | | | Feb. 1 | 11.24 | 142 | |
| | **Payette River basin** | | | | | | | |
| 46 | Cottonwood Creek near Horseshoe Bend, Idaho | 6.53 | 1961–62 | 1962 | | 13.05 | 112 | |
| | | | | | Feb. 1 | 16.81 | 303 | |
| 47 | Langley Gulch near New Plymouth, Idaho | 3.9 | 1961–62 | | Feb. 1 | 9.91 | 39 | |
| 48 | Clearwater River at Spalding, Idaho | 9,570 | 1911–13, 1925–62 | 1948 | | 23.76 | 177,000 | |
| | | | | | Feb. 5 | [10] 27.77 | | |

[1] At former site ¾ mile upstream; drainage area, 13 sq mi, approximately.
[2] Peak flow into pool at upstream end of culvert; maximum outflow through pipe, 1,840 cfs.
[3] Only the area below reservoir, 714 sq mi, contributed to the flow.
[4] At site 1.5 miles upstream; drainage area, 16.1 sq mi.
[5] Result of failure of highway fill 2 miles upstream; natural peaks, 3,690 cfs in 1962 and about 2,400 cfs in 1963.
[6] Maximum observed.
[7] Flow regulated by reservoir or reservoirs.
[8] At site 1.9 miles downstream; drainage area, 182 sq mi.
[9] At site 4.6 miles downstream; drainage area, 216 sq mi.
[10] Affected by backwater from ice.
[11] Flow from area below Magic Dam, 1,600 sq mi, noncontributing.
[12] Drainage area indeterminate.
[13] Prior to October 1960.
[14] Site and datum then in use.
[15] Reported by local resident to be highest since at least 1882.

Portneuf River basin was hardest hit of any basin in Idaho. Damage was estimated at about \$2½ million. Fish Creek (station 11) and Portneuf River basin tributary (station 10) near Bancroft were higher than in 1962. As in 1962, the 1963 flood washed out a road fill and culvert below Lava Hot Springs. The urban areas of Pocatello, Lava Hot Springs, and Bancroft sustained most of the damage in the Portneuf River basin.

Discharges of Rock Creek (stations 20, 21) and Bannock Creek (stations 18, 19) exceeded the capacity of the culverts, bridges, and channels, and serious washouts occurred. Traffic was rerouted and expensive structures were rebuilt, repaired, or replaced. Discharges of the Big Wood River and Clover Creek (station 31) exceeded any previously recorded flood in some parts of the basins. Rates of runoff were exceptionally high. Discharge of Silver Creek (station 28) was more than twice the highest previously recorded in 42 years of record. The Big Wood River near Gooding (station 30) was higher than any previously recorded peak in 46 years of record even though no flow from the 1,600 sq mi above Magic Dam was released. Unit discharge from Calf Creek (station 32), a tributary of Clover Creek, was 105 cfs per sq mi.

Sucker Creek (station 42), tributary to the Snake River near the Idaho-Oregon border, reached a peak more than five times the maximum of 6 years of record. This discharge is believed to have a recurrence interval of more than 50 years. The flood washed out a State highway bridge and reaches of county roads, eroded farmland, and damaged or destroyed farm improvements and livestock.

The Clearwater River in north-central Idaho had heavy ice cover on practically all channels at the end of January. On February 2, rain and snowmelt began to increase the riverflow and the ice loosened. As the flow increased, the channel became choked with ice that had moved downstream. Passage was blocked by heavy ice cover on the mill pond a few miles above Lewiston. Ice jams overtopped the banks, moved over roads, railroads, and other improvements, and piled against bridges and buildings. Maximum stages were reached on February 4 and 5. Discharges were not particularly high, but the stage of 27.77 ft at the Clearwater River at Spalding (station 48) was the maximum in a 42-year period of record.

Damages from the flood in Idaho as estimated by the U.S. Army Corps of Engineers, Walla Walla District, are briefly summarized by basins in table 2. Some of these damage figures are a large part of the property valuation in the areas flooded. It was estimated, for example, that damage in Portneuf River basin was 17 percent of the property valuation in the basin.

TABLE 2.—*Damage summary, flood of February 1963, in southern Idaho*

| *Basin* | *Damage* |
|---|---|
| Portneuf River | $2,580,000 |
| Bannock Creek | 136,000 |
| Rock Creek | 209,000 |
| Teton River and lower Henrys Fork | 165,000 |
| Big and Little Wood Rivers | 275,000 |
| Sucker Creek | 76,000 |
| Clearwater River | 287,000 |
| Total | $3,728,000 |

## FLOODS OF JANUARY 31–FEBRUARY 5 IN EASTERN OREGON

By D. D. HARRIS

Floods in the Lakeview area and in the Malheur, Powder, Owyhee, and Burnt River basins of eastern Oregon (fig. 5) during the period

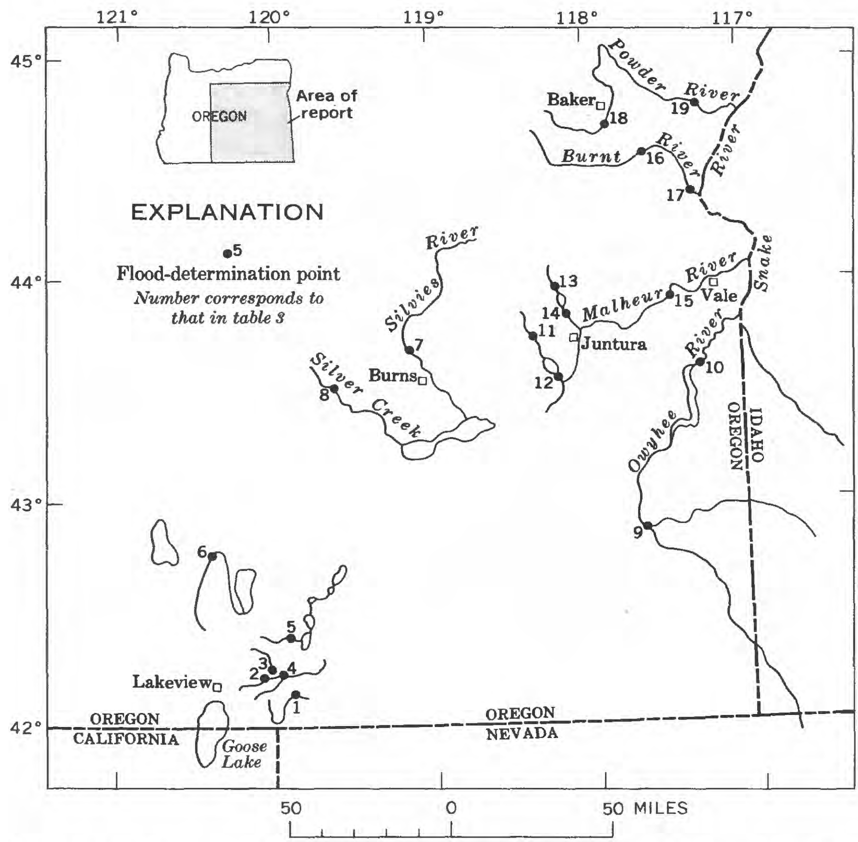



FIGURE 5.—Location of flood-determination points, floods of January 31–February 5, in eastern Oregon.

January 31–February 5 were caused by a sudden thaw accompanied by moderate rains on snow. A snow cover of 3 to 6 inches existed over many of the low valleys in late January. Extremely low temperatures during the period January 28–30 froze the ground and caused thick ice to form on many of the streams. Temperatures began rising late on January 30 and remained unseasonably warm through February 6. During this thawing period, steady rain fell over the entire area and totaled 2.44 inches at Lakeview, 1.22 inches at Vale, 1.73 inches at Burns, and 0.97 inches at Baker. Figure 6 shows the weather conditions at Baker before and during the flood period.

The combination of rain and snowmelt resulted in a heavy runoff that produced maximum flows of record on many streams in the Warner Lakes basin east of Lakeview. The peak discharge at Drake Creek near Adel (station 3), 4,050 cfs on January 31, was 2.7 times greater than the discharge for the 50-year flood at that site. Peak flows in other streams in the Warner Lakes valley approached or exceeded the 50-year flood. Peak discharges and their recurrence intervals at the sites shown on the map (fig. 5) are listed in table 3.

Flooding in the Malheur River basin extended along the flood plain from Juntura to the mouth. Floods near Vale were caused mainly by local runoff when about 12 inches of snow melted in a 4-hour period. Floodflows below Juntura would have been higher if reservoirs had not reduced the flow contributed from upstream runoff. The North Malheur River above Agency Valley Reservoir (station 13) had a record peak flow of 2,060 cfs on February 3. However, the flow below Agency Valley Reservoir (station 14) was held to less than 1 cfs during the entire flood period. Storage in Warmsprings Reservoir (above

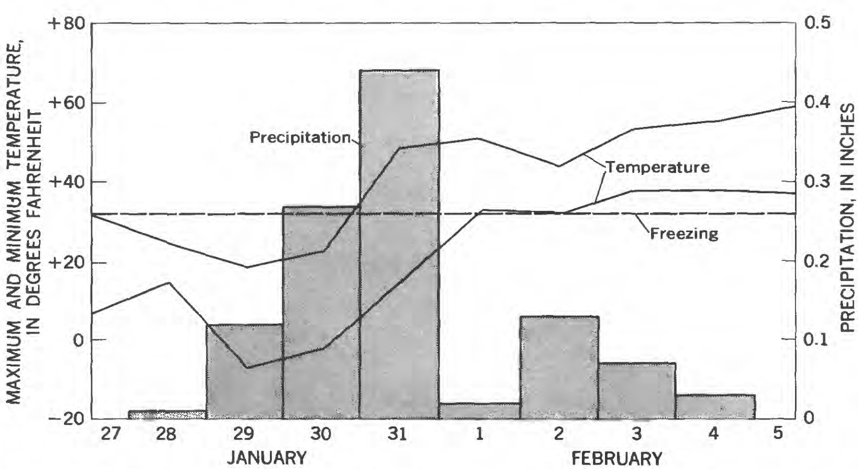



FIGURE 6.—Weather conditions for January 27–February 5 at Baker, Oreg.

TABLE 3.—*Flood stages and discharges, January 31–February 5, in eastern Oregon*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to January 1963, Period | Maximum floods: Prior to January 1963, Year | Maximum floods: January–February 1963 | Maximum floods: Gage height (feet) | Maximum floods: Discharge, Cfs | Maximum floods: Discharge, Recurrence interval (yr) |
|---|---|---|---|---|---|---|---|---|
| | **Warner Lakes basin** | | | | | | | |
| 1 | Twentymile Creek near Adel | [1] 194 | 1911–16, 1918–19, 1921–22, 1941–63 | 1955 | | 14.80 | 3,260 | |
| | | | | | Feb. 1 | 14.4 | 3,160 | 34 |
| 2 | Camas Creek near Lakeview | 63 | 1913–14, 1950–63 | 1955 | | 5.15 | 1,630 | |
| | | | | | Feb. 1 | 4.95 | 1,440 | [2] 1.01 |
| 3 | Drake Creek near Adel | 67 | 1915, 1922–23, 1949–63 | 1955 | | 3.93 | 1,100 | |
| | | | | | Jan. 31 | 5.69 | 4,050 | [2] 2.72 |
| 4 | Deep Creek above Adel | 249 | 1923, 1930–63 | 1937 | | 7.5 | 5,030 | |
| | | | | | Feb. 1 | 7.83 | 5,500 | [2] 1.30 |
| 5 | Honey Creek near Plush | 170 | 1890, 1910–15, 1921–22, 1930–63 | 1915 | | 9.20 | [3] 3,840 | |
| | | | | | Feb. 1 | 10.46 | 6,210 | [2] 1.98 |
| | **Albert Lake basin** | | | | | | | |
| 6 | Chewaucan River near Paisley | 275 | 1909, | 1909 | | (4) | 4,000 | |
| | | | 1912–21, 1924–63 | 1955 | | 5.45 | 3,260 | |
| | | | | | Feb. 1 | 5.42 | 3,100 | 13 |
| | **Malheur and Harney Lakes basin** | | | | | | | |
| 7 | Silvies River near Burns | 934 | 1904–06, 1909–63 | 1952 | | 15.2 | 4,960 | |
| | | | | | Feb. 4 | [5] 12.71 | (4) | (4) |
| 8 | Silver Creek near Riley | 228 | 1952–63 | 1952 | | 6.65 | 1,300 | |
| | | | | | Feb. 1 | 5.90 | 970 | 13 |
| | **Owyhee River basin** | | | | | | | |
| 9 | Owyhee River near Rome | 8,000 | 1882–1963 | 1952 | | 15.36 | 27,800 | |
| | | | | | Feb. 1 | 14.20 | 24,100 | 24 |
| 10 | Owyhee River below Owyhee Dam | 11,160 | 1929–63 | 1952 | | 15.7 | 22,900 | |
| | | | | | Feb. 1 | | [6] 3 | |
| | **Malheur River basin** | | | | | | | |
| 11 | Malheur River near Drewsey | 910 | 1920–22, 1927–63 | 1957 | | 13.20 | 10,700 | |
| | | | | | Feb. 1 | 11.7 | 6,000 | 31 |
| 12 | Malheur River below Warmsprings Reservoir near Riverside | 1,100 | 1909–10, 1915–17, 1919–63 | 1910 | | (4) | 7,200 | |
| | | | | | Feb. 1 | | [6] 1 | |

See footnotes at end of table.

TABLE 3.—*Flood stages and discharges, January 31–February 5, in eastern Oregon*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to January 1963: Period | Maximum floods: Prior to January 1963: Year | Maximum floods: January–February 1963 | Maximum floods: Gage height (feet) | Maximum floods: Discharge: Cfs | Maximum floods: Discharge: Recurrence interval (yr) |
|---|---|---|---|---|---|---|---|---|
| | **Malheur River basin—Continued** | | | | | | | |
| 13 | North Fork Malheur River above Agency Valley Reservoir near Beulah | 355 | 1914, 1937–63 | 1957 | | 3.50 | 1,600 | |
| | | | | | Feb. 3 | 5.78 | 2,060 | [2] 1.04 |
| 14 | North Fork Malheur River at Beulah | 440 | 1927–63 | 1942 | | 8.4 | [7] 7,000 | |
| | | | | | Feb. 2 | | [6] 1 | |
| 15 | Malheur River at Little Valley near Hope | 3,010 | 1949–63 | 1957 | | 11.5 | 12,300 | |
| | | | | | Feb. 2 | 10.65 | 10,600 | ([4]) |
| | **Burnt River basin** | | | | | | | |
| 16 | Burnt River near Bridgeport | 650 | 1957–63 | 1957 | | 5.43 | 1,270 | |
| | | | | | Feb. 3 | 4.01 | 704 | <2 |
| 17 | Burnt River at Huntington | 1,093 | 1929–32, 1957–63 | 1957 | | 6.39 | 2,190 | |
| | | | | | Feb. 3 | [5] 6.80 | ([4]) | ([4]) |
| | **Powder River basin** | | | | | | | |
| 18 | Powder River near Baker | 219 | 1904–14, 1927–63 | 1910 | | ([4]) | [8] 1,820 | |
| | | | | | Feb. 2 | [5] 5.58 | ([4]) | ([4]) |
| 19 | Powder River near Richland | 1,310 | 1958–63 | 1958 | | 4.76 | 2,210 | |
| | | | | | Feb. 3 | [5] 7.10 | | |
| | | | | | Feb. 5 | | 1,240 | <2 |

[1] Includes 46 sq mi in Cowhead Lake area.
[2] Ratio of peak discharge to 50-year flood.
[3] Caused by failure of storage dam.
[4] Not determined.
[5] Affected by backwater from ice.
[6] Flow regulated by reservoir; daily mean discharge.
[7] Caused by failure of gates at Agency Valley Dam.
[8] Daily mean discharge.

station 12) and in the partly completed Bully Creek Reservoir also helped to reduce flooding in the lower valley.

Owyhee Reservoir on the Owyhee River (above station 10) and Unity Reservoir on the Burnt River (above station 16) effectively controlled downstream floodflows. Flooding in the Powder River basin resulted from ice jams formed at channel constrictions, although runoff was not exceptionally great.

Property damage was extensive in the Powder and Malheur River basins. Damage in the Powder River basin, estimated by the Corps of Engineers at $128,000, was primarily the result of backwater from ice jams downstream from Baker. The backwater inundated the north residential area of Baker and more than 2,900 acres of farmland below

Baker. Damage in the Malheur River basin, estimated by the Corps of Engineers at $477,000, was mainly erosion of land and streambeds; roads, fences, and bridges also were damaged. The area flooded in the Malheur River valley was more than 7,500 acres. Damage occurred to roads and stream-diversion structures in the Warner Lakes basin east of Lakeview, particularly along Honey Creek. Damage was relatively minor in the Burnt River and Owyhee River basins.

## FLOODS OF FEBRUARY 1 AT VIVIAN PARK, UTAH

An intense storm near Vivian Park, Utah, on January 29–February 2 produced a peak discharge on the South Fork Provo River at Vivian Park (fig. 7) that was four times the previous maximum in 51 years of

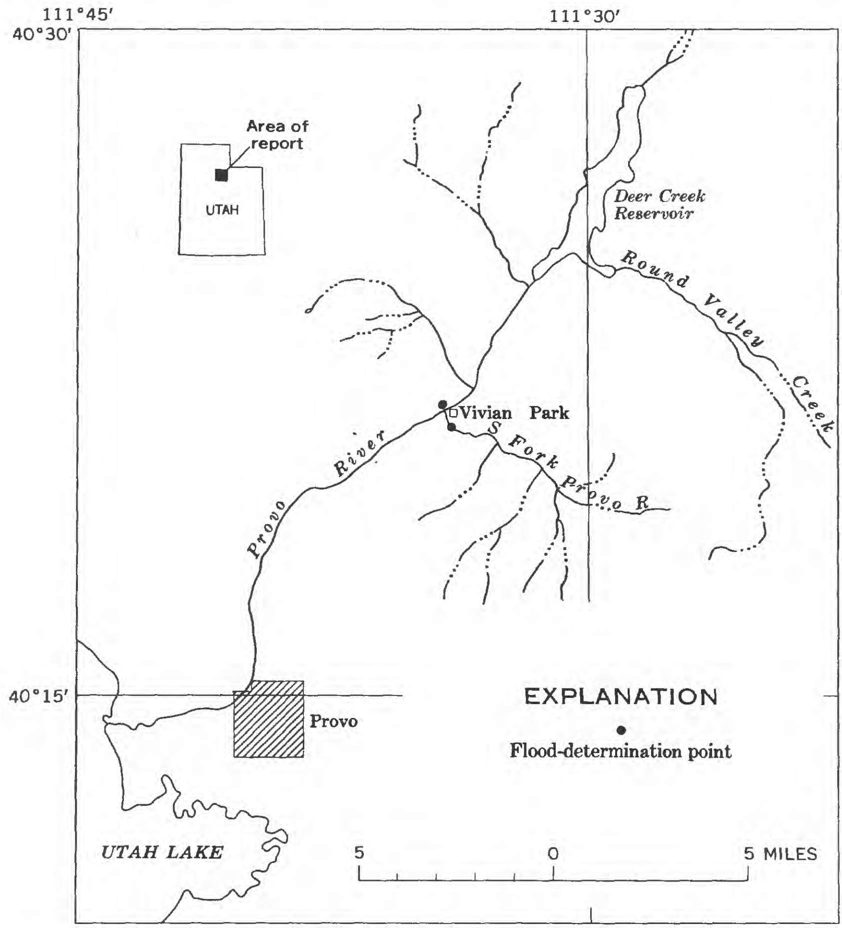



**Figure 7.—Location of flood-determination points for flood of February 1, at Vivian Park, Utah.**

record. The discharge on the Provo River at Vivian Park, although not of flood magnitude, was unusually high when associated with the area producing the runoff.

During the storm, the U.S. Weather Bureau rain gage at Deer Creek recorded 5.08, 8.88, 9.59, and 10.13 inches, respectively, for 24, 48, 72, and 96 hours. The magnitude of the 24-hour precipitation was about 1.7 times the 50-year rainfall and about 1.45 times the 100-year rainfall (U.S. Weather Bureau, 1961). The storm rainfall at the Deer Creek rain gage was the greatest recorded at any precipitation station in the State, and it exceeded all previous precipitation records in Utah for the 24-, 48-, 72-, and 96-hour storms.

The peak discharge, estimated at 500 cfs, on South Fork Provo River at Vivian Park came from a drainage area of 30 sq mi and was a rare hydrologic event. The magnitude of this peak was 1.5 times a 50-year flood. Before the flood of February 1, 1963, the maximum discharge observed at the site during the period of record, 1912–62, was 123 cfs on May 27, 1922.

Discharge on the Provo River above the mouth of the South Fork at Vivian Park is largely controlled 4 miles upstream by Deer Creek Reservoir. The increase in discharge of 490 cfs, which was caused by the rains, would not be considered a flood on the Provo River at this point (drainage area, 600 sq mi). The maximum discharge in the period of record, 1912–63, was 3,180 cfs in 1921. However, the additional discharge came from only a 40-sq mi drainage area downstream from the dam and was about three times a 50-year flood from that size contributing area.

## FLOODS OF FEBRUARY 3–7 IN SOUTHEASTERN WASHINGTON

By L. L. Hubbard

Snowmelt and ice breakup caused by a sharp rise in temperature and by moderate to heavy rainfall caused severe flooding during the period February 3–7 in many areas of southeastern Washington (fig. 8). Below-normal temperatures during the latter half of January and through February 2 froze the ground to depths as great as 2½ feet and produced ice up to 1½ feet thick on streams. Some parts of the area had as much as 15 inches of snow on the ground on February 2. Temperatures rose from below freezing on February 2 to the middle fifties by February 4. Most of the major flooding occurred on February 3 when moderate rains accompanied the temperature rise.

Twenty-four-hour precipitation varied considerably over the area. Approximately 1.2 inches was recorded north of Roosevelt in the upper Rock Creek basin and at Spokane. Recorded precipitation at stations between Rosalia and Anatone was generally about 0.8 inch, and at most of the remaining flood area it was about 0.2 inch.

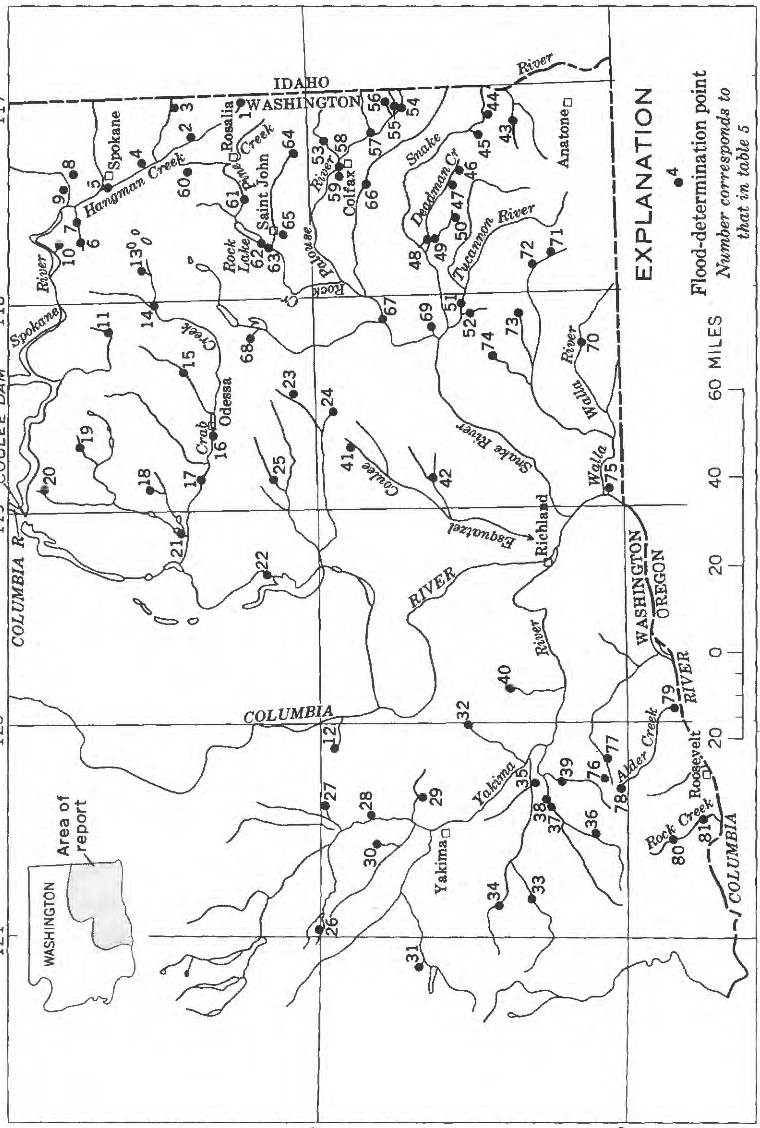



FIGURE 8.—Location of flood-determination points, floods of February 3–7, in southeastern Washington.

Many of the streams had returned to base flow by the evening of February 4. Heavy rains again fell in the same area on the still frozen ground and in some places caused peaks that exceeded those of February 3.

Major flooding occurred in the Hangman Creek drainage area of the Spokane River basin and in the basins of Crab Creek, Deadman Creek, Tucannon River, Palouse River, Alder Creek, and Rock Creek. Small tributary streams created the only flooding in the basins of Esquatzel Coulee, Yakima River, and Walla Walla River.

A notable reduction in the peak flow from Pine Creek was caused by storage in Rock Lake. Pine Creek above the lake had a peak flow of 10,800 cfs from 302 sq mi. Although additional tributaries flow into the lake, the peak discharge at the lake outlet (523-sq-mi drainage area) into Rock Creek was 4,000 cfs.

Flow in the main stem of the Palouse River at Hooper (table 5, station 67) exceeded the great floods of 1910 and 1948. Most of the flooding occurred in the nonurban areas. The major damage was soil erosion, silt and debris deposition, and washed-out bridges, roads, and fences.

The most severe flooding occurred in the Palouse River basin, where about 15,000 acres of land were flooded. The total estimated damage in the inspected parts of the basin amounted to $614,000, including $112,000 to railroads. Estimates of urban damage as reported by the Corps of Engineers, Walla Walla District, are shown in table 4.

TABLE 4.—*Estimate of damage in selected settled areas in the Palouse River basin resulting from the flood of February 1963*

[Excludes rural areas]

| Location | Stream | Estimated damage |
|---|---|---|
| Colfax | Palouse River and South Fork | $203,000 |
| Rosalia | Pine Creek | 61,000 |
| St. John | Pleasant Valley Creek | 20,000 |
| Garfield | Silver Creek | 16,000 |
| Endicott | Rebel Flat Creek | 15,000 |
| Oakesdale | McCoy Creek | 7,500 |
| Albion | South Fork Palouse River | 7,000 |
| Pullman | South Fork Palouse River and tributary | 2,000 |

About 1,400 acres of land were flooded near Richland along the lower Yakima River when ice jams created several feet of backwater. The Corps of Engineers estimated damage in the Richland area to be $14,000. The ice moved out prior to the peak floodflows and it was the freeing of the ice that prevented more severe damage. An estimated $25,000 damage to railroad and highway culverts and embankments was caused near Roosevelt by Rock Creek.

A summary of flood stages and discharges for the streams most affected by this flood is given in table 5.

TABLE 5.—*Flood stages and discharges, February 3–7, in southeastern Washington*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to February 1963: Period | Prior to February 1963: Year | February 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Spokane River basin** | | | | | | | |
| 1 | North Fork Hangman Creek at Tekoa | 64.6 | 1959 | 1959 | | | 3,750 | |
| | | | | | 3 | | 3,700 | 25 |
| 2 | Hangman Creek tributary near Latah | 2.18 | 1957 | 1957 | | 13.9 | (1) | |
| | | | 1961–63 | 1962 | | 10.64 | 142 | |
| | | | | | 3 | 10.82 | 155 | 6 |
| 3 | South Fork Rock Creek tributary near Fairfield | .59 | 1962–63 | 1962 | | [2] 4.84 | 32 | |
| | | | | | 4 | 10.74 | 43 | 3 |
| 4 | Stevens Creek tributary near Moran | 2.02 | 1954–63 | 1957 | | 8.24 | 52 | |
| | | | | | 4 | 10.66 | 125 | [3] 1.09 |
| 5 | Hangman Creek at Spokane | 689 | 1948–63 | 1959 | | 12.30 | 16,200 | |
| | | | | | 3 | 13.35 | 14,600 | 35 |
| 6 | Coulee Creek near Hite | 13.6 | | | 3 | | 871 | [3] 1.74 |
| 7 | Coulee Creek near Spokane | 53.9 | 1959 | 1959 | | | 1,530 | |
| | | | | | 3 | | 1,500 | [3] 1.03 |
| 8 | Bigelow Gulch near Spokane | 2.07 | 1950, 1962–63 | 1950 | | (1) | 1,510 | |
| | | | | | 3 | 12.56 | 222 | (1) |
| 9 | Little Creek at Dartford | 11.9 | | | 3 | 15.78 | 325 | (1) |
| 10 | Spring Creek tributary near Reardon | 1.14 | 1954–63 | 1959 | | 9.37 | 102 | |
| | | | | | 3 | 10.91 | 135 | 15 |
| | **Hawk Creek basin** | | | | | | | |
| 11 | Hawk Creek at Davenport | 23.2 | 1957, 1959, 1963 | 1957 | | 18.98 | 2,200 | |
| | | | | | 4 | 13.76 | 897 | 5 |
| | **Schnebly Coulee basin** | | | | | | | |
| 12 | Schnebly Coulee tributary near Vantage | 0.82 | 1955–63 | 1957 | | 11.41 | 42 | |
| | | | | | 7 | 10.76 | 19 | 3 |
| | **Crab Creek basin** | | | | | | | |
| 13 | South Fork Crab Creek tributary at Waukon | 0.68 | 1954–63 | 1957 | | 11.45 | 111 | |
| | | | | | 3 | 10.70 | 48 | 3 |
| 14 | South Fork Crab Creek near Edwall | 22.2 | 1957, 1959 | 1959 | | | 1,520 | |
| | | | | | 4 | | 920 | 6 |
| 15 | Coal Creek at Mohler | 64.7 | | | 3 | 4.42 | 1,060 | 3 |
| 16 | Crab Creek at Odessa | 815 | | | 5 | | 6,400 | (1) |
| 17 | Crab Creek at Irby | 1,042 | 1943–63 | 1957 | | 11.94 | 8,370 | |
| | | | | | 5 | 11.40 | 7,750 | [3] 1.17 |
| 18 | Canniwai Creek tributary near Govan | 25 | 1958–63 | 1958 | | 12.00 | 165 | |
| | | | | | 4 | 7.45 | 16 | 2 |
| 19 | Goose Creek near Wilbur | 43.0 | 1957, 1959 | 1957 | | | 3,040 | |
| | | | | | 3 | | 1,450 | 5 |
| 20 | Broadax Draw tributary near Wibur | 1.12 | 1955–63 | 1955 | | 14.64 | 205 | |
| | | | | | 3 | 8.44 | 44 | 2 |
| 21 | Wilson Creek at Wilson Creek | 427 | 1951–63 | 1957 | | 20.74 | 12,900 | |
| | | | | | 5 | 11.18 | 2,700 | [3] 1.61 |
| 22 | Crab Creek at Moses Lake | 2,228 | 1943–63 | 1957 | | 6.81 | 10,400 | |
| | | | | | 7 | 5.94 | 4,200 | 12 |
| 23 | Paha Coulee tributary near Ritzville | 8.52 | 1962–63 | 1962 | | 9.40 | 114 | |
| | | | | | 4 | 10.98 | 220 | 15 |
| 24 | Lind Coulee tributary near Lind | .21 | 1956, 1961–63 | 1956 | | 10.02 | 60 | |
| | | | | | 5 | 7.35 | 10 | 5 |
| 25 | Farrier Coulee near Schrag | 42.0 | | | 5 | 5.82 | 303 | 7 |

See footnotes at end of table.

TABLE 5.—*Flood stages and discharges, February 3–7, in southeastern Washington*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to February 1963: Period | Maximum floods: Prior to February 1963: Year | Maximum floods: February 1963 | Maximum floods: Gage height (feet) | Maximum floods: Discharge: Cfs | Maximum floods: Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Yakima River basin** | | | | | | | |
| 26 | South Fork Manashtash Creek tributary near Ellensburg | 2.12 | 1955–63 | 1957 | | 10.45 | 100 | |
| | | | | | 3 | 9.02 | 53 | 5 |
| 27 | Johnson Canyon tributary near Kittitas | .65 | 1956–63 | 1957 | | 11.13 | 43 | |
| | | | | | 7 | 10.17 | 28 | 10 |
| 28 | McPherson Canyon at Wymer | 5.48 | 1952, 1955–63 | 1952 | | 19.69 | 304 | |
| | | | | | 7 | 14.95 | 74 | 3 |
| 29 | Selah Creek tributary near Yakima | .68 | 1955–63 | 1961 | | 7.78 | 22 | |
| | | | | | 3 | 8.22 | 31 | 11 |
| 30 | Pine Canyon near Naches | 2.26 | 1961–63 | 1961 | | 20.31 | 52 | |
| | | | | | 3 | 22.77 | 137 | [3] 1.10 |
| 31 | Hause Creek near Rimrock | 3.91 | 1955–63 | 1956 | | 7.24 | 46 | |
| | | | | | 3 | 7.59 | 55 | 50 |
| 32 | Firewater Canyon near Moxee City | 7.30 | | | 3 | 7.06 | 77 | 2 |
| 33 | Toppenish Creek near Fort Simcoe | 122 | 1909–24 | 1916 | | 5.52 | 1,680 | |
| | | | | | 3 | 2.55 | 840 | 3 |
| 34 | Simcoe Creek below Spring Creek near Fort Simcoe | 83 | 1909–23 | 1910 | | 7.2 | 1,750 | |
| | | | | | 3 | | 882 | [3] 1.42 |
| 35 | Toppenish Creek tributary near Toppenish | 1.24 | 1955-63 | 1956 | | 19.47 | 33 | |
| | | | | | 3 | 19.06 | 23 | 2 |
| 36 | Satus Creek tributary near Toppenish | 8.54 | 1953, 1956, 1961, 1963 | 1956 | | 52.22 | 955 | |
| | | | | | 3 | 45.72 | 553 | [3] 1.60 |
| 37 | Satus Creek near Toppenish | 270 | 1953, 1956 | 1956 | | | 9,300 | |
| | | | | | 3 | | 8,530 | [3] 1.67 |
| 38 | Dry Creek near Toppenish | 158 | | | 3 | | 7,440 | [3] 2.19 |
| 39 | Mule Dry Creek near Satus | 8.61 | | | 3 | | 3,300 | [3] 1.57 |
| 40 | Yakima River tributary near Sunnyside | 1.91 | 1954–63 | 1954 | | 15.32 | 234 | |
| | | | | | 3 | 8.26 | 52 | 6 |
| | **Esquatzel Coulee basin** | | | | | | | |
| 41 | Hatton Coulee tributary 2 near Cunningham | 2.44 | 1961–63 | 1961 | | | 7 | |
| | | | | | 5 | 7.12 | 29 | 6 |
| 42 | Dunningan Coulee near Connell | 27.1 | 1956, 1963 | 1956 | | 19.04 | 465 | |
| | | | | | 5 | 14.01 | 131 | 5 |
| | **Asotin Creek basin** | | | | | | | |
| 43 | Asotin Creek below Kearney Gulch near Asotin | 170 | 1904, 1929–1959, 1960–63 | 1904 | | [4] 4.3 | 1,180 | |
| | | | | | 3 | 3.75 | 420 | 3 |
| | **Dry Creek basin** | | | | | | | |
| 44 | Dry Creek at mouth near Clarkston | 6.83 | | | 4 | 12.26 | 198 | 4 |
| | **Alpowa Creek basin** | | | | | | | |
| 45 | Clayton Gulch near Alpowa | 5.60 | 1954, 1961–63 | 1954 | | | [5] 1,600 | |
| | | | | | 3 | 11.38 | 298 | 15 |

See footnotes at end of table.

TABLE 5.—*Flood stages and discharges, February 3–7, in southeastern Washington*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to February 1963 — Period | Prior to February 1963 — Year | February 1963 | Gage height (feet) | Discharge — Cfs | Discharge — Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Deadman Creek basin** | | | | | | | |
| 46 | South Fork Deadman Creek tributary near Pataha | 0.54 | 1961–63 | 1961 | | 8.27 | 91 | |
| | | | | | 3 | 7.30 | 65 | 40 |
| 47 | Smith Gulch tributary near Pataha | 1.85 | 1955–63 | 1961 | | 10.86 | 254 | |
| | | | | | 4 | 10.69 | 246 | [3] 1.36 |
| 48 | Deadman Creek above Meadow Creek near Central Ferry | 135 | | | 3 | | 5,200 | [3] 1.05 |
| 49 | Ben Day Gulch tributary near Pomeroy | .78 | 1961–63 | 1961 | | 7.72 | 43 | |
| | | | | | 4 | 7.29 | 32 | 3 |
| 50 | Meadow Creek near Central Ferry | 65.1 | | | 3 | 7.33 | 2,230 | 2.5 |
| | **Tucannon River basin** | | | | | | | |
| 51 | Tucannon River near Starbuck | 431 | 1915–17, 1929–31, 1959–63 | 1930 | | [7] 8.08 | 6,000 | |
| | | | | | 3 | 7.90 | 4,700 | 30 |
| 52 | Kellog Creek at Starbuck | 35.3 | | | 3 | 11.80 | 2,140 | [3] 1.24 |
| | **Palouse River basin** | | | | | | | |
| 53 | Palouse River near Colfax | 491 | 1948 | 1948 | | (1) | [6] 6,930 | |
| | | | 1956–63 | 1959 | | 8.18 | 6,310 | |
| | | | | | 3 | 9.10 | 8,030 | 5 |
| 54 | South Fork Palouse River at Pullman | 132 | 1910 | 1910 | | (1) | [7] 7,500 | |
| | | | 1934–42, 1948, 1959–63 | 1948 | | [8] 9.5 | 5,000 | |
| | | | | | 3 | 6.91 | 2,160 | 5 |
| 55 | Missouri Flat Creek tributary near Pullman | 1.22 | 1955–63 | 1956 | | [2] 11.92 | 139 | |
| | | | | | 3 | 12.78 | 234 | [3] 1.79 |
| 56 | Missouri Flat Creek at Pullman | 27.1 | 1935–40, 1948, 1959–63 | 1948 | | 6.3 | 1,500 | |
| | | | | | 3 | 4.70 | 915 | 12 |
| 57 | Fourmile Creek at Shawnee | 71.6 | 1910 | 1910 | | (8) | (1) | |
| | | | 1934–40, 1959 | 1959 | | 6.00 | 1,990 | |
| | | | | | 3 | 8.50 | [9] 2,140 | 15 |
| 58 | Palouse River below South Fork at Colfax | 797 | | | 3 | 16.49 | 14,500 | 15 |
| 59 | Palouse River tributary at Colfax | 2.10 | 1955–63 | 1956 | | 19.18 | 70 | |
| | | | | | 3 | 21.82 | 180 | 35 |
| 60 | Hardman Draw tributary near Plaza | 1.64 | 1955–63 | 1957 | | 15.85 | [10] 1,780 | |
| | | | | | 4 | 13.00 | 175 | 15 |
| 61 | Pine Creek at Pine City | 302 | 1962–63 | 1962 | | 9.08 | 1,220 | |
| | | | | | 3 | 20.9 | 10,800 | [3] 1.05 |
| 62 | Rock Creek near Ewan | 523 | 1904–05, 1915–17, 1959 | 1904 | | [2] 15.6 | 1,980 | |
| | | | | | 4 | 7.10 | 4,000 | 11 |
| 63 | Rock Creek at Ewan | 526 | 1948 | 1948 | | 16.4 | (1) | |
| | | | | | 4 | 17.5 | 4,330 | 15 |
| 64 | Cottonwood Creek at Cashup | 10.8 | 1948 | 1948 | | (11) | (1) | |
| | | | | | 3–4 | (1) | 580 | 11 |
| 65 | Pleasant Valley Creek at St. John | 38.2 | | | 3 | | [12] 2,220 | [3] 1.19 |
| 66 | Union Flat Creek near Colfax | 189 | 1954–63 | 1958 | | 5.52 | 2,080 | |
| | | | | | 3 | 10.58 | 2,260 | 10 |

See footnotes at end of table.

TABLE 5.—*Flood stages and discharges, February 3–7, in southeastern Washington*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to February 1963: Period | Year | February 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Palouse River basin—Continued** | | | | | | | |
| 67 | Palouse River at Hooper | 2,500 | 1897–1916, 1948, 1951–63 | 1910 | | [2] 22.00 | 29,800 | |
| | | | | | 4 | 19.13 | 33,500 | [3] 1.26 |
| 68 | Cow Creek tributary near Ritzville | 1.51 | 1951 | 1951 | | 11.97 | 195 | |
| | | | 1955–63 | 1956 | | 9.25 | 105 | |
| | | | | | 4 | 7.75 | 53 | 2 |
| 69 | Stewart Canyon tributary near Riparia | 1.27 | 1958–63 | 1958 | | 8.87 | 18 | |
| | | | | | 4 | 13.35 | 277 | (1) |
| | **Walla Walla River basin** | | | | | | | |
| 70 | Dry Creek near Walla Walla | 48.4 | 1949–63 | 1949 | | 11.6 | 3,340 | |
| | | | | | 3 | 5.93 | 855 | 4 |
| 71 | Hatley Creek near Dayton | 4.12 | 1955–63 | 1962 | | 15.15 | 189 | |
| | | | | | 4 | 16.58 | 244 | 20 |
| 72 | Davis Hollow near Dayton | 3.10 | 1956–63 | 1956 | | | 305 | |
| | | | | | 4 | 17.16 | 81 | 3 |
| 73 | Thorn Hollow near Dayton | 2.68 | 1962–63 | 1962 | | 6.30 | 80 | |
| | | | | | 4 | 8.60 | 202 | 30 |
| 74 | Badger Hollow near Clyde | 4.16 | 1955–63 | 1956 | | 10.13 | 227 | |
| | | | | | 4 | 10.53 | [13] 262 | [3] 1.08 |
| 75 | Walla Walla River tributary near Wallula | .80 | 1955–63 | 1958 | | 15.45 | 6 | |
| | | | | | 4 | 15.26 | 4 | 3 |
| | **Glade Creek basin** | | | | | | | |
| 76 | Glade Creek tributary near Bickelton | 0.5 | 1961–63 | 1961 | | 3.97 | 26 | |
| | | | | | 3 | 4.65 | 43 | 10 |
| 77 | Glade Creek near Mabton | 14.2 | | | 3 | | 965 | [3] 1.86 |
| | **Alder Creek basin** | | | | | | | |
| 78 | Alder Creek near Bickelton | 8.35 | | | 3 | 13.05 | 880 | [3] 2.55 |
| 79 | Alder Creek at Alderdale | 195 | | | 3 | 8.80 | 5,560 | [3] 1.51 |
| | **Rock Creek basin** | | | | | | | |
| 80 | Rock Creek near Goldendale | 65.3 | 1953, 1956, 1961 | 1956 | | | 2,870 | |
| | | | | | 3 | | 1,930 | [3] 1.14 |
| 81 | Rock Creek near Roosevelt | 213 | | | 3 | 19.8 | 3,940 | 40 |

[1] Not determined.
[2] Site and datum then in use.
[3] Ratio of peak discharge to 50-year flood.
[4] At site 2.5 miles upstream.
[5] At site 1 mile downstream.
[6] At site 4 miles downstream.
[7] From Corps of Engineers' data.
[8] Maximum known since 1910.
[9] Contracted-opening measurement 0.9 mile upstream.
[10] Largest known flood in 65 years.
[11] Exceeded only by 1963 flood in last 30 years.
[12] Largest known flood since at least 1915.
[13] Largest known flood since at least 1932.

309-939 O - 69 - 3

## FLOODS OF MARCH FROM ALABAMA TO WEST VIRGINIA AND OHIO

After HARRY H. BARNES, JR., (1964) and WILLIAM P. CROSS (1964)

A succession of three storms associated with low pressure systems moved northeastward from northern Alabama to West Virginia and Ohio during the period March 4–19. The area most severely affected and for which peak stage and discharge data are furnished in this report is shown in figure 9.

On March 5–6, from 2 to 3 inches of rain fell over most of the area and up to 6 inches fell in widely scattered areas. On March 11–12 the second storm, accompanied by high winds and scattered tornadoes, moved over the area. Some parts were deluged with 5 to 6 inches of rain in less than 24 hours. The third storm on March 16–19 produced up to 4 inches of rain over the Cumberland River basin and the upper Ohio River basin.

The three storms produce widespread, prolonged, and disastrous floods in Kentucky, Ohio, West Virginia, Tennessee, Virginia, North Carolina, Alabama, and Georgia. The first storm (March 5–6) produced record-breaking floods in a few streams draining the western slopes of the Great Smoky Mountains and in southern Ohio. The first storm also primed the entire area for the second storm (March 11–12), which produced record-breaking floods in the upper Cumberland River basin in Kentucky; in the Tennessee River basin tributaries in Tennessee, Virginia, North Carolina, and Alabama; in the Guyandotte River in West Virginia; and in the Big Sandy River tributaries in West Virginia and Kentucky. The period of flooding following the third storm on March 17 was prolonged on many streams in Kentucky, Virginia, and West Virginia.

Data of peak stages and discharges at 308 flood-determination sites (fig. 10) are given in table 6.

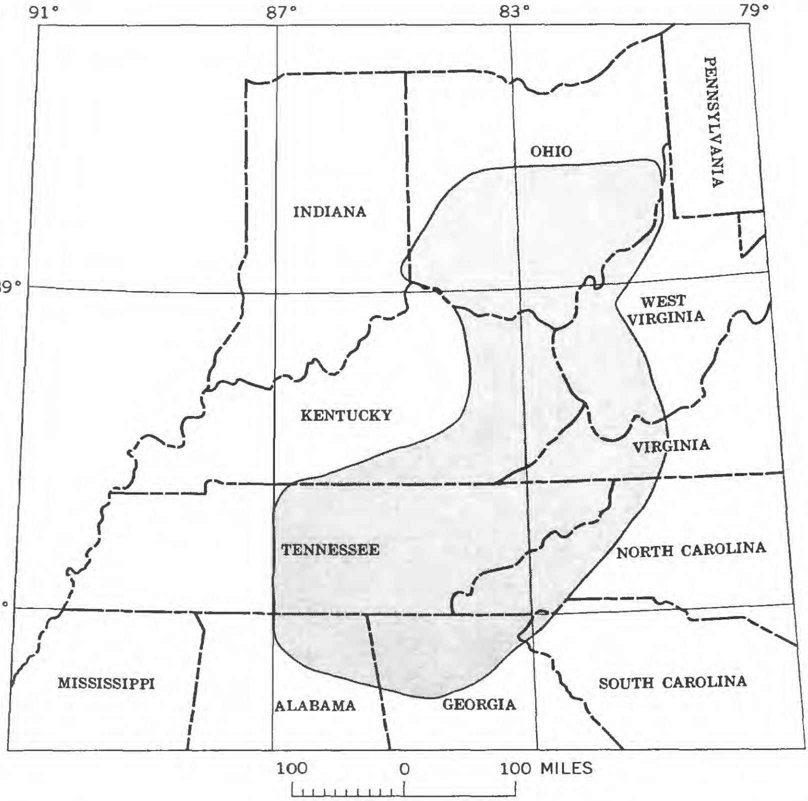
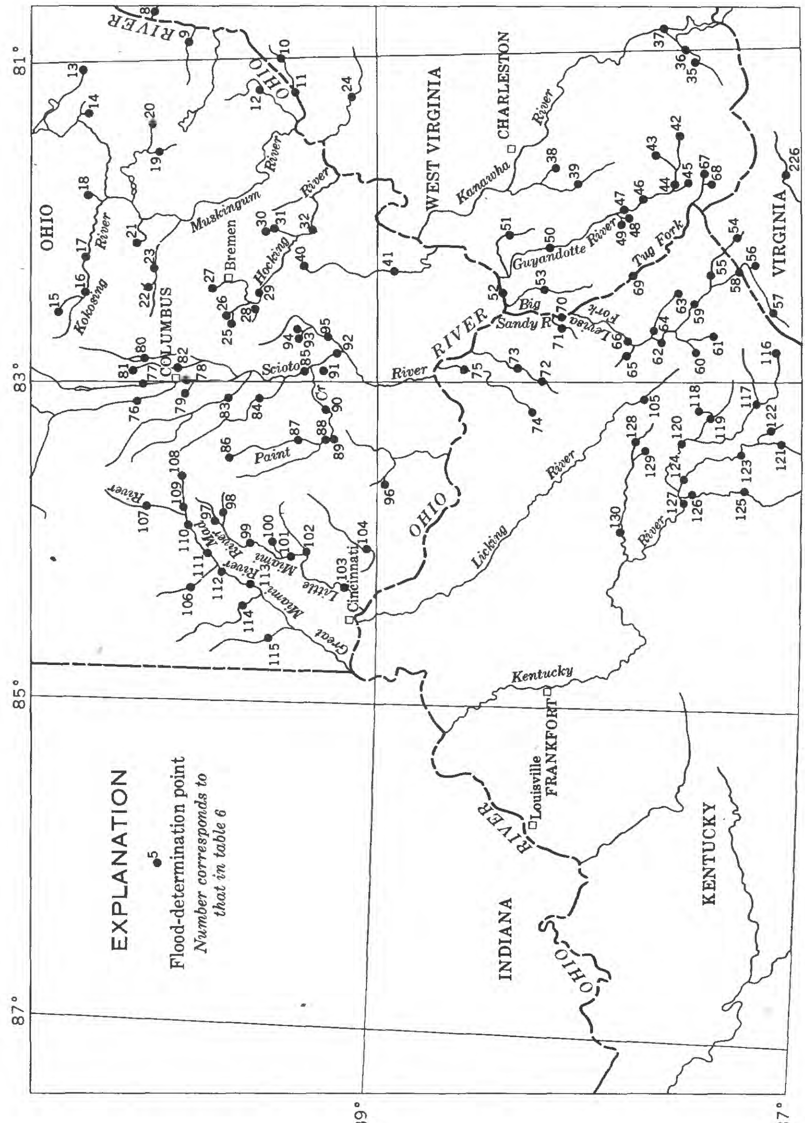



FIGURE 9.—Area flooded in March from Alabama to West Virginia and Ohio.


EXPLANATION
•5
Flood-determination point
Number corresponds to that in table 6
OHIO
WEST VIRGINIA
VIRGINIA
KENTUCKY
INDIANA
COLUMBUS
CHARLESTON
Bremen
Cincinnati
Louisville
FRANKFORT
OHIO RIVER
Kokosing River
Muskingum River
Hocking River
Scioto River
Paint Cr
Mad River
Great Miami River
Little Miami River
Licking River
Kentucky River
Kanawha River
Guyandotte River
Big Sandy R
Tug Fork
Levisa Fork
81°
83°
85°
87°
39°
37°

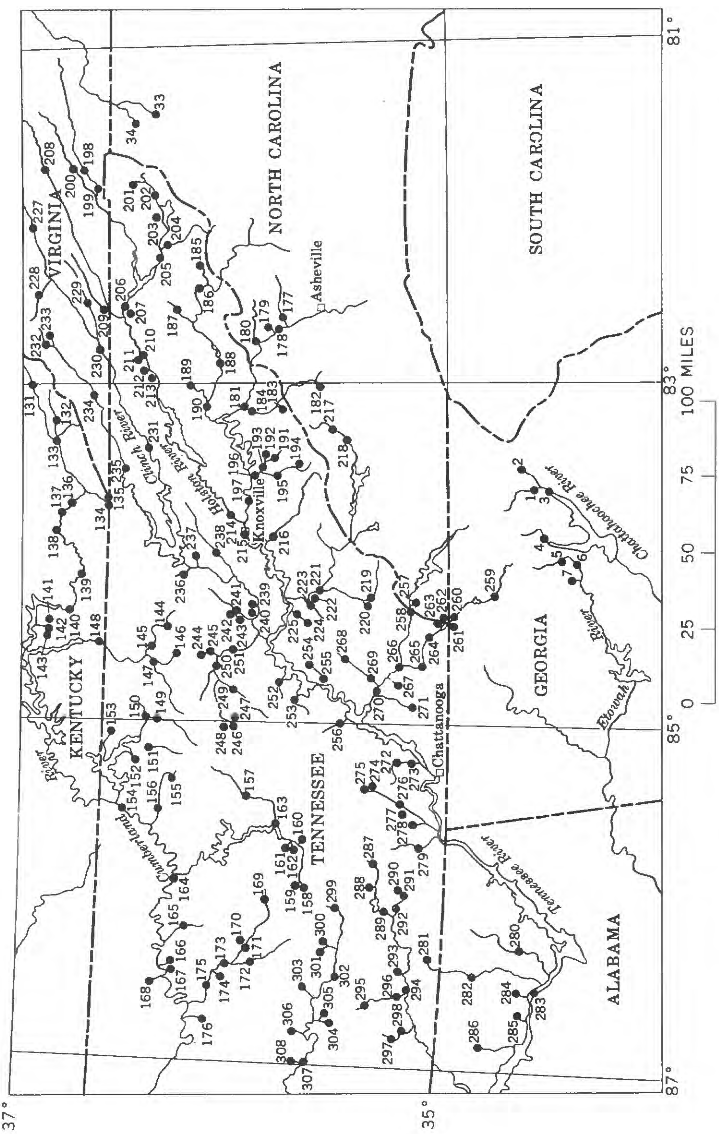



FIGURE 10.—Location of flood-determination points, floods of March, from Alabama to West Virginia and Ohio.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Prior to March 1963: Year | March 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Apalachicola River basin** | | | | | | | |
| 1 | Chattahoochee River near Leaf, Ga | 150 | 1940–63 | 1946 | | 13.6 | 14,100 | |
| | | | | | 12 | 14.8 | 16,200 | [1] 1.10 |
| 2 | Soque River near Demorest, Ga | 156 | 1870–1963 | 1949 | | 28.5 | 21,000 | |
| | | | | | 13 | 20.27 | 12,200 | 20 |
| 3 | Chattahoochee River near Cornelia, Ga | 315 | 1958–63 | 1962 | | 16.2 | 17,800 | |
| | | | | | 12 | 20.6 | 24,800 | [1] 1.10 |
| 4 | Chestatee River near Dahlonega, Ga | 153 | 1907–63 | 1907 | | [2] 25 | (3) | |
| | | | 1929–32, 1940–63 | 1946 | | 22.1 | 15,300 | |
| | | | | | 12 | 24.53 | 21,700 | [1] 1.45 |
| | **Mobile River basin** | | | | | | | |
| 5 | Etowah River near Dahlonega, Ga | 68 | 1950–63 | 1962 | | 13.9 | 9,000 | |
| | | | | | 12 | 11.76 | 3,000 | 2 |
| 6 | Etowah River near Dawsonville, Ga | 103 | 1940–63 | 1961 | | 16.18 | 5,010 | |
| | | | | | 12 | 15.62 | 4,810 | 3 |
| 7 | Shoal Creek near Dawsonville, Ga | 20.5 | 1959–63 | 1961 | | 7.60 | 2,380 | |
| | | | | | 12 | 11.85 | 6,160 | [1] 1.29 |
| | **Wheeling Creek basin** | | | | | | | |
| 8 | Wheeling Creek at Elm Grove, W. Va | 282 | 1941–63 | 1942 | | 13.67 | 22,100 | |
| | | | | | 5 | 13.5 | 21,500 | 40 |
| | **Captina Creek basin** | | | | | | | |
| 9 | Captina Creek at Armstrongs Mills, Ohio | 135 | 1927–35, 1959–63 | 1935 | | 14.40 | 10,500 | |
| | | | | | 4 | [4,5] 13.86 | 11,800 | [1] 1.19 |
| | **Middle Island Creek basin** | | | | | | | |
| 10 | Middle Island Creek at Little, W. Va | 458 | 1875–1922 | 1875 | | 33.5 | (3) | |
| | | | 1915–22, 1928–63 | 1950 | | 28.0 | 25,000 | |
| | | | | | 6 | 25.62 | 24,800 | 28 |
| | **Ohio River main stem** | | | | | | | |
| 11 | Ohio River at St. Marys, W. Va | 26,850 | 1884–1963 | 1913 | | 54.2 | (3) | |
| | | | 1938–63 | 1943 | | [5] 46.67 | 421,000 | |
| | | | | | 7 | [5] 37.28 | 266,000 | (3) |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Prior to March 1963: Year | March 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Little Muskingum River basin** | | | | | | | |
| 12 | Little Muskingum River at Bloomfield, Ohio | 210 | 1959–63 | 1959 | | 24.16 | 9,700 | |
| | | | | | 5 | 28.08 | 21,200 | [1]1.5 |
| | **Muskingum River basin** | | | | | | | |
| 13 | Conotton Creek at Jewett, Ohio | 14.1 | 1947–63 | 1952 | | 16.30 | 1,060 | |
| | | | | | 4 | 14.84 | 1,170 | 17 |
| 14 | Stillwater Creek at Uhrichsville, Ohio | 367 | 1913 | 1913 | | 15.5 | (3) | |
| | | | 1922–63 | 1935 | | 12.8 | 7,650 | |
| | | | | | 6 | 10.30 | [6]5,990 | (3) |
| 15 | North Branch Kokosing River near Fredericktown, Ohio | 45.0 | | 1959 | | 13.4 | (3) | |
| | | | | | 4 | 6.83 | 2,430 | 3 |
| 16 | Kokosing River at Mount Vernon, Ohio | 200 | 1953–63 | 1959 | | 18.19 | 38,000 | |
| | | | | | 4 | 12.99 | 10,100 | 9 |
| 17 | Kokosing River at Millwood, Ohio | 454 | 1922–63 | 1959 | | 34.00 | 75,900 | |
| | | | | | 5 | 20.79 | 25,600 | 27 |
| 18 | Mill Creek near Coshocton, Ohio | 27.2 | 1937–63 | 1957 | | 12.73 | 7,650 | |
| | | | | | 4 | 11.54 | 4,810 | [1]1.60 |
| 19 | Wills Creek at Cambridge, Ohio | 406 | 1935 | 1935 | | 25.4 | (3) | |
| | | | 1926–28, 1937–63 | 1945 | | 21.32 | [6]7,860 | |
| | | | | | 6 | [5]20.95 | [6]7,600 | (3) |
| 20 | Salt Fork near Cambridge, Ohio | 55.6 | 1957–63 | 1959 | | 11.2 | 1,960 | |
| | | | | | 5 | 11.90 | 3,890 | 10 |
| 21 | Wakatomika Creek near Frazeysburg, Ohio | 140 | 1937–63 | 1959 | | 13.15 | 13,700 | |
| | | | | | 5 | 12.60 | 12,400 | 37 |
| 22 | Log Pond Run at Newark, Ohio | 5.02 | | | 4 | | 619 | (3) |
| 23 | Licking River near Newark, Ohio | 536 | 1940–63 | 1959 | | 20.3 | 45,000 | |
| | | | | | 5 | 18.09 | 30,400 | 30 |
| | **Little Kanawha River basin** | | | | | | | |
| 24 | Hughes River at Cisko, W. Va | 452 | 1915–22, 1928–31, 1938–63 | 1950 | | 32.69 | 31,700 | |
| | | | | | 5 | 31.35 | 25,900 | 36 |
| | **Hocking River basin** | | | | | | | |
| 25 | Hunters Run at Lancaster, Ohio | 10.0 | 1948 | 1948 | | 15.4 | 11,200 | |
| | | | 1956–63 | 1959 | | | [6]1,250 | |
| | | | do | 1961 | | 6.03 | | |
| | | | | | 4 | 7.09 | [6]1,360 | (3) |
| 26 | Hocking River at Lancaster, Ohio | 48.2 | 1956–63 | 1961 | | 13.70 | [6]2,440 | |
| | | | | | 4 | 15.36 | [6]3,420 | (3) |
| 27 | Little Rush Creek near Rushville, Ohio | 30.1 | | | 4 | | 5,140 | [1]1.14 |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Year | March 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Hocking River basin—Continued** | | | | | | | |
| 28 | Clear Creek near Rockbridge, Ohio | 87.7 | 1940–63 | 1948 | | 17.68 | 16,000 | |
| | | | | | 4 | 13.68 | 7,170 | 20 |
| 29 | Hocking River at Enterprise, Ohio | 460 | 1907 | 1907 | | 22.0 | 36,000 | |
| | | | 1930–63 | 1940 | | 19.94 | 25,200 | |
| | | | | | 5 | 19.24 | 16,600 | 22 |
| 30 | Sunday Creek at Burr Oak, Ohio | 57.0 | 1952–63 | 1961 | | 691.50 | [6] 2,370 | |
| | | [7] 24.2 | | | 5 | 692.72 | [6] 3,690 | (3) |
| 31 | Sunday Creek at Glouster, Ohio | 104 | 1907 | 1907 | | 22.0 | (3) | |
| | | | 1952–63 | 1961 | | 15.40 | [6] 2,850 | |
| | | | | | 5 | 17.81 | [6] 7,020 | (3) |
| 32 | Hocking River at Athens, Ohio | 944 | 1907 | 1907 | | 26.7 | 50,000 | |
| | | | 1915–63 | 1945 | | 23.0 | 30,400 | |
| | | | | | 6 | 23.10 | 27,700 | 21 |
| | **Kanawha River basin** | | | | | | | |
| 33 | South Fork New River near Jefferson, N.C | 207 | 1916–63 | 1940 | | 22.50 | 52,800 | |
| | | | | | 13 | 7.60 | 6,400 | 2 |
| 34 | Buffalo Creek at Warrensville, N.C | 23 | 1940, 1955–63 | 1940 | | 27 | 8,400 | |
| | | | | | 12 | 15.94 | 2,000 | 5 |
| 35 | Camp Creek near Camp Creek, W. Va | 32.0 | 1946–63 | 1957 | | 6.35 | 3,410 | |
| | | | | | 12 | 6.33 | 3,380 | 43 |
| 36 | Bluestone River near Pipestem, W. Va | 363 | 1908–63 | 1957 | | 14.49 | 16,100 | |
| | | | | | 12 | 14.00 | 15,000 | 11 |
| 37 | New River at Hinton, W. Va | 6,257 | 1936–63 | 1940 | | 18.97 | [6] 246,000 | |
| | | | | | 12 | 8.14 | [6] 54,200 | (3) |
| 38 | Big Coal River at Ashford, W. Va | 383 | 1908–16, 1930–63 | 1916 | | 35.66 | 35,800 | |
| | | | | | 12 | 25.8 | 24,800 | 24 |
| 39 | Little Coal River at Danville, W. Va | 270 | 1930–63 | 1939 | | 30.2 | 42,800 | |
| | | | | | 12 | 25.86 | 23,500 | [1] 1.08 |
| | **Racoon Creek basin** | | | | | | | |
| 40 | Sandy Run near Lake Hope, Ohio | 4.99 | 1958–63 | 1958 | | 8.41 | 3,770 | |
| | | | | | 4 | 7.68 | 2,370 | (3) |
| 41 | Raccoon Creek at Adamsville, Ohio | 587 | 1937 | 1937 | | 25.2 | (3) | |
| | | | 1915–35, 1939–63 | 1948 | | 24.92 | 15,500 | |
| | | | | | 8 | 24.52 | 12,800 | 7 |
| | **Guyandotte River basin** | | | | | | | |
| 42 | Guyandotte River at Pineville, W. Va | 261 | | | 12 | 15.5 | 23,000 | [1] 1.09 |
| 43 | Clear Fork at Oceana, W. Va | 93.9 | | | 12 | | 10,100 | 50 |
| 44 | Guyandotte River near Justice, W. Va | 512 | | | 12 | 27.0 | 38,000 | [1] 1.10 |
| 45 | Little Huff Creek near Justice, W. Va | 40.9 | | | 12 | | 5,090 | 32 |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Year | March 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Guyandotte River basin—Continued** | | | | | | | |
| 46 | Guyandotte River at Man, W. Va | 762 | 1928–63 | 1934 | | | 40,000 | |
| | | | do | 1957 | | 22.25 | | |
| | | | | | 12 | 24.78 | 49,000 | [1] 1.06 |
| 47 | Guyandotte River at Logan, W. Va | 836 | | | 12 | 34.98 | 55,000 | [1] 1.12 |
| 48 | Island Creek near Logan, W. Va | 53.6 | | | 12 | | 4,250 | 20 |
| 49 | Copperas Mine Fork near Logan, W. Va | 14.4 | | | 12 | | 1,750 | (3) |
| 50 | Guyandotte River at Branchland, W. Va | 1,226 | 1907 | 1907 | | 44 | 43,500 | |
| | | | 1915–22, 1929–63 | 1955 | | [8] 42.57 | | |
| | | | do | 1957 | | | 40,400 | |
| | | | | | 13 | 43.83 | 44,500 | 27 |
| 51 | Mud River near Milton, W. Va | 256 | 1938–63 | 1939 | | 29.35 | | |
| | | | do | 1962 | | | 15,100 | |
| | | | | | 12 | 18.59 | 5,270 | <2 |
| | **Ohio River main stem** | | | | | | | |
| 52 | Ohio River at Huntington, W. Va | 55,900 | 1935–63 | 1937 | | [5] 69.45 | 654,000 | |
| | | | | | 8 | [5] 55.20 | 468,000 | (3) |
| | **Twelvepole Creek basin** | | | | | | | |
| 53 | Twelvepole Creek at Wayne, W. Va | 291 | 1939 | 1939 | | 31.03 | 22,000 | |
| | | | 1915–22, 1929–31, 1947–54, 1956–63 | 1962 | | 29.46 | 15,900 | |
| | | | | | 13 | 18.28 | 6,270 | <2 |
| | **Big Sandy River basin** | | | | | | | |
| 54 | Levisa Fork near Grundy, Va | 235 | 1942–63 | 1957 | | [9] 19.06 | 33,200 | |
| | | | | | 12 | 18.19 | 24,100 | 15 |
| 55 | Levisa Fork at Fishtrap, Ky | 386 | 1862–1963 | 1957 | | 33.9 | 33,000 | |
| | | | | | 12 | 31.91 | 30,400 | 16 |
| 56 | Russell Fork at Haysi, Va | 286 | 1926–63 | 1957 | | 23.17 | 46,600 | |
| | | | | | 12 | 21.10 | 33,800 | 27 |
| 57 | North Fork Pound River at Pound, Va | 18.6 | 1957, 1962–63 | 1957 | | 19 | (3) | |
| | | | | | 12 | 16.70 | 4,480 | (3) |
| 58 | Russell Fork at Elkhorn City, Ky | 554 | 1957–63 | 1957 | | 24.21 | 51,200 | |
| | | | | | 12 | 21.73 | 41,800 | 20 |
| 59 | Levisa Fork at Pikeville, Ky | 1,237 | 1862, 1903, 1908–63 | 1957 | | 52.72 | 85,500 | |
| | | | | | 12 | 50.00 | 76,000 | 21 |
| 60 | Right Fork Beaver Creek at Bosco, Ky | 126 | 1927–63 | 1927 | | (10) | | |
| | | | | | 12 | | 25,300 | [1] 1.47 |
| 61 | Left Fork Beaver Creek at Price, Ky | 33.0 | | | 12 | | 6,200 | 33 |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Prior to March 1963: Year | March 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Big Sandy River basin—Continued** | | | | | | | |
| 62 | Levisa Fork at Prestonsburg, Ky | 1,701 | 1862 | 1862 | | 49.4 | (3) | |
| | | | 1957–63 | 1957 | | 48.78 | 69,700 | |
| | | | | | 13 | 47.3 | 57,000 | 3 |
| 63 | Johns Creek near Meta, Ky | 55.8 | 1941–63 | 1957 | | 14.54 | 4,680 | |
| | | | | | 12 | 17.38 | 7,380 | [1] 1.06 |
| 64 | Johns Creek near Van Lear, Ky | 206 | 1940–63 | 1946 | | | 8,350 | |
| | | | do | 1957 | | [8] 27.88 | | |
| | | | | | 13 | [8] 26.10 | | |
| | | | | | 18 | | [6] 3,400 | (3) |
| 65 | Paint Creek at Staffordsville, Ky | 103 | 1950–63 | 1961 | | 31.41 | 17,400 | |
| | | | | | 12 | 17.77 | 5,030 | <2 |
| 66 | Levisa Fork at Paintsville, Ky | 2,143 | 1862 | 1862 | | 46.6 | (3) | |
| | | | 1915–16, 1929–63 | 1957 | | 45.92 | 69,700 | |
| | | | | | 14 | 44.20 | 58.100 | 15 |
| 67 | Tug Fork at Litwar, W. Va | 502 | 1930–63 | 1957 | | 21.60 | 35.700 | |
| | | | | | 12 | 17.89 | 28,300 | 20 |
| 68 | Panther Creek near Panther, W. Va | 30.8 | 1946–63 | 1957 | | 9.50 | 3,600 | |
| | | | | | 12 | 10.67 | 4,570 | 50 |
| 69 | Tug Fork near Kermit, W. Va | 1,185 | 1934–63 | 1957 | | 43.88 | 61,300 | |
| | | | | | 13 | 45.65 | 69,600 | [1] 1.59 |
| 70 | Big Sandy River at Louisa, Ky | 3,892 | 1939–63 | 1955 | | | 89,400 | |
| | | | do | 1958 | | 46.37 | | |
| | | | | | 14 | [5] 44.71 | 78,400 | 9 |
| 71 | Blaine Creek at Yatesville, Ky | 217 | 1915–20, 1938–63 | 1962 | | 29.64 | 21,000 | |
| | | | | | 12 | 17.50 | 5,050 | <2 |
| | **Little Sandy River basin** | | | | | | | |
| 72 | Little Sandy River at Leon, Ky | 255 | 1962–63 | 1962 | | 31.0 | 10,800 | |
| | | | | | 12 | 23.67 | 6,180 | <2 |
| 73 | Little Sandy River near Grayson, Ky | 402 | 1884–1963 | 1950 | | [5] 27.53 | 24,500 | |
| | | | | | 12 | 20.82 | 9,380 | <2 |
| 74 | Tygarts Creek at Olive Hill, Ky | 59.6 | 1957–63 | 1958 | | 14.20 | | |
| | | | do | 1962 | | | 7,310 | |
| | | | | | 12 | 15.01 | 8,970 | [1] 1.69 |
| 75 | Tygarts Creek near Greenup, Ky | 242 | 1941–63 | 1962 | | 21.38 | 14,800 | |
| | | | | | 13 | 17.10 | 6,900 | <2 |
| | **Scioto River basin** | | | | | | | |
| 76 | Scioto River below O'Shaughnessy Dam near Dublin, Ohio | 988 | 1913 | 1913 | | 24.6 | 74,500 | |
| | | | 1921–63 | 1959 | | 22.04 | [6] 55,200 | |
| | | | | | 5 | [4] 14.74 | | |
| | | | | | 6 | | [6] 22,700 | (3) |
| 77 | Olentangy River near Worthington, Ohio | 493 | 1956–63 | 1959 | | 15.68 | [6] 16,500 | |
| | | | | | 4 | 11.68 | [6] 7,340 | (3) |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963 — Period | Prior to March 1963 — Year | March 1963 | Gage height (feet) | Discharge — Cfs | Discharge — Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Scioto River basin—Continued** | | | | | | | |
| 78 | Scioto River at Columbus, Ohio | 1,624 | 1913 | 1913 | | [11] 25.9 | 138,000 | |
| | | | 1921–63 | 1959 | | 27.22 | [6] 68,200 | |
| | | | | | 5 | 23.47 | [6] 34,600 | (3) |
| 79 | Scioto Big Run at Briggsdale, Ohio | 11.0 | 1947–63 | 1959 | | 12.09 | 2,920 | |
| | | | | | 4 | 10.3 | 2,260 | 7 |
| 80 | Big Walnut Creek at Central College, Ohio | 190 | 1938–63 | 1959 | | 19.75 | [6] 22,800 | |
| | | | | | 5 | 12.07 | [6] 5,910 | (3) |
| 81 | Alum Creek at Africa, Ohio | 120 | | | 5 | 14.2 | 6,460 | 7 |
| 82 | Alum Creek at Columbus, Ohio | 190 | 1923–35, 1938–63 | 1959 | | 19.59 | 26,400 | |
| | | | | | 5 | 15.17 | 12,500 | 44 |
| 83 | Big Darby Creek at Darbyville, Ohio | 533 | 1922–35, 1938–63 | 1959 | | 17.94 | 49,000 | |
| | | | | | 6 | 13.92 | 17,600 | 6 |
| 84 | Deer Creek at Williamsport, Ohio | 331 | 1927–35, 1938–56, 1959–63 | 1959 | | 17.6 | 39,600 | |
| | | | | | 5 | 17.5 | 37,600 | [1] 1.10 |
| 85 | Scioto River at Chillicothe, Ohio. | 3,847 | 1913 | 1913 | | 39.8 | 260,000 | |
| | | | 1921–63 | 1959 | | 32.50 | [6] 144,000 | |
| | | | | | 6 | 25.25 | [6] 77,000 | (3) |
| 86 | East Fork Paint Creek near Sedalia, Ohio. | 4.23 | 1947–63 | 1959 | | 14.47 | 515 | |
| | | | | | 4 | 14.49 | 462 | 23 |
| 87 | Paint Creek near Greenfield, Ohio. | 251 | 1926–35, 1940–56, 1959–63 | 1959 | | 11.0 | 14,500 | |
| | | | | | 5 | 12.2 | 15,600 | 21 |
| 88 | Paint Creek at damsite near Bainbridge, Ohio. | 573 | | | 5 | 26.5 | 42,300 | (3) |
| 89 | Rocky Fork near Barretts Mills, Ohio. | 141 | 1940–63 | 1945 | | 15.56 | 13,200 | |
| | | | | | 4 | 12.44 | [6] 7,170 | (3) |
| 90 | Paint Creek near Bourneville, Ohio. | 808 | 1922–63 | 1945 | | 19.2 | 52,100 | |
| | | | | | 5 | 20.08 | [6] 52,700 | 28 |
| 91 | Indian Creek at Massieville, Ohio. | 9.71 | 1947–63 | 1953 | | 16.95 | 5,640 | |
| | | | | | 4 | 17.81 | 4,510 | [1] 1.08 |
| 92 | Scioto River at Higby, Ohio | 5,129 | 1913 | 1913 | | 31.6 | (3) | |
| | | | 1931–63 | 1937 | | [5] 26.4 | 177,000 | |
| | | | | | 6 | 23.55 | [6] 105,000 | (3) |
| 93 | West Branch Tar Hollow Creek at Tar Hollow State Park, Ohio. | .30 | 1950–63 | 1958 | | 5.72 | 42 | |
| | | | | | 4 | 5.87 | 62 | (3) |
| 94 | Tar Hollow Creek at Tar Hollow State Park, Ohio. | 1.35 | 1947–63 | 1958 | | 5.62 | 374 | |
| | | | | | 4 | 5.3 | 251 | 20 |
| 95 | Salt Creek near Londonderry, Ohio | 267 | | | 5 | 22.7 | 31,600 | [1] 1.96 |
| | **Ohio Brush Creek basin** | | | | | | | |
| 96 | West Branch Turkey Run near Winchester, Ohio | .89 | 1956–63 | 1956 | | 19.3 | 720 | |
| | | | | | 19 | 13.69 | 301 | (3) |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Prior to March 1963: Year | March 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Little Miami River basin** | | | | | | | |
| 97 | Little Miami River near Oldtown, Ohio | 129 | 1952–63 | 1959 | | 12.20 | 14,800 | |
| | | | | | 4 | 12.18 | 14,600 | [1] 1.52 |
| 98 | Massies Creek at Wilberforce, Ohio | 64.3 | 1953–63 | 1959 | | 11.25 | 7,300 | |
| | | | | | 4 | 11.25 | 7,300 | [1] 1.27 |
| 99 | Little Miami River at Spring Valley, Ohio | 361 | 1926–35, 1940–52, 1959 | 1959 | | 19.0 | 36,400 | |
| | | | | | 5 | 19.14 | 38,000 | [1] 1.88 |
| 100 | Caesar Creek at Harveysburg, Ohio | 202 | 1959–63 | 1959 | | 20.5 | (3) | |
| | | | 1961–63 | 1961 | | 14.35 | 12,900 | |
| | | | | | 5 | 15.63 | 14,900 | 19 |
| 101 | Little Miami River near Fort Ancient, Ohio | 677 | 1939–52, 1959 | 1959 | | 21.9 | 67,000 | |
| | | | | | 5 | 20.2 | 54,000 | [1] 1.29 |
| 102 | Todd Fork near Roachester, Ohio | 219 | 1953–63 | 1959 | | 19.50 | 25,500 | |
| | | | | | 4 | 18.82 | 20,600 | [1] 1.10 |
| 103 | Little Miami River at Milford, Ohio | 1,195 | 1913 | 1913 | | 25.5 | (3) | |
| | | | 1915–20, 1925–63 | 1959 | | 22.30 | 84,100 | |
| | | | | | 5 | 19.23 | 59,300 | 34 |
| 104 | East Fork Little Miami River at Williamsburg, Ohio | 238 | 1949–53, 1959–63 | 1959 | | 12.2 | 14,000 | |
| | | | | | 5 | 14.34 | 18,000 | 7 |
| | **Licking River basin** | | | | | | | |
| 105 | Licking River near Salyersville, Ky | 140 | 1939–63 | 1939 | | 25.4 | 14,300 | |
| | | | | | 12 | 20.52 | 6,230 | 5 |
| | **Great Miami River basin** | | | | | | | |
| 106 | Stillwater River at Englewood, Ohio | 646 | 1913 | 1913 | | (3) | 85,400 | |
| | | | 1926–63 | 1958 | | 80.88 | [6] 9,980 | |
| | | | | | 6 | 79.09 | [6] 9,370 | (3) |
| 107 | Mad River near Urbana, Ohio | 162 | 1926–31, 1940–63 | 1959 | | 12.05 | 8,000 | |
| | | | | | 5 | 11.84 | 7,660 | 22 |
| 108 | Beaver Creek at Brighton, Ohio | 3.33 | 1961–63 | 1961 | | 9.77 | 156 | |
| | | | | | 4 | 11.28 | 430 | (3) |
| 109 | Buck Creek at Springfield, Ohio | 139 | 1913, 1915–21, 1924–63 | 1929 | | 14.3 | 13,000 | |
| | | | | | 4 | 11.20 | 10,400 | [1] 1.04 |
| 110 | Mad River near Springfield, Ohio | 490 | 1904–05, 1913–63 | 1913 | | 16.9 | 55,400 | |
| | | | | | 5 | 14.43 | 22,400 | 27 |
| 111 | Mad River near Dayton, Ohio | 635 | 1913–63 | 1913 | | [9] 14.0 | 75,700 | |
| | | | | | 5 | 86.21 | [6] 18,500 | (3) |
| 112 | Great Miami River at Dayton, Ohio | 2,513 | 1893–1963 | 1913 | | [9] 29.0 | 250,000 | |
| | | | | | 6 | 33.74 | [6] 47,500 | (3) |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Maximum floods: Prior to March 1963: Year | Maximum floods: March 1963 | Maximum floods: Gage height (feet) | Maximum floods: Discharge: Cfs | Maximum floods: Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Great Miami River basin—Continued** | | | | | | | |
| 113 | Great Miami River at Miamisburg, Ohio | 2,718 | 1913 | 1913 | | (3) | 257,000 | |
| | | | 1916–20, 1925–35, 1953–63 | 1959 | | 20.65 | [6] 61,800 | |
| | | | | | 6 | 19.36 | [6] 53 200 | (3) |
| 114 | Twin Creek near Germantown, Ohio | 275 | 1913–23, 1927–63 | 1913 | | [9] 18.3 | 66,000 | |
| | | | | | 5 | 28.33 | [6] 8 400 | (3) |
| 115 | Sevenmile Creek at Collinsville, Ohio | 121 | 1913 | 1913 | | 14.6 | (3) | |
| | | | 1959–63 | 1959 | | 11.08 | 16,600 | |
| | | | | | 4 | 9.68 | 11,400 | 9 |
| | **Kentucky River basin** | | | | | | | |
| 116 | North Fork Kentucky River at Whitesburg, Ky | 66.4 | 1957–63 | 1957 | | 14.7 | 7,730 | |
| | | | | | 12 | 13.05 | 6,240 | 5 |
| 117 | North Fork Kentucky River at Hazard, Ky | 466 | 1940–63 | 1957 | | 37.54 | 47,800 | |
| | | | | | 12 | 35.00 | 43 700 | 50 |
| 118 | Bear Branch near Noble, Ky | 2.21 | 1955–63 | 1962 | | 3.36 | 415 | |
| | | | | | 11 | 3.23 | 382 | 3 |
| 119 | Troublesome Creek at Noble, Ky | 177 | 1939 | 1939 | | 29 | (3) | |
| | | | 1950–63 | 1962 | | 26.86 | 18 300 | |
| | | | | | 12 | 29.75 | 22,800 | [1] 1.04 |
| 120 | North Fork Kentucky River at Jackson, Ky | 1,101 | 1905–07, 1917–21, 1927–31, 1935–63 | 1939 | | 43.10 | | |
| | | | do | 1957 | | | 53 500 | |
| | | | | | 12 | | 43 400 | 3 |
| | | | | | 13 | 37.17 | | |
| 121 | Middle Fork Kentucky River near Hyden, Ky | 202 | 1957–63 | 1957 | | 33.3 | 60,000 | |
| | | | | | 12 | 26.13 | 37,400 | [1] 1.56 |
| 122 | Cutshin Creek at Wooton, Ky | 61.3 | 1957 | 1957 | | 19.43 | (3) | |
| | | | 1958–63 | 1959 | | 9.60 | 4 840 | |
| | | | | | 12 | 16.23 | 14 200 | [1] 1.40 |
| 123 | Middle Fork Kentucky River at Buckhorn, Ky | 420 | 1957–63 | 1957 | | 43.1 | 82,300 | |
| | | | | | 19 | 13.76 | [6] 6,200 | (3) |
| 124 | Middle Fork Kentucky River at Tallega, Ky | 537 | 1929, 1931–32, 1935, 1937, 1939–63 | 1957 | | 43.33 | 52,700 | |
| | | | | | 12 | 22.86 | [6] 7,320 | (3) |
| 125 | South Fork Kentucky River at Oneida, Ky | 486 | 1957–63 | 1957 | | 40.19 | 53 000 | |
| | | | | | 12 | 36.89 | 43 800 | 39 |
| 126 | South Fork Kentucky River at Booneville, Ky | 722 | 1925–31, 1937, 1939–63 | 1957 | | [5] 43.40 | 66,100 | |
| | | | | | 12 | | 48 800 | 18 |
| | | | | | 13 | 39.85 | | |
| 127 | Kentucky River at lock 14 at Heidelberg, Ky | 2,657 | 1921–63 | 1939 | | 35.6 | 120 000 | |
| | | | | | 13 | 25.87 | [6] 69 400 | (3) |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Year | March 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Kentucky River basin—Continued** | | | | | | | |
| 128 | Red River near Hazel Green, Ky | 65.8 | 1954–63 | 1962 | | 22.12 | 9,080 | |
| | | | | | 12 | 9.66 | 2,780 | <2 |
| 129 | Stillwater Creek at Stillwater, Ky | 24.0 | 1954–63 | 1962 | | 17.43 | 7,390 | |
| | | | | | 11 | 10.82 | 2,610 | 10 |
| 130 | Red River at Clay City, Ky | 362 | 1931–32, 1937–63 | 1962 | | 23.90 | 22,600 | |
| | | | | | 13 | 17.75 | 8,480 | <2 |
| | **Cumberland River basin** | | | | | | | |
| 131 | Poor Fork at Cumberland, Ky | 82.3 | 1940–63 | 1957 | | 11.50 | 11,800 | |
| | | | | | 12 | 9.75 | 8,740 | 9 |
| 132 | Clover Fork at Evarts, Ky | 82.4 | 1958–63 | 1962 | | 7.50 | 6,550 | |
| | | | | | 12 | 12.37 | 14,100 | 39 |
| 133 | Cumberland River near Harlan, Ky | 374 | 1940–63 | 1946 | | 22.81 | 37,900 | |
| | | | | | 12 | 24.89 | 43,100 | 30 |
| 134 | Yellow Creek bypass at Middlesboro, Ky | 35.3 | 1940–63 | 1952 | | 5.00 | 7,200 | |
| | | | | | 12 | 4.01 | 4,660 | 10 |
| 135 | Yellow Creek near Middlesboro, Ky | 58.2 | 1941–63 | 1946 | | 20.92 | 6,160 | |
| | | | | | 12 | 18.09 | 5,830 | 6 |
| 136 | Cumberland River at Pineville, Ky | 676 | 1929–31, 1957 | 1957 | | 32.62 | 45,000 | |
| | | | | | 12–13 | 36.50 | [3] | [3] |
| 137 | Cumberland River near Pineville, Ky | 809 | 1929, 1939–63 | 1946 | | 49.31 | 57,900 | |
| | | | | | 13 | 47.93 | 48,900 | 6 |
| 138 | Cumberland River at Barbourville, Ky | 960 | 1946 | 1946 | | 42.8 | [3] | |
| | | | 1923–31, 1948–63 | 1927 | | | 47,900 | |
| | | | do | 1957 | | 42.28 | | |
| | | | | | 13 | 41.43 | 45,600 | 4 |
| 139 | Cumberland River at Williamsburg, Ky | 1,607 | 1918–63 | 1946 | | 34.2 | [3] | |
| | | | 1951–63 | 1957 | | 33.78 | 49,700 | |
| | | | | | 14 | 29.19 | 36,800 | 7 |
| 140 | Cumberland River at Cumberland Falls, Ky | 1,977 | 1916–63 | 1918 | | 15.5 | 59,600 | |
| | | | | | 12 | 11.78 | 38,800 | 2 |
| 141 | Cane Branch near Parkers Lake, Ky | .67 | 1956–63 | 1957 | | [4] 2.43 | 198 | |
| | | | | | 11 | 1.67 | 127 | [3] |
| 142 | West Fork Cane Branch near Parkers Lake, Ky | .26 | 1956–63 | 1957 | | 2.20 | 129 | |
| | | | | | 11 | 1.07 | 24 | [3] |
| 143 | Helton Branch at Greenwood, Ky | .85 | 1956–63 | 1962 | | 1.45 | 182 | |
| | | | | | 11 | 1.35 | 130 | [3] |
| 144 | Brimstone Creek at Walker Bridge near Robbins, Tenn | 48.7 | 1954–63 | 1957 | | 20.35 | [3] | |
| | | | | | 12 | 18.32 | 7,100 | 6 |
| 145 | New River at New River, Tenn | 382 | 1929 | 1929 | | [3] | 74,700 | |
| | | | 1935–63 | 1939 | | 33.58 | 44,300 | |
| | | | | | 12 | 29.06 | 35,300 | 5 |

See footnote at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Year | March 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Cumberland River basin—Continued** | | | | | | | |
| 146 | White Oak Creek at Sunbright, Tenn. | 13.5 | 1929, 1932–63 | 1929 | | 17.45 | 4,900 | |
| | | | | | 11 | 13.36 | 2,740 | 17 |
| 147 | Clear Fork near Robbins, Tenn. | 272 | 1929 | 1929 | | [9] 22.1 | (3) | |
| | | | 1931–63 | 1939 | | [9] 18.5 | 34,000 | |
| | | | | | 12 | 16.25 | 25,900 | 5 |
| 148 | South Fork Cumberland River near Stearns, Ky. | 954 | 1929 | 1929 | | 52.9 | (3) | |
| | | | 1943–63 | 1948 | | 38.50 | 69,600 | |
| | | | | | 12 | 36.45 | 62,100 | 4 |
| 149 | East Fork Obey River near Jamestown, Tenn. | 202 | 1929 | 1929 | | 30.7 | (3) | |
| | | [7] 196 | 1943–63 | 1948 | | 27.20 | 28,300 | |
| | | | | | 12 | 26.71 | 30,800 | 19 |
| 150 | Puncheon Camp Creek at Allred, Tenn. | 15.5 | 1954–63 | 1955 | | 11.38 | (3) | |
| | | | | | 17 | 9.27 | (3) | (3) |
| 151 | West Fork Obey River near Alpine, Tenn. | 115 | 1943–63 | 1955 | | 16.30 | 15,100 | |
| | | [7] 81 | | | 17 | 14.40 | 12,100 | 9 |
| 152 | Big Eagle Creek near Livingston, Tenn. | 7.98 | 1954–63 | 1962 | | 6.23 | 1,170 | |
| | | | | | 17 | 5.37 | 1,000 | (3) |
| 153 | Wolf River near Byrdstown, Tenn. | 106 | 1929 | 1929 | | 10.8 | (3) | |
| | | | 1943–63 | 1957 | | 10.84 | 22,600 | |
| | | | | | 12 | 9.21 | 13,800 | 7 |
| 154 | Cumberland River at Celina, Tenn. | 7,320 | 1793–1963 | 1826 | | 59.2 | (3) | |
| | | | 1923–63 | 1926 | | [5] 57.25 | 145,000 | |
| | | | | | 17 | [5] 27.30 | [6] 49,300 | (3) |
| 155 | Mathews Branch tributary near Livingston, Tenn. | .49 | 1954–63 | 1956 | | 5.54 | 273 | |
| | | | | | 17 | 5.85 | 297 | (3) |
| 156 | Roaring River near Hilham, Tenn. | 78.7 | 1932–63 | 1962 | | 12.02 | 8,530 | |
| | | [7] 51.6 | | | 17 | 12.98 | 9,770 | 42 |
| 157 | Calfkiller River below Sparta, Tenn. | 175 | 1929 | 1929 | | (3) | 25,000 | |
| | | [7] 111 | 1941–63 | 1949 | | 25.80 | 14,600 | |
| | | | | | 12 | 25.04 | 13,500 | (3) |
| 158 | Barren Fork near Trousdale, Tenn. | 126 | 1933–63 | 1948 | | 16.99 | 32,000 | |
| | | | | | 12 | 15.23 | 23,900 | 29 |
| 159 | Owen Branch near Centertown, Tenn. | 4.60 | 1954–63 | 1955 | | 7.0 | 2,860 | |
| | | | | | 12 | 4.45 | (3) | (3) |
| 160 | Collins River near McMinnville, Tenn. | 642 | 1854, 1925–63 | 1929 | | 39.1 | 73,300 | |
| | | | | | 12 | 30.53 | 43,400 | 8 |
| 161 | Sink tributary at McMinnville, Tenn. | .47 | 1954–63 | 1961 | | 7.94 | 520 | |
| | | | | | 12 | 7.0 | 438 | (3) |
| 162 | Charles Creek at Faulkner Springs near McMinnville, Tenn. | 31.1 | 1952 | 1952 | | (3) | 23,100 | |
| | | | 1954–63 | 1955 | | 13.00 | 8,950 | |
| | | | | | 12 | 13.68 | 10,800 | [1] 1.59 |
| 163 | Caney Fork near Rock Island, Tenn. | 1,678 | 1912–63 | 1929 | | 40.6 | 210,000 | |
| | | | | | 12 | 26.28 | [6] 98,500 | (3) |
| 164 | Cumberland River at Carthage, Tenn. | 10,700 | 1793–1963 | 1926 | | [5] 59.8 | 210,000 | |
| | | | | | 17 | [5] 32.49 | [6] 83,400 | (3) |
| 165 | Spring Creek near Lebanon, Tenn. | 35.3 | 1954–63 | 1962 | | 10.65 | 9,140 | |
| | | | | | 16 | 10.73 | 9,330 | [1] 1.38 |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963, Period | Prior to March 1963, Year | March 1963 | Gage height (feet) | Discharge, Cfs | Discharge, Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Cumberland River basin—Continued** | | | | | | | |
| 166 | Spencer Creek near Lebanon, Tenn | 3.32 | 1954–63 | 1957 | | 8.4 | 2,220 | |
| | | | | | 16 | 7.64 | 1,540 | (3) |
| 167 | Cedar Creek tributary at Green Hill, Tenn | .86 | 1954–63 | 1957 | | 5.4 | 331 | |
| | | | | | 16 | 4.67 | 263 | (3) |
| 168 | Drakes Creek above Hendersonville, Tenn | 19.2 | 1954–63 | 1957 | | | 3,370 | |
| | | | do | 1962 | | [8,9] 10.70 | | |
| | | | | | 16 | 5.55 | | |
| 169 | East Fork Stones River at Woodbury, Tenn | 39.1 | | | 11 | [12] 16.52 | 5,710 | 23 |
| 170 | Bradley Creek at Lascassas, Tenn | 37.0 | 1954–63 | 1955 | | 10.66 | 12,800 | |
| | | | | | 11 | 10.03 | 11,000 | [1] 1.54 |
| 171 | East Fork Stones River near Lascassas, Tenn | 262 | 1902–63 | 1955 | | 34.07 | 21,300 | |
| | | | | | 12 | 34.22 | 21,500 | 3 |
| 172 | West Fork Stones River near Murfreesboro, Tenn | 128 | 1902 | 1902 | | 25.0 | 50,000 | |
| | | [7] 125 | 1932–63 | 1948 | | 22.73 | 38,000 | |
| | | | | | 12 | 19.80 | 24,900 | 31 |
| 173 | Stones River near Smyrna, Tenn | 571 | 1902 | 1902 | | 43.4 | 60,000 | |
| | | | 1925–63 | 1948 | | 41.03 | 54,100 | |
| | | | | | 12 | [5] 34.51 | 39,400 | 8 |
| 174 | Stewart Creek near Smyrna, Tenn | 69.7 | 1952–63 | 1955 | | 17.61 | 8,700 | |
| | | | | | 11 | 12.48 | 4,410 | 2 |
| 175 | Stones River above Donelson, Tenn | 830 | 1902 | 1902 | | 59.6 | 73,000 | |
| | | | 1939–63 | 1948 | | [5] 58.46 | 68,700 | |
| | | | | | 12 | | 39,700 | 3 |
| | | | | | 13 | 49.30 | | |
| 176 | Mill Creek near Antioch, Tenn | 64.0 | 1953–63 | 1955 | | 19.73 | 17,000 | |
| | | | | | 11 | 14.80 | 7,220 | 20 |
| | **Tennessee River basin** | | | | | | | |
| 177 | Ivy River near Marshall, N.C. | 158 | 1934–63 | 1940 | | 12.67 | 8,880 | |
| | | | | | 12 | 14.35 | 13,300 | [1] 1.21 |
| 178 | French Broad River at Marshall, N.C. | 1,332 | 1791–1963 | 1916 | | 22.0 | 115,000 | |
| | | | | | 12 | 11.10 | 37,800 | 14 |
| 179 | Brush Creek at Walnut, N.C. | 7.96 | 1954–63 | 1954 | | 15.23 | 1,190 | |
| | | | | | 12 | 16.82 | 1,400 | [1] 1.39 |
| 180 | Big Laurel Creek near Stackhouse, N.C. | 126 | 1934–63 | 1957 | | 8.15 | 7,700 | |
| | | | | | 6 | 9.20 | 9,940 | [1] 1.09 |
| 181 | French Broad River near Newport, Tenn | 1,858 | 1867 | 1867 | | 24 | 110,000 | |
| | | | 1901, 1903–05, 1921–63 | 1940 | | 19.25 | 76,300 | |
| | | | | | 13 | 16.75 | 60,600 | 22 |
| 182 | Cataloochee Creek near Cataloochee, N.C. | 49.2 | 1934–52, 1963 | 1940 | | 7.01 | 3,390 | |
| | | | | | 6 | 8.08 | 5,080 | [1] 1.17 |
| 183 | Cosby Creek near Cosby, Tenn | 10.2 | 1958–63 | 1959 | | 4.59 | (3) | |
| | | | | | 12 | 5.06 | (3) | (3) |
| 184 | Pigeon River at Newport, Tenn | 666 | 1901–29, 1945–46, 1949–63 | 1902 | | 21.4 | 50,000 | |
| | | | | | 12 | 15.36 | 35,500 | 8 |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Year | March 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Tennessee River basin—Continued** | | | | | | | |
| 185 | North Indian Creek near Unicoi, Tenn. | 15.9 | 1945–57, 1959–63 | 1962 | | 4.39 | 559 | |
| | | | | | 12 | 4.64 | 619 | <2 |
| 186 | Nolichucky River at Embreeville, Tenn. | 805 | 1901–63 | 1901 | | ([3]) | 120,000 | |
| | | | | | 12 | 12.76 | 47,900 | 38 |
| 187 | Muddy Fork at Fairview, Tenn. | 9.86 | 1954–63 | 1962 | | 6.51 | ([8]) | |
| | | | | | 12 | 5.00 | ([8]) | ([8]) |
| 188 | Nolichucky River below Nolichucky Dam, Tenn. | 1,184 | 1901 | 1901 | | 38 | ([8]) | |
| | | | 1903–09, 1919–25, 1946–63 | 1906 | | [9] 19.3 | 73,500 | |
| | | | | | 13 | 21.30 | 52,100 | 19 |
| 189 | Lick Creek at Mohawk, Tenn. | 220 | 1946–63 | 1950 | | 16.24 | 10,700 | |
| | | | | | 12 | 17.35 | 12,200 | 13 |
| 190 | Nolichucky River near Morristown, Tenn. | 1,679 | 1901 | 1901 | | 26 | 85,000 | |
| | | | 1920–63 | 1940 | | 22.68 | 61,900 | |
| | | | | | 13 | 23.05 | 60,700 | 29 |
| 191 | Little Pigeon River near Sevierville, Tenn. | 110 | 1954–63 | 1957 | | 16.23 | ([8]) | |
| | | | | | 12 | 16.94 | 9,910 | 14 |
| 192 | East Fork Little Pigeon River near Sevierville, Tenn. | 64.1 | 1954–63 | 1961 | | 15.76 | 5,140 | |
| | | | | | 12 | 19.28 | 7,950 | 27 |
| 193 | Little Pigeon River above West Prong at Sevierville, Tenn. | 201 | 1954–63 | 1961 | | 15.53 | 15,700 | |
| | | | | | 12 | 16.98 | 23,500 | 50 |
| 194 | Hog Pen Branch near Gatlinburg, Tenn. | .61 | 1958–63 | 1961 | | 2.29 | ([8]) | |
| | | | | | 6 | 2.23 | ([8]) | ([8]) |
| 195 | West Prong Little Pigeon River near Pigeon Forge, Tenn. | 76.2 | 1946–49, 1954–63 | 1957 | | 10.98 | 6,400 | |
| | | | | | 12 | 11.01 | 6,450 | 9 |
| 196 | Little Pigeon River at Sevierville, Tenn. | 353 | 1867–1963 | 1875 | | 18 | 55 000 | |
| | | | | | 12 | 15.74 | 36,900 | 50 |
| 197 | French Broad River near Knoxville, Tenn. | 5,101 | 1867 | 1867 | | 855 | 160 000 | |
| | | | 1946–63 | 1957 | | 828.82 | [6] 47,500 | |
| | | | | | 12 | 832.20 | [6] 64 300 | ([8]) |
| 198 | South Fork Holston River at Riverside, near Chilhowie, Va. | 76.1 | 1921–31, 1943–63 | 1923 | | 9.0 | 6,000 | |
| | | | | | 12 | 6.82 | 2,520 | 3 |
| 199 | South Fork Holston River at Vestal, Va. | 301 | 1932–63 | 1957 | | 15.35 | 15,100 | |
| | | | | | 12 | 13.12 | 11,000 | 9 |
| 200 | Middle Fork Holston River at Sevenmile Ford, Va. | 132 | 1943–63 | 1957 | | 10.75 | 7,680 | |
| | | | | | 12 | 6.08 | 5 800 | 10 |
| 201 | Corn Creek at Mountain City, Tenn. | 5.34 | 1959–61 | 1961 | | 2.93 | ([8]) | |
| | | | | | 12 | 4.05 | 363 | ([8]) |
| 202 | Roan Creek near Neva, Tenn. | 102 | 1943–55, 1959–63 | 1961 | | 6.56 | 4 040 | |
| | | | | | 12 | 7.92 | 4 560 | 9 |
| 203 | Kopley Creek tributary at Butler, Tenn. | .76 | 1958–63 | 1962 | | 1.78 | ([8]) | |
| | | | | | 12 | 2.21 | ([8]) | ([8]) |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Year | March 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Tennessee River basin—Continued** | | | | | | | |
| 204 | Doe River at Elizabethton, Tenn | 137 | 1901 | 1901 | | ([3]) | 39,000 | |
| | | | 1912–16, 1920–63 | 1940 | | 6.75 | 7,300 | |
| | | | | | 12 | 7.31 | 7,860 | 10 |
| 205 | Watauga River at Elizabethton, Tenn | 692 | 1901 | 1901 | | 21 | 75,900 | |
| | | | 1926–49, 1953–63 | 1940 | | 20.87 | 75,100 | |
| | | | | | 12 | 10.70 | [6] 14,500 | ([3]) |
| 206 | South Fork Holston River at Kingsport, Tenn | 1,935 | 1926–63 | 1940 | | [9] 18.80 | 68,800 | |
| | | | | | 12 | 9.01 | [6] 24,200 | ([3]) |
| 207 | Horse Creek at Sullivan Gardens, Tenn | 33.9 | | | 12 | 35.50 | 5,200 | [1] 1.21 |
| 208 | North Fork Holston River near Saltville, Va | 222 | 1908, 1921–63 | 1957 | | 13.20 | 16,500 | |
| | | | | | 12 | 12.15 | 14,500 | 22 |
| 209 | North Fork Holston River near Gate City, Va | 672 | 1862 | 1862 | | 22.5 | 54,000 | |
| | | | 1932–63 | 1957 | | 16.73 | 28,700 | |
| | | | | | 12 | 16.42 | 30,000 | 13 |
| 210 | Holston River at Surgoinsville, Tenn | 2,874 | 1941–63 | 1944 | | 17.48 | 59,600 | |
| | | | | | 13 | 17.13 | [6] 59,300 | ([3]) |
| 211 | Surgoinsville Creek at Surgoinsville, Tenn | 4.38 | 1954–63 | 1955 | | 3.55 | ([3]) | |
| | | | | | 12 | 3.66 | ([3]) | ([3]) |
| 212 | Big Creek near Rogersville, Tenn | 47.3 | 1941–49, 1955–63 | 1955 | | 6.83 | 3,280 | |
| | | | | | 12 | 9.40 | 5,760 | [1] 1.06 |
| 213 | Big Creek tributary near Rogersville, Tenn | 2.00 | 1954–63 | 1958 | | [9] 7.52 | ([3]) | |
| | | | | | 12 | 6.06 | 205 | 4 |
| 214 | Holston River near Knoxville, Tenn | 3,747 | 1791–1963 | 1867 | | 41 | ([3]) | |
| | | | 1931–63 | 1935 | | [9] 20.20 | 62,900 | |
| | | | | | 12 | 11.20 | [6] 31,400 | ([3]) |
| 215 | Tennessee River at Knoxville, Tenn | 8,934 | 1867 | 1867 | | [9] 45.0 | 290,000 | |
| | | | 1900–63 | 1902 | | [9] 36.4 | 195,000 | |
| | | | | | 12 | 24.47 | [6] 89,200 | ([3]) |
| 216 | Little River near Maryville, Tenn | 269 | 1875–1963 | 1875 | | 31.0 | ([3]) | |
| | | | 1951–63 | 1957 | | 21.18 | 19,600 | |
| | | | | | 12 | 24.20 | 32,200 | 28 |
| 217 | Oconaluftee River at Cherokee N.C | 131 | 1920–49 | 1946 | | 11.50 | 11,200 | |
| | | | | | 6 | 11.60 | 11,400 | 14 |
| 218 | Oconaluftee River at Birdtown, N.C | 184 | 1945–46, 1948–63 | 1946 | | [5] 12.0 | 15,000 | |
| | | | | | 6 | 11.90 | 15,000 | 14 |
| 219 | Tellico River at Tellico Plains, Tenn | 118 | 1925–63 | 1957 | | 13.60 | 17,500 | |
| | | | | | 6 | 11.63 | 11,500 | 8 |
| 220 | Tellico River tributary at Tellico Plains, Tenn | .25 | 1958–63 | 1959 | | 4.24 | ([3]) | |
| | | | | | 12 | 4.22 | ([3]) | ([3]) |
| 221 | Little Tennessee River at McGhee, Tenn | 2,443 | 1867 | 1867 | | [9] 39.0 | ([3]) | |
| | | | 1905–63 | 1906 | | [9] 30.8 | 104,000 | |
| | | | | | 12 | 17.80 | [6] 37,800 | ([3]) |
| 222 | Island Creek at Vonore, Tenn | 11.2 | 1954–63 | 1959 | | 10.19 | 1,810 | |
| | | | | | 12 | 13.9 | 3,970 | [1] 1.82 |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963, Period | Prior to March 1963, Year | March 1963 | Gage height (feet) | Discharge, Cfs | Discharge, Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Tennessee River basin—Continued** | | | | | | | |
| 223 | Bat Creek near Vonore, Tenn | 30.7 | 1954–63 | 1962 | | 11.59 | 2,230 | |
| | | | | | 12 | 15.92 | 5,060 | 19 |
| 224 | Sweetwater Creek at Sweetwater, Tenn | 23.7 | | | 12 | 92.44 | 3,410 | 9 |
| 225 | Sweetwater Creek near Loudon, Tenn | 62.2 | 1954–63 | 1957 | | 9.96 | 2,370 | |
| | | | | | 12 | 11.90 | 3,540 | <2 |
| 226 | Clinch River at Richlands, Va | 139 | 1901 | 1901 | | 21.3 | 11,500 | |
| | | | 1946–63 | 1957 | | 19.3 | 9,640 | |
| | | | | | 12 | 16.09 | 7,370 | 8 |
| 227 | Clinch River at Cleveland, Va | 528 | 1921–63 | 1957 | | 24.40 | 31,000 | |
| | | | | | 12 | 22.70 | 27,200 | 18 |
| 228 | Guest River at Coeburn, Va | 87.3 | 1918 | 1918 | | 16.7 | 8,360 | |
| | | | 1949–63 | 1957 | | 14.20 | 6,360 | |
| | | | | | 12 | 15.87 | 7,720 | 31 |
| 229 | Copper Creek near Gate City, Va | 106 | 1948–63 | 1950 | | 13.0 | 6,800 | |
| | | | | | 12 | 13.14 | 6,940 | 14 |
| 230 | Clinch River at Speers Ferry, Va | 1,126 | 1862–1963 | 1862 | | 33 | 58,000 | |
| | | | | | 12 | 29.93 | 46,800 | 16 |
| 231 | Clinch River above Tazewell, Tenn | 1,474 | 1862 | 1862 | | 24 | 66,000 | |
| | | | 1919–63 | 1957 | | 21.00 | 51,100 | |
| | | | | | 13 | 22.27 | 56,700 | 15 |
| 232 | Powell River at Big Stone Gap, Va | 112 | 1918 | 1918 | | 15.7 | 33,000 | |
| | | | 1945–63 | 1946 | | 9.8 | 16,500 | |
| | | | | | 12 | 13.72 | 23,700 | [1] 1.24 |
| 233 | South Fork Powell River at Big Stone Gap, Va | 40 | 1918 | 1918 | | 11.2 | 6,000 | |
| | | | 1945–63 | 1946 | | 8.0 | 3,100 | |
| | | | | | 12 | 9.94 | 4,800 | 8 |
| 234 | Powell River near Jonesville, Va | 319 | 1918 | 1918 | | 33 | (3) | |
| | | | 1932–63 | 1946 | | 30.8 | 30,000 | |
| | | | | | 12 | 33.36 | 31,100 | 16 |
| 235 | Powell River near Arthur, Tenn | 685 | 1826–1963 | 1826 | | 27.5 | 34,000 | |
| | | | | | 13 | 26.08 | 30,500 | 14 |
| 236 | Coal Creek at Lake City, Tenn | 24.5 | 1929, 1933, 1955–63 | 1929 | | 17.5 | 8,400 | |
| | | | | | 12 | 5.66 | 4,100 | [1] 1.28 |
| 237 | Buffalo Creek at Norris, Tenn | 9.45 | 1948–50, 1955–63 | 1957 | | 9.03 | 1,130 | |
| | | | | | 12 | 7.67 | 722 | 5 |
| 238 | Bullrun Creek near Halls Crossroads, Tenn | 68.5 | 1957–63 | 1957 | | 10.26 | 3,360 | |
| | | | | | 12 | 11.08 | 6,200 | 30 |
| 239 | Whiteoak Creek below Oak Ridge National Laboratory near Oak Ridge, Tenn | 3.62 | 1950–53, 1955–63 | 1950 | | 5.18 | 642 | |
| | | | | | 11 | 5.24 | 407 | 2 |
| 240 | Melton Branch near Oak Ridge, Tenn | 1.48 | 1956–63 | 1961 | | 5.39 | 298 | |
| | | | | | 11 | 5.47 | 242 | (3) |
| 241 | Poplar Creek near Oak Ridge, Tenn | 82.5 | 1900–63 | 1928 | | (3) | [13] 14,000 | |
| | | | 1961–63 | 1961 | | 20.68 | 4,830 | |
| | | | | | 12 | 22.38 | 6,850 | 2 |
| 242 | East Fork Poplar Creek near Oak Ridge, Tenn | 19.5 | 1944 | 1944 | | (3) | [14] 4,600 | |
| | | | 1961–63 | 1962 | | 9.25 | 1,340 | |
| | | | | | 12 | 10.91 | 1,800 | 3 |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963, Period | Prior to March 1963, Year | March 1963 | Gage height (feet) | Discharge, Cfs | Discharge, Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Tennessee River basin—Continued** | | | | | | | |
| 243 | Bear Creek near Oak Ridge, Tenn | 7.15 | 1961–63 | 1961 | | 6.05 | 565 | |
| | | | | | 12 | 6.42 | 594 | 2 |
| 244 | Rock Creek near Sunbright, Tenn | 5.54 | 1954–63 | 1955 | | 6.21 | 1,560 | |
| | | | | | 12 | 5.61 | 1,150 | 11 |
| 245 | Emory River near Wartburg, Tenn | 83.2 | 1929 | 1929 | | 32 | 30,000 | |
| | | | 1934–63 | 1939 | | 25.62 | 18,700 | |
| | | | | | 12 | 21.84 | 12,500 | 9 |
| 246 | Obed River at Crossville, Tenn | 12.0 | 1954–63 | 1955 | | 8.78 | 980 | |
| | | | | | 12 | 8.80 | 985 | 2 |
| 247 | Little Obed River near Crossville, Tenn | 4.71 | 1954–63 | 1955 | | 8.00 | [3] | |
| | | | | | 12 | 7.42 | 783 | 5 |
| 248 | Obed River tributary near Crossville, Tenn | .72 | 1954–63 | 1955 | | 6.03 | [3] | |
| | | | | | 12 | 5.37 | 165 | [3] |
| 249 | Daddys Creek near Hebbertsburg, Tenn | 139 | 1956–63 | 1957 | | 13.15 | 11,100 | |
| | | | | | 12 | 13.23 | 11,200 | 5 |
| 250 | Obed River near Lancing, Tenn | 518 | 1929 | 1929 | | 33.9 | [3] | |
| | | | 1957–63 | 1957 | | 18.95 | 40,600 | |
| | | | | | 12 | 22.40 | 53,100 | 9 |
| 251 | Emory River at Oakdale, Tenn | 764 | 1857–1963 | 1929 | | 42.3 | 195,000 | |
| | | | | | 12 | 29.10 | 89,400 | 18 |
| 252 | Whites Creek near Glen Alice, Tenn | 108 | 1929 | 1929 | | 27.1 | 66,000 | |
| | | | 1935–63 | 1957 | | 25.1 | 51,000 | |
| | | | | | 12 | 17.33 | 15,200 | 7 |
| 253 | Piney River at Spring City, Tenn | 95.9 | 1928–30, 1955–63 | 1957 | | 18.00 | 33,200 | |
| | | | | | 12 | 13.83 | 7,680 | 2 |
| 254 | Ten Mile Creek near Decatur, Tenn | 26.4 | 1954–63 | 1957 | | 13.75 | 5,480 | |
| | | | | | 12 | 14.07 | 5,890 | 45 |
| 255 | Sewee Creek near Decatur, Tenn | 117 | 1934–63 | 1946 | | 23.97 | 23,900 | |
| | | | | | 12 | 22.81 | 20,400 | [1] 1.03 |
| 256 | Richland Creek near Dayton, Tenn | 50.2 | 1903 | 1903 | | [3] | 14,000 | |
| | | | 1928–31, 1935–63 | 1957 | | 10.2 | 11,000 | |
| | | | | | 12 | 9.02 | 8,660 | 11 |
| 257 | Turtletown Creek at Turtletown, Tenn | 26.9 | 1934–63 | 1961 | | 6.71 | 1,260 | |
| | | | | | 12 | 5.93 | 935 | 2 |
| 258 | Hiwassee River near McFarland, Tenn | 1,136 | 1943–63 | 1952 | | 10.42 | 22,500 | |
| | | | | | 12 | 6.98 | [6] 10,700 | [3] |
| 259 | Toccoa River near Dial, Ga | 177 | 1906 | 1906 | | [15] 18.5 | [15] 28,000 | |
| | | | 1913–63 | 1952 | | 11.20 | 10,800 | |
| | | | | | 12 | 5.82 | 3,290 | <2 |
| 260 | Ocoee River at Copperhill, Tenn | 352 | 1903–13, 1919–25, 1943–63 | 1906 | | [9] 18.5 | 35,000 | |
| | | | | | 12 | 7.44 | [6] 7,880 | [3] |
| 261 | Fightingtown Creek at McCaysville, Ga | 70.9 | 1943–63 | 1951 | | 11.92 | 5,420 | |
| | | | | | 12 | 10.26 | 4,090 | 7 |
| 262 | Davis Mill Creek at Copperhill, Tenn | 5.16 | 1940–41, 1949–63 | 1949 | | 6.02 | 3,950 | |
| | | | | | 12 | 4.50 | [6] 1,740 | [3] |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Prior to March 1963: Year | March 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Tennessee River basin—Continued** | | | | | | | |
| 263 | North Potato Creek near Ducktown, Tenn | 13.0 | 1934–63 | 1936 | | 7.2 | 7,030 | |
| | | | | | 5 | 4.97 | [6] 942 | (3) |
| 264 | Ocoee River at Emf, Tenn | 524 | 1913–63 | 1916 | | 13.7 | 29,400 | |
| | | | | | 12 | 10.40 | [6] 16,400 | (3) |
| 265 | Ocoee River at Parksville, Tenn | 595 | 1911–16, 1921–63 | 1951 | | 20.22 | 21,700 | |
| | | | | | 13 | 16.79 | [6] 16,900 | (3) |
| 266 | Hiwassee River above Charleston, Tenn | 2,001 | 1954–63 | 1961 | | [5] 24.63 | [6] 34,200 | |
| | | | | | 12 | | [6] 34,900 | (3) |
| | | | | | 13 | 25.72 | | |
| 267 | South Chestuee Creek near Benton, Tenn | 31.8 | 1958–63 | 1961 | | 9.09 | 4,140 | |
| | | | | | 12 | 8.87 | 3,750 | 40 |
| 268 | Oostanula Creek at Athens, Tenn | 26.8 | | | 12 | 105.71 | 6,100 | [1] 1.71 |
| 269 | Oostanula Creek near Sanford, Tenn | 57.0 | 1955–63 | 1961 | | 9.38 | 2,040 | |
| | | | | | 12 | 12.62 | 6,840 | [1] 1.09 |
| 270 | Hiwassee River at Charleston, Tenn | 2,298 | 1886 | 1886 | | 34.0 | 70,000 | |
| | | | 1900–02, 1920–39, 1963 | 1932 | | 28.58 | [6] 55,800 | (3) |
| | | | | | 13 | 25.61 | [5,6] 45,300 | |
| 271 | Brymer Creek near McDonald, Tenn | 9.68 | 1954–63 | 1961 | | 6.50 | (3) | |
| | | | | | 12 | 6.03 | (3) | (3) |
| 272 | North Chickamauga Creek at mile 12.82, near Hixson, Tenn | 97.6 | | | 12 | 671.65 | 25,200 | [1] 1.07 |
| 273 | North Chickamauga Creek at mile 6.29, at Hixson, Tenn | 114 | | | 12 | 663.22 | 15,300 | 8 |
| 274 | McWilliams Creek near Dunlap, Tenn | 6.64 | 1959–63 | 1961 | | 8.48 | (3) | |
| | | | | | 12 | 9.51 | (3) | (3) |
| 275 | Little Brush Creek near Dunlap, Tenn | 15.4 | 1957 | 1957 | | 8.6 | 2,600 | |
| | | | 1959–63 | 1960 | | 7.39 | 1,980 | |
| | | | | | 12 | 9.62 | 3,130 | 50 |
| 276 | Sequatchie River near Whitwell, Tenn | [7] 384 | 1867–1963 | 1867 | | 19 | (3) | |
| | | | 1921–63 | 1957 | | 16.71 | 22,600 | |
| | | | | | 12 | 17.11 | 25,700 | 12 |
| 277 | Brown Spring Branch near Sequatchie, Tenn | .67 | 1954–63 | 1957 | | 6.23 | 140 | |
| | | | | | 12 | [16] 8.56 | 165 | (3) |
| 278 | Little Sequatchie River near Sequatchie, Tenn | 97.5 | | | 12 | 98.86 | 32,700 | [1] 2.46 |
| 279 | Battle Creek near Monteagle, Tenn | 50.4 | 1955–63 | 1957 | | 9.09 | 5,850 | |
| | | | | | 12 | 12.20 | 10,200 | 50 |
| 280 | Paint Rock River near Woodville, Ala | 320 | 1936–63 | 1942 | | | 31,300 | |
| | | | do | 1949 | | 20.84 | | |
| | | | | | 12 | 22.60 | 46,700 | [1] 1.08 |
| 281 | Big Huckleberry Creek near Belvidere, Tenn | 2.18 | 1955–63 | 1961 | | 6.19 | 773 | |
| | | | | | 12 | 8.58 | 1,470 | (3) |
| 282 | Flint River near Chase, Ala | 342 | 1929–63 | 1929, 1954 | | 25.00 | 42,000 | |
| | | | | | 12 | 27.55 | 55,900 | [1] 1.22 |
| 283 | Tennessee River at Whitesburg, Ala | 25,610 | 1867 | 1867 | | 31.4 | (3) | |
| | | | 1925–63 | 1957 | | 23.93 | [6] 293,000 | |
| | | | | | 14 | [5] 23.37 | [6] 285,000 | 4 |

See footnotes at end of table.

**TABLE 6.**—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963 — Period | Prior to March 1963 — Year | March 1963 | Gage height (feet) | Discharge — Cfs | Discharge — Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Tennessee River basin—Continued** | | | | | | | |
| 284 | Aldridge Creek near Farley, Ala | 14.1 | 1961–63 | 1961 | | 8.34 | 2,050 | |
| | | | | | 12 | 8.82 | 2,200 | 8 |
| 285 | Indian Creek near Madison, Ala | 49.0 | 1960–63 | 1962 | | 8.96 | 2,180 | |
| | | | | | 12 | 10.70 | 8,170 | 26 |
| 286 | Piney Creek near Athens, Ala | 55.8 | 1959–63 | 1959 | | 9.61 | 3,670 | |
| | | | | | 12 | 13.38 | 12,900 | [1] 1.14 |
| 287 | Elk River near Pelham, Tenn | 65.6 | 1952–63 | 1957 | | 12.02 | 4,950 | |
| | | | | | 12 | 13.17 | 7,240 | 8 |
| 288 | Bradley Creek near Prairie Plains, Tenn | 41.3 | 1952–63 | 1962 | | 12.35 | 3,880 | |
| | | | | | 12 | 13.63 | 4,950 | 8 |
| 289 | Elk River at Estill Springs, Tenn | 282 | 1921–63 | 1929 | | 20.2 | 22,900 | |
| | | | | | 12 | 18.15 | [6] 19,100 | (3) |
| 290 | Miller Creek near Cowan, Tenn | 4.30 | 1955–63 | 1961 | | 7.08 | 2,240 | |
| | | | | | 12 | 7.09 | 2,260 | (3) |
| 291 | Boiling Fork Creek at Cowan, Tenn | 17.0 | 1955–63 | 1961 | | 9.79 | 3,760 | |
| | | | | | 12 | 11.48 | 4,590 | [1] 1.89 |
| 292 | Boiling Fork Creek above Winchester, Tenn | 55.9 | | | 12 | 14.52 | 11,100 | [1] 1.77 |
| 293 | West Fork Mulberry Creek at Mulberry, Tenn | 41.2 | 1953–63 | 1957 | | 14.8 | 12,800 | |
| | | | | | 12 | 13.74 | 9,460 | [1] 1.95 |
| 294 | Elk River above Fayetteville, Tenn | 827 | 1842 | 1842 | | 27.5 | (3) | |
| | | | 1935–63 | 1949 | | 27.14 | 35,500 | |
| | | | | | 12 | 27.05 | [6] 35,300 | (3) |
| 295 | Norris Creek tributary near Belleville, Tenn | .03 | 1955–63 | 1962 | | 5.82 | 87 | |
| | | | | | 12 | 5.77 | 75 | (3) |
| 296 | Norris Creek near Fayetteville, Tenn | 42.6 | 1954–63 | 1957 | | 12.2 | 14,300 | |
| | | | | | 12 | 11.50 | (3) | (3) |
| 297 | Bradshaw Creek at Frankewing, Tenn | 36.5 | 1955–63 | 1955 | | 16.38 | 12,600 | |
| | | | | | 12 | 14.97 | 8,360 | [1] 1.89 |
| 298 | Chicken Creek at McBurg, Tenn | 7.66 | 1955–63 | 1955 | | 6.66 | 3,660 | |
| | | | | | 11 | 7.19 | 4,510 | (3) |
| 299 | Duck River below Manchester, Tenn | 107 | 1902 | 1902 | | 23.2 | | |
| | | | 1929 | 1929 | | 23.2 | 50,000 | |
| | | | 1934–63 | 1948 | | 18.93 | 30,000 | |
| | | | | | 12 | 17.40 | 23,000 | 35 |
| 300 | Garrison Fork at Fairfield, Tenn | 66.3 | 1954–63 | 1955 | | 23.13 | 25,300 | |
| | | | | | 11 | 21.24 | 19,800 | [1] 1.14 |
| 301 | Wartrace Creek at Bell Buckle, Tenn | 16.3 | 1954–63 | 1955 | | 11.25 | 8,240 | |
| | | | | | 11 | 10.26 | 5,920 | [1] 1.67 |
| 302 | Duck River near Shelbyville, Tenn | 481 | 1902 | 1902 | | 39.6 | (3) | |
| | | | 1929 | 1929 | | 37.6 | 70,000 | |
| | | | 1934–63 | 1948 | | 36.40 | 62,900 | |
| | | | | | 12 | 29.90 | 31,300 | 13 |
| 303 | Weakly Creek near Rover, Tenn | 9.46 | 1955–63 | 1955 | | 6.15 | 2,330 | |
| | | | | | 12 | 5.89 | 1,380 | (3) |
| 304 | Big Rock Creek at Lewisburg, Tenn | 24.9 | 1954–63 | 1955 | | [17] 17.62 | [17] 16,700 | |
| | | | | | 12 | 10.32 | 2,930 | 12 |
| 305 | East Rock Creek at Farmington, Tenn | 43.1 | 1954–63 | 1961 | | 14.11 | (3) | |
| | | | | | 6 | 12.08 | 6,020 | 32 |

See footnotes at end of table.

TABLE 6.—*Flood stages and discharges, March, Alabama to West Virginia and Ohio*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Year | March 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Tennessee River basin—Continued** | | | | | | | |
| 306 | Little Flat Creek tributary near Rally Hill, Tenn | .63 | 1955–63 | 1955 | | 5.98 | 372 | |
| | | | | | 12 | 5.26 | 302 | (3) |
| 307 | Duck River at Columbia, Tenn | 1,208 | 1905–08, 1920–63 | 1948 | | 51.75 | 61,100 | |
| | | | | | 14 | 37.00 | 29,200 | 2 |
| 308 | Rutherford Creek near Carters Creek, Tenn | 68.8 | 1954–63 | 1955 | | 24.38 | 11,800 | |
| | | | | | 11 | 17.13 | 5,630 | 8 |

1 Ratio of peak discharge to 50-year flood.
2 Affected by dam failure.
3 Unknown.
4 Affected by backwater from ice.
5 Did not occur simultaneously with peak discharge.
6 Regulated by reservoir or reservoirs.
7 Contributing drainage area.
8 Affected by backwater from other streams or from debris.
9 At different site or datum.
10 About 1 ft lower than that of March 1963.
11 Before channel improvements and levee construction.
12 Maximum known since 1902.
13 At site 5.0 miles upstream; drainage area, 55.9 sq mi.
14 At site 5.1 miles upstream.
15 Maximum known since about 1840.
16 Affected by backwater from railroad bridge.
17 Maximum known since 1856.

## KENTUCKY

Peak discharges during the period March 11–14 approached the maximum of the period of record at many gaging stations in southeastern Kentucky. Maximum discharges occurred at five gaging stations whose records include those of the floods of 1957: Johns Creek near Meta (station 63), Tygarts Creek at Olive Hill (station 74), Troublesome Creek at Noble (station 119), Cumberland River near Harlan (station 133), and Cumberland River at Pineville (station 136). At most gaging stations in the area, peak stages were only 1 or 2 feet below the maximums, which occurred during the disastrous floods of January-February 1957 or other great previous floods, and peak discharges were not much less than the maximum discharges of these floods. The area affected by the floods was about the same as that of the floods of January-February 1957.

Peak discharges on Levisa Fork and tributaries in the Big Sandy River basin were about equal to a 25-year flood. In Beaver Creek basin, where precipitation had been heavy, the discharge from a drainage area of 126 sq mi (station 60) exceeded a 50-year flood. The maximum peak discharge of record on Johns Creek near Meta was also greater that a 50-year flood.

Rainfall amounts were moderate in the basins of the Little Sandy River, Tygarts Creek, and the Licking River. Peak discharges were not particularly large except in Tygarts Creek at Olive Hill where the discharge of 8,970 cfs from 59.6 sq mi was 1.7 times the 50-year flood.

The long-term gaging stations in the upper Kentucky River basin generally had peak discharges 10 to 25 percent less than in 1957. At four stations the peak discharges ranged from 1.0 to about 1.6 times a 50-year flood.

The discharge was moderate in Poor Fork (station 131; drainage area, 82.3 sq mi), the main headwater tributary of the Cumberland River. But owing to the large contribution from Clover Fork, the peak discharge in Cumberland River near Harlan (drainage area, 374 sq mi) exceeded all previously known peak stages. The high peak of Clover Fork and Martins Fork, the principal tributary of Clover Fork, flooded Harlan and nearby towns. Peak discharges on the Cumberland River at Barbourville (station 138) and near Pineville (station 137), downstream from Harlan, were not of unusually high recurrence intervals. Both peak stages were below those of 1946, and the peak stage at Barbourville was 0.85 foot below that of the 1957 flood.

A rare condition developed along the Ohio River when the entire 980-mile reach from Pittsburgh, Pa., to Cairo, Ill., crested during the short period March 20–22. and on March 21 all points were above flood stage. The river at Louisville, Ky., first reached flood stage on March 7 and remained above it for 21 days—almost equal to the record of 22 days above flood stage in 1937.

### OHIO

In southern Ohio the peak stages generally occurred March 4–6 and were due to 2 to 4 inches of rain that fell on snow-covered ground.

Discharges were high in the eastern part of the flood area. The peak discharge on Captina Creek (station 9) exceeded all records since 1927 and was greater than that of the August 1935 flood. The peak discharge of the Little Muskingum River was the greatest since at least 1913. Flood damage was minor.

In the Muskingum River basin, noncontrolled tributaries in the area of heavy rainfall had severe flooding but not as great as in 1913 and 1959. Some streams below flood-control dams had the highest stages since the construction of the dams. Stillwater Creek at Uhrichsville (station 14) had the greatest peak discharge since 7,460 cfs in 1937. The flood on the Kokosing River exceeded the 25-year flood but was well below that of 1959. The stage of Wakatomika Creek (station 21) was within half a foot of the 1959 stage, and the peak discharge of the Licking River near Newark (station 23) was equal to the 30-year flood. Damage in the Muskingum River basin was widespread and exceeded $700,000. The 15 flood-control reservoirs of the Muskingum Conservancy District, operated by the Corps of Engineers, averted greater flooding by the Muskingum River. The Corps of Engineers estimated that reduction in stages on the Muskingum River by the reservoirs were 10.5 feet at Coshocton, 12 feet at Dresden, 11 feet at Zanesville, and 6.6 feet at McConnelsville. Reservoirs on Stillwater Creek and on Brushy Fork reduced the stage on Stillwater Creek at Uhrichsville an estimated 4.7 feet.

The floods in the Hocking River basin were the worst since 1945, and in the upper reaches of Rush Creek near Bremen, stages exceeded those of the 1913 flood. Bremen was isolated by floodwaters for a day. Athens, on the Hocking River (station 32), was the only city in Ohio to be appreciably damaged. The total damage in the Hocking River basin was about $1.8 million.

The upper Scioto River basin above Columbus did not have severe flooding, although Alum Creek at Columbus (station 82; drainage area, 190 sq mi) had an unusually high discharge of 12,500 cfs when compared to that of 6,460 cfs in Alum Creek at Africa (station 81; drainage area, 120 sq mi). The flood on the Olentangy River near Worthington (station 77), with the gates closed at Delaware Dam a short distance upstream, was high but was less than half that of the 1959 flood. The floods were more severe in the lower part of the basin. The stage on Deer Creek at Williamsport (station 84) was only about 0.1 foot lower than the 1959 peak stage, and the stage on Paint Creek exceeded all previous records. A resident reported that the 1913 flood stage had been exceeded at a point on Paint Creek between the mouths of Rattlesnake Creek and Rocky Fork, a few miles upstream from Bainbridge near station 88. A washout of railroad tracks caused a train wreck near the mouth of North Fork Paint Creek. The peak discharge on Salt Creek near Londonderry (station 95) was extremely high, about two times a 50-year flood. Flood damage in the Scioto River basin totaled about $3.6 million, much of which was concentrated in the Paint Creek area.

Stages in the Little Miami River approached those of 1959 upstream from Spring Valley and exceeded that of 1959 at Spring Valley (station 99). Downstream from Spring Valley, stages were markedly below those of 1959. In the East Fork Little Miami River, where the 1959 peaks had not been outstanding, the 1963 peaks were the highest since 1945. The small towns of Morrow, Loveland, and Milford, at station 103, were extensively damaged, but because of the small populations the total dollar value was not great.

In the Great Miami River basin the 1963 flood was not outstanding except in the Mad River area. The flood stage of the Mad River near

Urbana (station 107) was only 0.21 foot below that of 1959, and near Springfield (station 110) it was 1.33 feet below that of 1959. Elsewhere the floods caused widespread but modest damage. The five dams of the Miami Conservancy District prevented great flood damage except in the places where encroachments had been made on the flood plains.

### WEST VIRGINIA

Severe flooding occurred in the western part of West Virginia during each of the three storm periods. In the Guyandotte and Big Sandy River basins the floods of March 12 were the highest since at least 1915, and flooding along the main stem of the Guyandotte River was the highest known.

Discharge hydrographs of the Guyandotte River (fig. 11) show the peaks from the three storms and also show the attenuation of the last two peaks as they moved downstream from Logan (station 47; drainage area, 836 sq mi) to Branchland (station 50; drainage area, 1,226 sq mi). The peak discharge of 69,600 cfs on March 13 in Tug Fork near Kermit (station 69) was the highest known during the period of record, 1934–63.

During the prolonged period of flooding in western West Virginia, five lives were lost, about 5,000 persons were forced to leave their homes, and property damage amounted to more than $15 million.

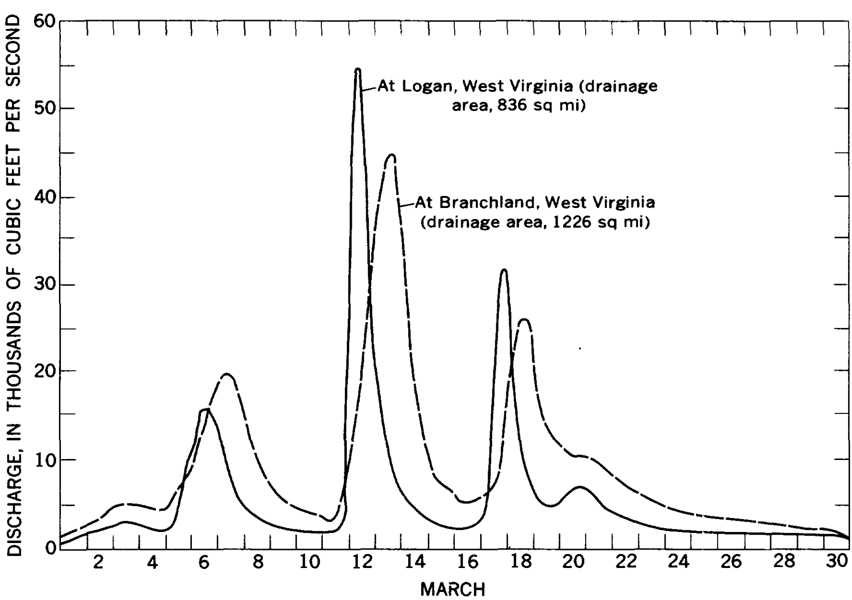



FIGURE 11.—Discharges in the Guyandotte River for March 1963.

### TENNESSEE

Two storm periods, March 5–6 and 11–12, produced high runoff from almost the entire State of Tennessee. The first storm produced rainfall of 2 to 6 inches over the eastern half of the State and caused floods on many streams that are tributary to the Tennessee River. In general, streams draining the western slopes of the Smoky Mountains had floods of the greatest magnitudes.

One week later the second storm, accompanied by tornadic winds, dropped 5 to 6 inches of rain over the same area in less than 24 hours. The severe flooding caused maximum peak stages and discharges in the period of record at many gaging stations.

Sevierville, at station 196, was isolated when the Little Pigeon River had its second major flood within a week, the greatest since the historical discharge of 55,000 cfs in 1875. The peak discharge was 30,300 cfs on March 6 and 36,900 cfs on March 12; these discharges were about 5 percent less and 15 percent greater, respectively, than the previous maximum discharge during the period of gaging-station record which began in 1921. More than 200 persons were forced to leave their homes and flood waters up to 5 feet deep coursed through the town square.

The Clinch River above Tazewell (station 231) had a third peak on March 18, and each of the three peaks was greater than the mean annual flood (25,800 cfs). The March 13 peak discharge of 56,700 cfs was second only to the peak discharge of 66,000 cfs during the flood of 1862 (fig. 12).

The peak discharge (25,700 cfs) on March 12 in Sequatchie River near Whitwell (station 276) exceeded all previous floods since 1867. The Elk River above Fayetteville (station 294) crested at 35,300 cfs on March 12, a discharge which equaled the peak of 1949, and the stage was within half a foot of the 1842 crest.

In the early morning of March 12 an unprecedented flood discharge (32,700 cfs), 2.46 times a 50-year flood, swept down the Little Sequatchie River near Sequatchie (station 278), claimed four lives, and caused enormous destruction.

The Little River near Maryville (station 216) crested at 32,200 cfs on March 12 and exceeded all previous floods since 1875. More than a hundred families were evacuated. The floodwater disrupted Maryville's water supply, destroyed the Tennessee Avenue bridge, and inundated the sewage treatment plant to a depth of 3 feet.

The severe flooding throughout middle and eastern Tennessee caused five deaths and severe property damage to homes, business establishments, streets, highways, and bridges. Several railroads, Federal and State highways, and many county roads were inundated and closed to

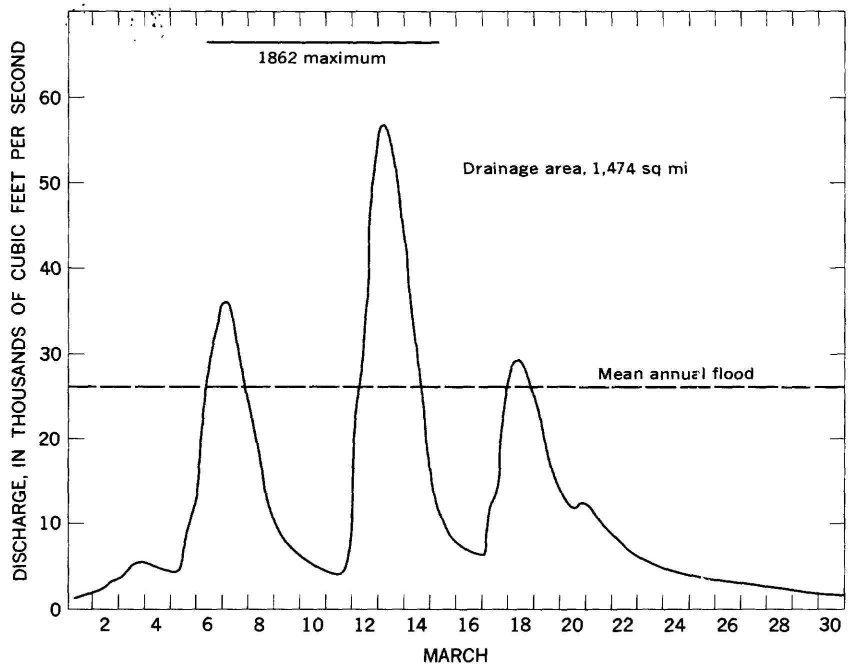



**FIGURE 12.—Discharge in the Clinch River above Tazewell, Tenn., for March 1963.**

traffic. On March 12 practically all highway traffic from Knoxville was interrupted or detoured because of high water or washouts. All land routes between Knoxville and Chattanooga were closed. The Tennessee Division of Water Resources reported that more than 3,000 homes were damaged or destroyed, about 1,500 head of livestock were lost, more than 100,000 acres of winter crops were damaged, almost 500,000 acres of cropland were damaged, and 1,000 bridges were damaged or destroyed in 50 counties.

#### VIRGINIA

Floods in southwestern Virginia followed the rain of March 11–12. Floods in the Big Sandy River basin were outstanding, but they were lower than the floods of 1957. Russell Fork at Haysi (station 56) had a peak discharge on March 12 of 33,800 cfs, a recurrence interval of about 25 years, and Levisa Fork near Grundy (station 54) had a peak discharge of about a 15-year recurrence interval.

In general, the floods of March 12 in the Tennessee River basin were the second highest in 100 years, being exceeded only by the floods of 1957. The peak discharge of 14,500 cfs on the North Fork Holston River near Saltville (station 208) was less than the peak of 1957, but the daily mean discharge of 9,200 cfs on March 12 greatly exceeded the previous maximum daily mean discharge of 5,500 cfs in 43 years of record.

The peak discharge (46,800 cfs) in the Clinch River at Speers Ferry (station 230) on March 12 was the greatest since 1862. The town of Coeburn (station 228) was flooded twice within a week when the discharge on March 12 in the Guest River exceeded all other peaks since 1918.

Seven counties in the southwestern corner of the State were designated disaster areas. About 5,000 persons were evacuated, and flood damage was estimated at $6 million.

### NORTH CAROLINA

Flooding in North Carolina was confined mostly to the Tennessee River basin.

On March 12, Brush Creek at Walnut (station 179) had a peak discharge of 1,400 cfs, a discharge greater than a 50-year flood. The peak discharge of 13,300 cfs on Ivy River near Marshall (station 177) had a recurrence interval greater than 50 years, and the peak discharge of 37,800 cfs on French Broad River at Marshall (station 178) had a recurrence interval of about 15 years.

Damage was light, being confined mostly to secondary roads and to short-duration flooding of low bottom lands.

### ALABAMA

Heavy rainfall was associated with the two distinct storm systems that occurred over the northern part of Alabama during the period March 5–12. Rainfall ranged from 2 to 4 inches throughout the area on March 5–6. The second storm, accompanied by high winds and tornadoes, swept across the Tennessee Valley on March 11–12, produced up to 8 inches of rainfall, and caused outstanding floods on some streams.

The U.S. Weather Bureau station at Athens reported 7.84 inches of rainfal on March 12. The highest recorded rainfall during a 24-hour period was 7.97 inches at Rousseau Hollow in the Paint Rock River basin. The Tennessee Valley Authority (1964) reported that the March 11–12 rainfall averaged 7.0 inches on the Paint Rock River basin and 6.5 inches on the Flint River basin.

The intense rains of March 11–12 produced record floods at several stations in northeastern Alabama. The peak discharge on the Paint Rock River near Woodville (station 280) was the maximum for 28 years of record and was almost 50 percent greater than the previous maximum, which occurred in 1942. The peak stage recorded at the Flint River near Chase (station 282) was 2.55 feet higher than the previous maximum stage in September 1929. The peak discharges at the stations on the Paint Rock and the Flint Rivers and on Piney

Creek near Athens (station 286) were estimated to have recurrence intervals in excess of 50 years. Maximum discharges of record also occurred on Aldridge Creek near Farley (station 284) and on Indian Creek near Madison (station 285).

Flood damage to highways, bridges, and agriculture was estimated at more than $1 million.

#### GEORGIA

The flood area extended into a small area in northern Georgia in the upper parts of the basins of the Chattahoochie, Etowah, and Ocoee Rivers.

On the Chestatee River near Dahlonega (station 4) the peak discharge of 21,700 cfs was the highest since 1907 and exceeded the 50-year flood. On the Chattahoochie River near Leaf (station 1) the peak discharge was the highest since 1940 and was also greater than a 50-year flood.

Damage, principally to county roads and bridges, was low.

#### FLOOD DAMAGE

The U.S. Weather Bureau estimated the total damage in the Ohio River basin from the March floods to have been $97.6 million, and 26 lives were lost. The States having the greatest estimates of losses were Kentucky, $37 million; Ohio, $22 million; West Virgina, $18 million; and Tennessee and Virgina, each $6 million. Estimated damage in river basins were Ohio River, $31 million; Big Sandy River, $20 million; Guyandotte River, $8 million; Great Miami and Little Miami Rivers, $7 million; Kentucky River, $6 million, Cumberland River, $5 million; and Scioto River, $4 million.

### FLOODS OF MARCH 4–7 IN SOUTHERN INDIANA

Severe flooding occurred in the White River and the Whitewater River basins in Indiana (fig. 13) during the period March 4–7. At least two lives were lost, several hundred persons were evacuated from their homes, and property damage was widespread.

The flood resulted from heavy rains falling on deeply frozen ground that was largely covered with snow. The cumulative precipitation, March 4–5, ranged from 2.06 inches at Washington to 4.68 inches at North Vernon. Most of the flood area received about 3 inches of rainfall during March 3–6. The heavy rains that produced the floods of March 4–7 were the beginning of an extended period of precipitation that produced the wettest month at Indianapolis since Janury 1954 and the wettest March since 1904.

Maximum stages during periods of known floods ranging from 5 to 45 years in length were equaled or exceeded at three gaging stations (table 7). The locations of 34 flood-determination points are shown in figure 13. The recurrence interval of the flood equaled or exceeded 50 years at six or more of these gaging stations, 25 years at 11 or more stations, and 10 years at 23 or more stations. At most sites, however, the March 1963 flood was considerably less than the great flood of 1913.

The peak discharge in Fall Creek at Millersville (station 5), although significantly controlled by Geist Reservoir, had a recurrence interval of 27 years. The recurrence interval of the peak discharge in the White River below the mouth of Fall Creek (station 6) was only 9 years.

The peak discharge (10,600 cfs on March 5) in Mill Creek near Cataract (station 16) was impounded in Cagle Mill Reservoir, and the mean daily outflow from the reservoir was reduced to 82 cfs. Although Big Walnut Creek and Deer Creek had peak discharges of exceptionally high recurrence intervals, that of Eel River at Bowling Green (station 19) was only 8 years.

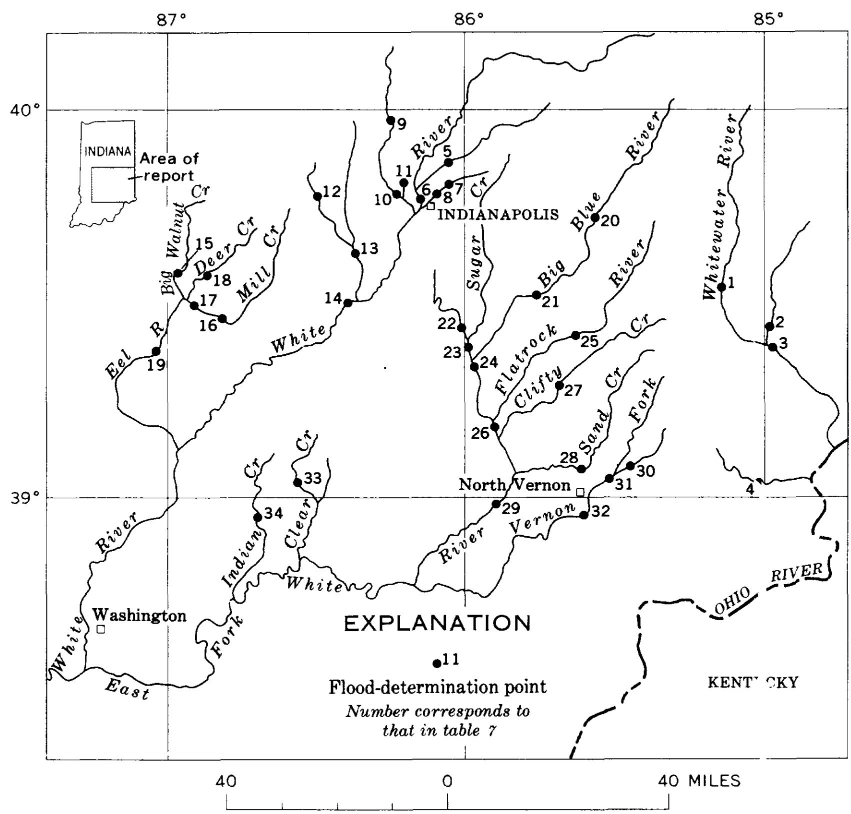



FIGURE 13.—Location of flood-determination points for March 4–7 in southern Indiana.

TABLE 7.—*Flood stages and discharges, March 4–7, in southern Indiana*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963, Period | Prior to March 1963, Year | March 1963 | Gage height (feet) | Discharge, Cfs | Discharge, Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Miami River basin** | | | | | | | |
| 1 | Whitewater River near Alpine | 539 | 1928–63 | 1937 | | 16.61 | 37,100 | |
| | | | | | 5 | 16.47 | 35,900 | 50 |
| 2 | East Fork Whitewater River at Brookville | 382 | 1954–63 | 1959 | | 16.50 | 36,100 | |
| | | | | | 5 | 15.1 | 28,000 | 11 |
| 3 | Whitewater River at Brookville | 1,239 | 1913 | 1913 | | 39.0 | (1) | |
| | | | 1915–20, 1923–63 | 1959 | | 27.78 | 81,800 | |
| | | | | | 5 | 24.91 | 64,500 | 10 |
| | **Hogan Creek basin** | | | | | | | |
| 4 | South Hogan Creek near Dillsboro | 38.2 | 1959–63 | 1959 | | 14.00 | 16,300 | |
| | | | | | 4 | 10.82 | 8,630 | 22 |
| | **Wabash River basin** | | | | | | | |
| 5 | Fall Creek at Millersville | 313 | 1913 | 1913 | | 16.3 | 22,000 | |
| | | | 1929–63 | 1956 | | 13.53 | 12,900 | |
| | | | | | 6 | 12.32 | 11,000 | 27 |
| 6 | White River at Indianapolis | 1,627 | 1913 | 1913 | | 30.0 | 70,000 | |
| | | | 1904–06, 1930–63 | 1937 | | 21.57 | | |
| | | | do | 1943 | | | 37,200 | |
| | | | | | 6 | 17.55 | [2] 28,000 | 9 |
| 7 | Pleasant Run at Arlington Ave., Indianapolis | 7.67 | 1956 | 1956 | | 16.0 | (1) | |
| | | | 1959–63 | 1961 | | 9.49 | 1,360 | |
| | | | | | 4 | 10.32 | 1,610 | (1) |
| 8 | Pleasant Run at Brookville Rd., Indianapolis | 10.3 | 1959–63 | 1961 | | 8.18 | 1,560 | |
| | | | | | 4 | 9.22 | 2,010 | (1) |
| 9 | Eagle Creek at Zionville | 102 | 1957–63 | 1957 | | 19.20 | (1) | |
| | | | 1958–63 | 1958 | | 13.22 | 9,100 | |
| | | | | | 4 | 12.25 | 7,160 | 27 |
| 10 | Eagle Creek at Indianapolis | 179 | 1913 | 1913 | | 16.0 | (1) | |
| | | | 1938–63 | 1957 | | 16.38 | 28,800 | |
| | | | | | 5 | 9.25 | 8,840 | 11 |
| 11 | Little Eagle Creek at Speedway | 18.6 | 1959–63 | 1961 | | 7.44 | 1,940 | |
| | | | | | 4 | 7.21 | 1,830 | (1) |
| 12 | West Fork White Lick Creek at Danville | 28.9 | 1957–63 | 1957 | | 16.0 | 6,660 | |
| | | | | | 4 | 10.12 | 2,700 | 20 |
| 13 | White Lick Creek at Mooresville | 212 | 1957–63 | 1957 | | 22.5 | (1) | |
| | | | 1958–63 | 1961 | | 21.56 | 14,100 | |
| | | | | | 4 | 22.95 | 18,000 | [3] 1.30 |
| 14 | White River near Centerton | 2,435 | 1913 | 1913 | | [4] 22.8 | 90,000 | |
| | | | 1930–31, 1946–63 | 1950 | | [5] 17.2 | 43,000 | |
| | | | | | 5 | 16.72 | 41,600 | 13 |
| 15 | Big Walnut Creek near Reelsville | 338 | 1949–63 | 1957 | | 18.63 | 30,700 | |
| | | | | | 4 | 17.71 | 19,800 | [3] 1.04 |
| 16 | Mill Creek near Cataract | 241 | 1949–63 | 1960 | | 22.58 | 11,400 | |
| | | | | | 5 | 22.06 | 10,600 | 10 |

See footnotes at end of table.

TABLE 7.—*Flood stages and discharges, March 4–7, in southern Indiana*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to March 1963: Period | Prior to March 1963: Year | March 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Wabash River basin—Continued** | | | | | | | |
| 17 | Mill Creek near Manhattan | 292 | 1931, 1938–63 | 1950 | | 18.38 | 8,930 | |
| | | | | | 4 | [6] 14.92 | | |
| | | | | | 5 | | [7] 82 | |
| 18 | Deer Creek near Putnamville | 59.0 | 1954–63 | 1962 | | 15.05 | 10,500 | |
| | | | | | 4 | 12.95 | 10,700 | [3] 1.97 |
| 19 | Eel River at Bowling Green | 844 | 1875 | 1875 | | 30.0 | (1) | |
| | | | 1931–63 | 1950 | | 23.53 | 34,000 | |
| | | | | | 5 | 22.04 | 25,500 | 8 |
| 20 | Big Blue River at Carthage | 187 | 1950–63 | 1959 | | 13.28 | 8,340 | |
| | | | | | 4 | 14.62 | 12,900 | [3] 1.03 |
| 21 | Big Blue River at Shelbyville | 425 | 1913 | 1913 | | 20.2 | (1) | |
| | | | 1943–63 | 1949 | | [8] 17.00 | 14,800 | |
| | | | | | 5 | 17.70 | 15,800 | 9 |
| 22 | Youngs Creek near Edinburg | 109 | 1942–63 | 1952 | | 13.4 | 10,700 | |
| | | | | | 5 | 12.43 | 8,230 | 43 |
| 23 | Sugar Creek near Edinburg | 462 | 1942–63 | 1956 | | 18.38 | 27,600 | |
| | | | | | 5 | 16.43 | 17,300 | 10 |
| 24 | Driftwood River near Edinburg | 1,054 | 1913 | 1913 | | 20.3 | (1) | |
| | | | 1940–63 | 1956 | | 16.80 | 37,500 | |
| | | | | | 6 | 16.97 | 40,500 | 33 |
| 25 | Flatrock River at St. Paul | 298 | 1913 | 1913 | | 20.5 | (1) | |
| | | | 1930–63 | 1949 | | | 18,500 | |
| | | | do | 1959 | | 11.34 | | |
| | | | | | 5 | 12.17 | 17,100 | 11 |
| 26 | East Fork White River at Columbus | 1,692 | 1913 | 1913 | | 17.9 | 100,000 | |
| | | | 1947–63 | 1952 | | 16.00 | 48,700 | |
| | | | | | 6 | 16.23 | 52,300 | 22 |
| 27 | Clifty Creek at Hartsville | 88.8 | 1913 | 1913 | | 25.1 | (1) | |
| | | | 1948–63 | 1959 | | 14.29 | 11,300 | |
| | | | | | 5 | 12.42 | 7,760 | 17 |
| 28 | Sand Creek near Brewersville | 156 | 1948–63 | 1959 | | 22.2 | 19,900 | |
| | | | | | 5 | 16.55 | 9,450 | 2 |
| 29 | East Fork White River at Seymour | 2,333 | 1913 | 1913 | | 21.0 | 120,000 | |
| | | | 1923–63 | 1949 | | 19.67 | 78,500 | |
| | | | | | 7 | 18.64 | 52,000 | 8 |
| 30 | Brush Creek near Nebraska | 11.7 | 1955–63 | 1962 | | 10.90 | 3,120 | |
| | | | | | 4 | 10.04 | 2,540 | (1) |
| 31 | Vernon Fork near Butlerville | 87.3 | 1942–63 | 1959 | | 25.41 | 26,200 | |
| | | | | | 4 | 17.30 | 9,380 | 4 |
| 32 | Vernon Fork at Vernon | 201 | 1939–63 | 1959 | | 32.83 | 56,800 | |
| | | | | | 5 | 24.16 | 24,500 | 15 |
| 33 | Clear Creek at Harrodsburg | 55.2 | 1960–63 | 1960 | | 16.47 | 10,200 | |
| | | | | | 4 | 12.64 | 5,860 | [3] 1.13 |
| 34 | Indian Creek near Springville | 60.9 | 1950–51 | (1) | | 18.4 | (1) | |
| | | | 1961–63 | 1962 | | 11.23 | 4,800 | |
| | | | | | 4 | 11.60 | 5,120 | 32 |

1 Not determined.
2 Flow regulated by reservoir.
3 Ratio of peak discharge to 50-year flood.
4 At Martinsville site, 8½ miles downstream at datum 17.72 ft tower.
5 At site ⅜ mile upstream.
6 Affected by backwater from Deer Creek.
7 Mean daily discharge.
8 At site ¼ mile upstream at datum 3.5 ft higher.

## FLOODS OF MARCH–MAY IN HAWAII

After WALTER C. VAUDREY (1963)

Floods occur somewhere in Hawaii nearly every year. The floods of March–May 1963 were unusually large and caused great damage to homes, highways, and other facilities in some areas.

Heavy rains occurred in the Koloa District, Kauai (fig. 14), on March 5 and 6; near Waimanalo, Oahu (fig. 15), on March 6, and near Hana, Maui (fig. 16), on March 13. In the March 13 storm, rainfall intensity at Hanahuli was 4 inches in 45 minutes. A storm of this intensity will occur in the vicinity of Hanahuli on an average of once in 35–40 years.

The month of April was extremely wet on Kauai and Oahu. The rainstorm of April 12–16 was the culmination of an unusually long period (3 weeks) of cloudy and rainy weather. Such an extended period of rainy weather is rare in Hawaii, particularly over the leeward sections of the State.

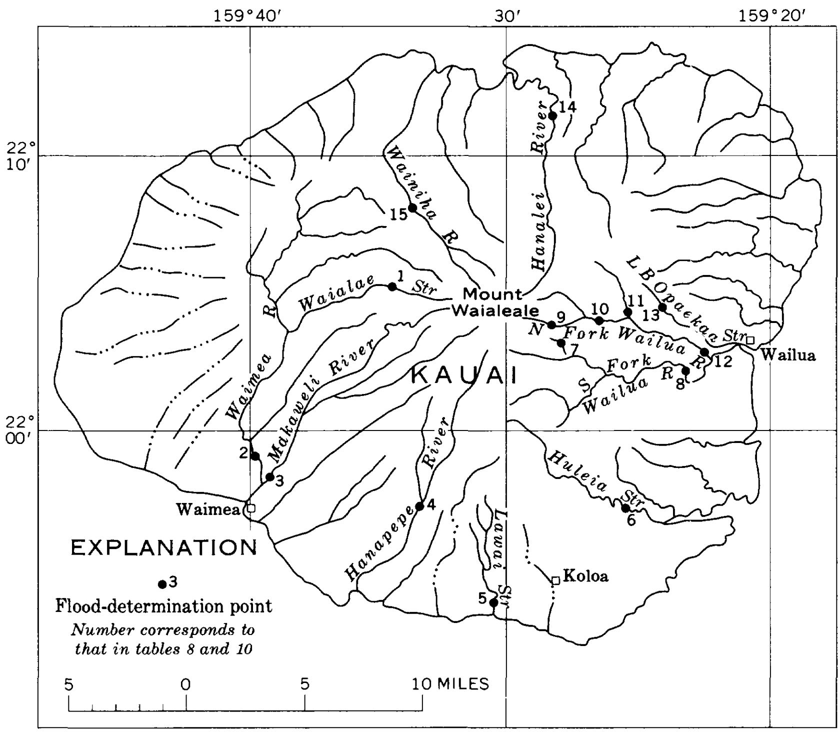



FIGURE 14.—Location of flood-determination points, floods of March 6 and April 15, on Kauai, Hawaii.

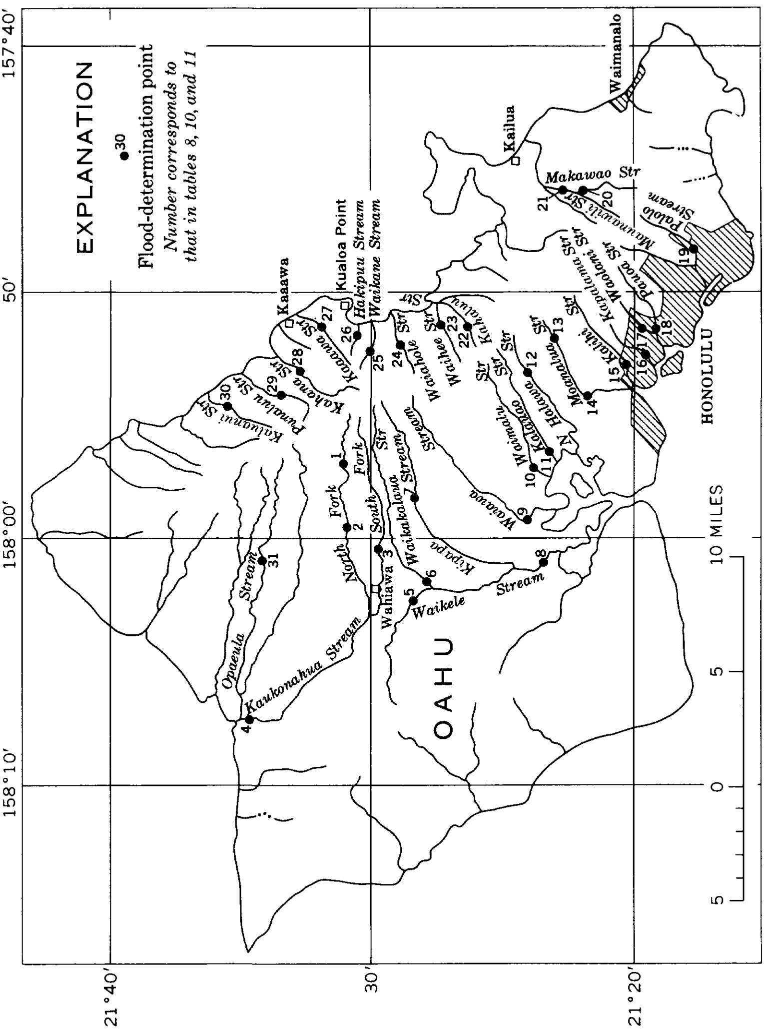



**FIGURE 15.**—Location of flood-determination points, floods of March 6, April 15, and May 14, on Oahu, Hawaii.

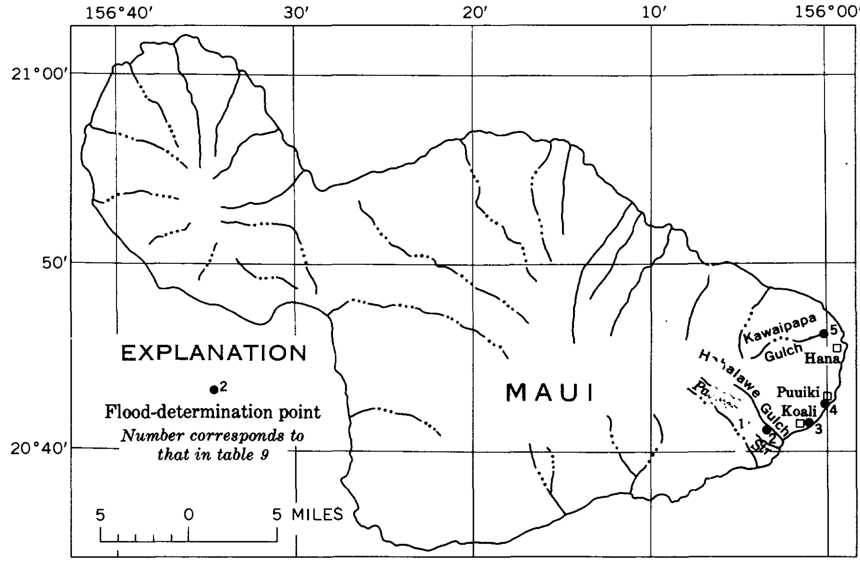



FIGURE 16.—Location of flood-determination points, floods of March 13, on Maui, Hawaii.

The heaviest rainfall for the storm occurred in the Hakipuu-Kualoa-Kaaawa area of windward Oahu (fig. 15), and the greatest amount reported for the April 12–16 storm was 30.77 inches at an unofficial rain gage at Hakipuu Mauka. More than 18 inches of rain fell over most of windward Oahu during the 5-day period, and precipitation was generally less than 10 inches over leeward and central valley areas. The heaviest 24-hour rainfall recorded was 18.96 inches at Hakipuu Mauka; a storm of this intensity in this area has a recurrence interval of about 100 years (U.S. Weather Bureau, 1962).

Rainfall over Kauai was considerably less than it was in the areas of heavy rainfall on Oahu. The greatest rainfall reported for April 12-16 was 16.68 inches and for 1 day was 14.78 inches at North Wailua Ditch (fig. 14). The heaviest rainfall was probably in central and south-central Kauai, but no precipitation stations were in operation there to measure the amounts. The daily rainfall observed can be expected to occur, on the average, about once in 10 years. Precipitation over the western part of the island was less than 8 inches at most precipitation stations.

High-intensity rain fell on part of Oahu on May 14. An unofficial amount of 2.70 inches was reported in a clock-hour period. At Honolulu Federal Building 2.41 inches was recorded in the hour 1400–1500, which is the heaviest hourly rainfall of record for May since at least 1905.

Such an amount, although rare in May, can be expected to occur on the average about once in 20 years in other months. The daily rainfall amount of 3.08 inches at Honolulu was not unusual; however, it was the heaviest daily precipitation amount of record for May.

The storm of early March on Kauai and Oahu, which caused high peak discharges at only three discharge stations (table 8), damaged more than 100 homes on Kauai and damaged more than 100 homes and destroyed some livestock on Oahu. The peak stage on Makawao Stream near Kailua, Oahu (station 20), was only 0.05 foot lower than the maximum stage of record.

The cloudburst of March 13 on Maui (fig. 16) caused a flash flood in Koali Valley. Five streams overflowed their banks in the flood area in the easternmost tip of Maui. Peak discharges were exceptionally high (table 9). On Waiohonu Stream at Puuiki near Hana (station 4), the peak discharge was 13,800 cfs from a drainage area of 4.30 sq. mi.

TABLE 8.—*Flood stages and discharges, March 6, on Kauai and Oahu, Hawaii*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods | | | | |
|---|---|---|---|---|---|---|---|
| | | | Prior to March 1963 | | March 1963 | Gage height (feet) | Discharge (cfs) |
| | | | Period | Year | | | |
| | **Kauai** | | | | | | |
| 6 | Huleia Stream near Lihue | 17.6 | 1912–16, 1962–63 | 1962 | | 15.20 | 5,880 |
| | | | | | 6 | 18.75 | 11,300 |
| | **Oahu** | | | | | | |
| 20 | Makawao Stream near Kailua | 2.04 | 1913–16, 1958–63 | 1958 | | 9.08 | 2,140 |
| | | | | | 6 | 9.03 | 2,140 |
| 21 | Maunawili Stream above Kailua Rd., near Kailua | 5.62 | 1958–63 | 1958 | | 11.08 | 2,550 |
| | | | | | 6 | 8.85 | 1,560 |

TABLE 9.—*Flood stages and discharges, March 13, on Maui, Hawaii*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods | | | | |
|---|---|---|---|---|---|---|---|
| | | | Prior to March 1963 | | March 1963 | Gage height (feet) | Discharge (cfs) |
| | | | Period | Year | | | |
| 1 | Palikea Stream below diversion dam near Kipahulu | 6.29 | 1927–29, 1932–63 | 1955 | | 17.5 | 15,000 |
| | | | | | 13 | 12.68 | 9,080 |
| 2 | Hahalawe Gulch near Kipahulu | .43 | 1927–63 | 1937 | | 15.74 | 3,560 |
| | | | | | 13 | 4.65 | 1,310 |
| 3 | Papaahawahawa Gulch at Muolea near Hana | .95 | | | 13 | | 3,690 |
| 4 | Waiohonu Stream at Puuiki near Hana | 4.30 | | | 13 | | 13,800 |
| 5 | Kawaipapa Gulch at Hana | 5.83 | | | 13 | | 3,670 |

The storm of April 12–16 caused major flooding in many streams on Kauai and Oahu (table 10). On Kauai previous maximum discharges were exceeded at the discharge stations on South Fork Wailua River (station 8), Hanapepe River (station 4), Makaweli River (station 3), and Hanalei River (station 14) in periods of record of 52, 41, 21, and 9 years, respectively. The relative magnitude and the frequency of the flood peaks of April 15, 1963, on South Fork Wailua River and on Hanapepe River are indicated in figure 17.

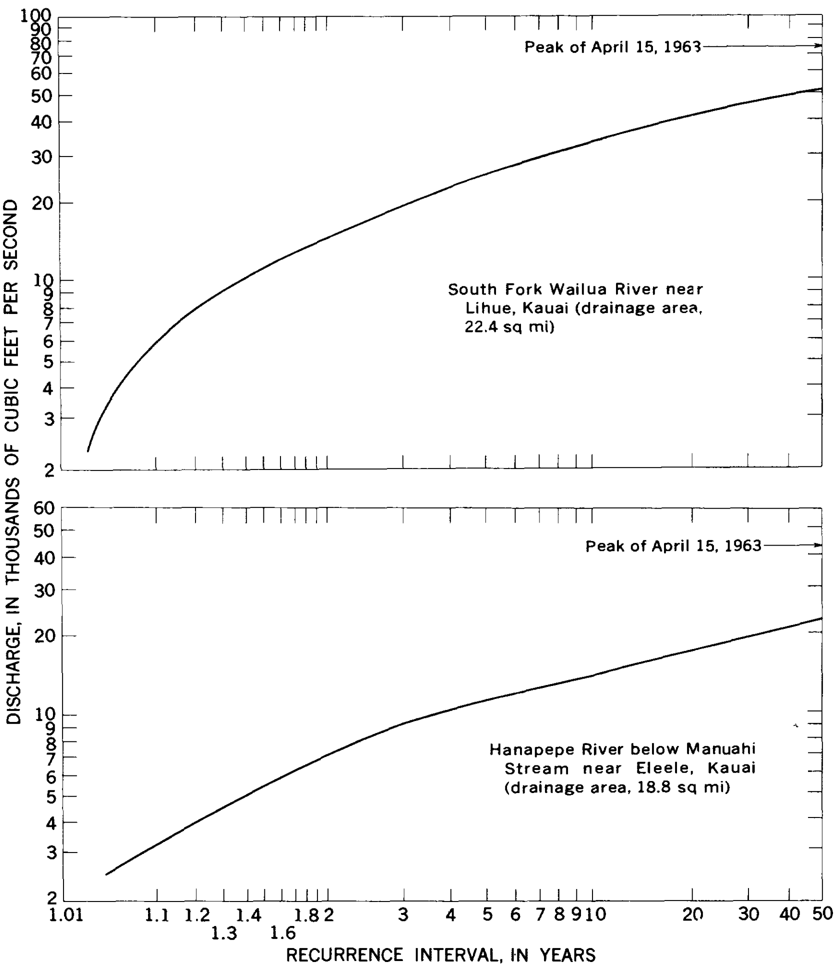



FIGURE 17.—Magnitude and frequency of the flood peaks of April 15 on South Fork Wailua River and on Hanapepe River. Kauai. Hawaii.

On Oahu, extensive flooding occurred from rains of April 12–16 that were intense for more than 36 hours. Flooding was most severe on the windward side of the island (fig. 15). At Kahana Stream near Kahana (station 28), 27.2 inches of precipitation was measured in 4 days, and the peak discharge was 5,430 cfs. Flooding at low elevations was general in the storm area, and several gaging stations had maximum peaks of record (table 10). The peak stage on North Fork Kaukonahua Stream above Right Branch near Wahiawa (station 1) was about equal to a 40-year flood (fig. 18).

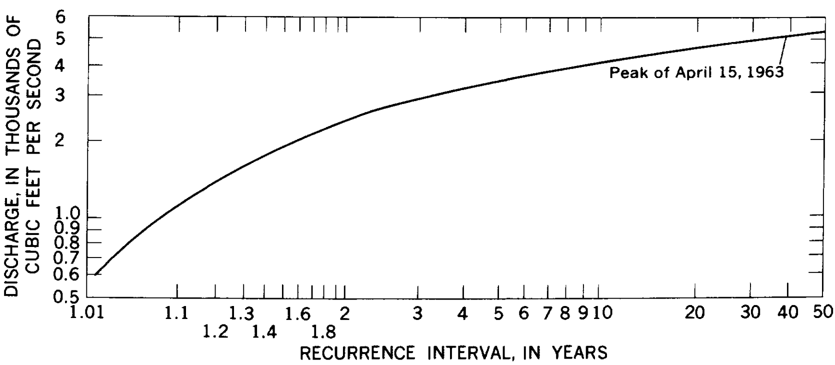



**Figure 18.**—Magnitude and frequency of the flood peak of April 15 on North Fork Kaukonahua Stream above Right Branch near Wahiawa, Oahu, Hawaii.

Table 10.—*Flood stages and discharges, April 15, on Kauai and Oahu, Hawaii*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to April 1963: Period | Year | April 1963 | Gage height (feet) | Discharge (cfs) |
|---|---|---|---|---|---|---|---|
| | | | **Kauai** | | | | |
| 1 | Waialae Stream at alt 3820 ft near Waimea | 2.5 | 1920–32, 1952–63 | 1921 | | 8.44 | 4,530 |
| | | | | | 15 | 5.23 | 1,750 |
| 2 | Waimea River near Waimea | 57.8 | 1910–19, 1944–63 | 1949 | | 19.3 | 37,100 |
| | | | | | 15 | 9.99 | 7,490 |
| 3 | Makaweli River near Waimea | 25 | 1943–63 | 1952 | | 11.19 | 13,600 |
| | | | | | 15 | 12.25 | 15,900 |
| 4 | Hanapepe River below Manuahi Stream near Eleele | 18.8 | 1917–1920, 1927–63 | 1949 | | 11.74 | 24,400 |
| | | | | | 15 | 14.87 | 39,000 |
| 5 | Lawai Stream near Koloa | 6.60 | 1962–63 | 1962 | | 7.70 | 1,900 |
| | | | | | 15 | 9.16 | 3,170 |
| 6 | Huleia Stream near Lihue | 17.6 | 1912–16, 1962–63 | 1963 | | 18.75 | 11,300 |
| | | | | | 15 | 19.82 | 13,200 |
| 7 | Waikoko Stream at North Wailua ditch crossing near Lihue | 1.1 | | | 15 | | 4,020 |
| 8 | South Fork Wailua River near Lihue | 22.4 | 1912–63 | 1955 | | 11.52 | 46,700 |
| | | | | | 15 | 22.90 | 87,300 |

See footnotes at end of table.

TABLE 10.—*Flood stages and discharges, April 15, on Kauai and Oahu, Hawaii*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to April 1963, Period | Maximum floods: Prior to April 1963, Year | Maximum floods: April 1963 | Maximum floods: Gage height (feet) | Maximum floods: Discharge (cfs) |
|---|---|---|---|---|---|---|---|
| | **Kauai—Continued** | | | | | | |
| 9 | South Branch of North Fork Wailua River near Lihue | 1.55 | | | 15 | | 5,650 |
| 10 | North Fork Wailua River at alt 650 ft near Lihue | 6.6 | 1915–63 | 1955 | | 13.53 | 13,200 |
| | | | | | 15 | 12.11 | 9,870 |
| 11 | East Branch of North Fork Wailua River near Lihue | 6.2 | 1912–63 | 1955 | | 14.7 | (1) |
| | | | | | 15 | 9.31 | 6,540 |
| 12 | North Fork Wailua River near Kapaa | 18.7 | 1952–63 | 1955 | | 20.8 | 53,200 |
| | | | | | 15 | 13.67 | 21,000 |
| 13 | Left Branch Opaekaa Stream near Kapaa | .7 | 1960–63 | 1960 | | 4.72 | 311 |
| | | | | | 15 | 5.21 | 365 |
| 14 | Hanalei River near Hanalei | 19.1 | 1912–19, 1963 | 1914 | | 17.52 | 21,700 |
| | | | | | 15 | 13.13 | 34,700 |
| 15 | Wainiha River near Hanalei | 10.2 | 1953–63 | 1959 | | 8.19 | 20,100 |
| | | | | | 15 | 6.39 | 7,840 |
| | **Oahu** | | | | | | |
| 1 | North Fork Kaukonahua Stream above Right Branch near Wahiawa | 1.38 | 1913–53, 1960–63 | 1933 | | 11.7 | 5,490 |
| | | | | | 15 | 12.46 | 5,040 |
| 2 | North Fork Kaukonahua Stream near Wahiawa | 4.86 | 1947–63 | 1954 | | 15.55 | 3,400 |
| | | | | | 15 | 20.95 | 4,660 |
| 3 | South Fork Kaukonahua Stream at East Pump Reservoir near Wahiawa | 4.04 | 1958–63 | 1959 | | 6.40 | 1,960 |
| | | | | | 15 | 11.33 | 5,460 |
| 4 | Kaukonahua Stream at Waialua | 38.7 | | | 15 | | 15,600 |
| 5 | Waikele Stream at Wheeler Field | 5.93 | 1958–63 | 1958 | | 19.8 | 1,810 |
| | | | | | 15 | 10.34 | 1,010 |
| 6 | Waikakalaua Stream near Wahiawa | 7.14 | 1958–63 | 1958 | | 10.31 | 1,020 |
| | | | | | 15 | 16.5 | 4,820 |
| 7 | Kipapa Stream near Wahiawa | 4.29 | 1957–63 | 1957 | | 9.57 | 2,350 |
| | | | | | 15 | 11.57 | 4,580 |
| 8 | Waikele Stream at Waipahu | 45.7 | 1952–63 | 1954 | | 14.82 | 13,600 |
| | | | | | 15 | 9.65 | 7,250 |
| 9 | Waiawa Stream near Pearl City | 26.4 | 1953–63 | 1954 | | 19.27 | 16,900 |
| | | | | | 15 | 14.16 | 8,510 |
| 22 | Kahaluu Stream near Heeia | .28 | 1936–63 | 1937 | | [2] 5.47 | 449 |
| | | | | | 15 | 3.42 | 477 |
| 23 | Waihee Stream near Heeia | .93 | 1936–63 | 1958 | | 5.69 | 1,120 |
| | | | | | 15 | 6.06 | 1,560 |
| 24 | Waiahole Stream at alt 250 ft near Waiahole | .99 | 1956–63 | 1960 | | 4.32 | 967 |
| | | | | | 15 | 4.80 | 2,230 |
| 25 | Waikane Stream at alt 75 ft at Waikane | 2.25 | 1960–63 | 1960 | | 7.45 | 2,370 |
| | | | | | 15 | 9.46 | 4,560 |
| 26 | Hakipuu Stream near Waikane | .78 | | | 15 | | 2,030 |
| 27 | Kaaawa Stream near Kaaawa | 1.64 | | | 15 | | 4,280 |
| 28 | Kahana Stream at alt 30 ft near Kahana | 3.74 | 1915–17, 1959–63 | 1961 | | 6.69 | 3,510 |
| | | | | | 15 | 8.10 | 5,430 |
| 29 | Punaluu Stream near Punaluu | 2.78 | 1953–63 | 1961 | | 6.06 | 2,970 |
| | | | | | 15 | 5.77 | 2,750 |
| 30 | Kaluanui Stream at alt 30 ft near Hauula | 2.12 | 1958–63 | 1961 | | 5.12 | 2,170 |
| | | | | | 15 | 5.16 | 2,470 |
| 31 | Opaeula Stream near Wahaiwa | 2.98 | 1960–63 | 1961 | | 7.05 | 3,220 |
| | | | | | 15 | 8.12 | 2,260 |

[1] Not determined.
[2] Different control.

The driving rainstorm of May 14, which dropped almost 6 inches of rain on leeward Oahu, inundated low-lying areas in Honolulu under more than 2 feet of water. Flooding in the Honolulu area was severe (table 11). Four persons lost their lives in the flood. Table 12 gives the amount of damage from the floods reported as estimated by the Corps of Engineers.

TABLE 11.—*Flood stages and discharges, May 14, on Oahu, Hawaii*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to May 1963: Period | Prior to May 1963: Year | May 1963 | Gage height (feet) | Discharge (cfs) |
|---|---|---|---|---|---|---|---|
| 1 | North Fork Kaukonahua Stream above Right Branch near Wahiawa | 1.38 | 1913–53, 1960–63 | 1933 | | 11.7 | 5,490 |
| | | | | | 14 | 8.97 | 2,890 |
| 7 | Kipapa Stream near Wahiawa | 4.29 | 1957–63 | 1957 | | 9.57 | 2,350 |
| | | | | | 14 | 12.29 | 5,680 |
| 9 | Waiawa Stream near Pearl City | 26.4 | 1953–63 | 1954 | | 19.27 | 16,900 |
| | | | | | 14 | 18.18 | 15,500 |
| 10 | Waimalu Stream near Aiea | 6.07 | 1952–63 | 1960 | | 9.49 | 4,320 |
| | | | | | 14 | (1) | 5,320 |
| 11 | Kalauao Stream at Moanalua Rd. at Aiea | 2.59 | 1954–63 | 1960 | | 6.29 | 1,790 |
| | | | | | 14 | 6.63 | 2,580 |
| 12 | North Halawa Stream near Aiea | 3.45 | 1930–33, 1953–63 | 1932 | | 13.36 | 6,650 |
| | | | | | 14 | 13.46 | 5,620 |
| 13 | Moanalua Stream near Honolulu | 2.73 | 1926–63 | 1930 | | 12.58 | 4,580 |
| | | | | | 14 | 11.82 | 3,370 |
| 14 | Moanalua Stream at alt 100 ft near Honolulu | 4.16 | 1958–63 | 1958 | | 7.50 | 2,720 |
| | | | | | 14 | 7.46 | 2,670 |
| 15 | Kalihi Stream at Kalihi | 5.18 | 1960–63 | 1960 | | 8.0 | 6,350 |
| | | | | | 14 | 8.24 | 6,330 |
| 16 | Kapalama Stream at Kalihi | 1.48 | | | 14 | | 1,590 |
| 17 | Waolani Stream at Honolulu | 1.28 | 1958–63 | 1960 | | 3.90 | 1,160 |
| | | | | | 14 | 6.14 | 2,500 |
| 18 | Pauoa Stream at Lusitana St., at Honolulu | 1.52 | 1958–63 | 1962 | | 1.72 | 251 |
| | | | | | 14 | 4.65 | 2,200 |
| 19 | Palolo Stream near Honolulu | 3.63 | 1952–63 | 1958 | | 5.33 | 3,250 |
| | | | | | 14 | 4.12 | 1,670 |
| 23 | Waihee Stream near Heeia | .93 | 1936–63 | 1963 | | 6.06 | 1,560 |
| | | | | | 14 | (1) | 1,130 |

[1] Not determined.

TABLE 12.—*Damage from the floods of March–May in Hawaii*

| Date of flood | Location | Damage: Public | Private | Total |
|---|---|---|---|---|
| Mar. 6 | Windward Oahu | $10,600 | $30,600 | $41,200 |
| 13 | East Maui | 3,500 | 1,500 | 5,000 |
| Apr. 15 | Oahu | 895,000 | 805,000 | 1,700,000 |
| Do. | Kauai | 143,000 | 349,000 | 492,000 |
| May 14 | Oahu | 137,000 | 163,000 | 300,000 |

## FLOODS OF JUNE 1 NEAR SAN JOSE, N. MEX.

By G. L. Haynes, Jr.

An intense localized storm on June 1 caused flooding on the Pecos River and tributaries in the vicinity of San Jose (fig. 19). Local residents reported precipitation amounts up to 3 inches near San Jose, but a total of only 0.76 inch was recorded on June 1 and 2 at Ribera, the only U.S. Weather Bureau gage in the area.

Residents reported that the storm was between San Jose and San Isidro and moved northeastward, and the runoff pattern confirmed this report. Only a small area of the Pecos River basin was affected.

Extensive damage to cropland and irrigation works occurred. Stream crossings at Soham, San Jose, and Ribera were overtopped. No bridges were washed out, but some pavement was damaged.

Indirect measurements of discharge were made at four miscellaneous sites (table 13).

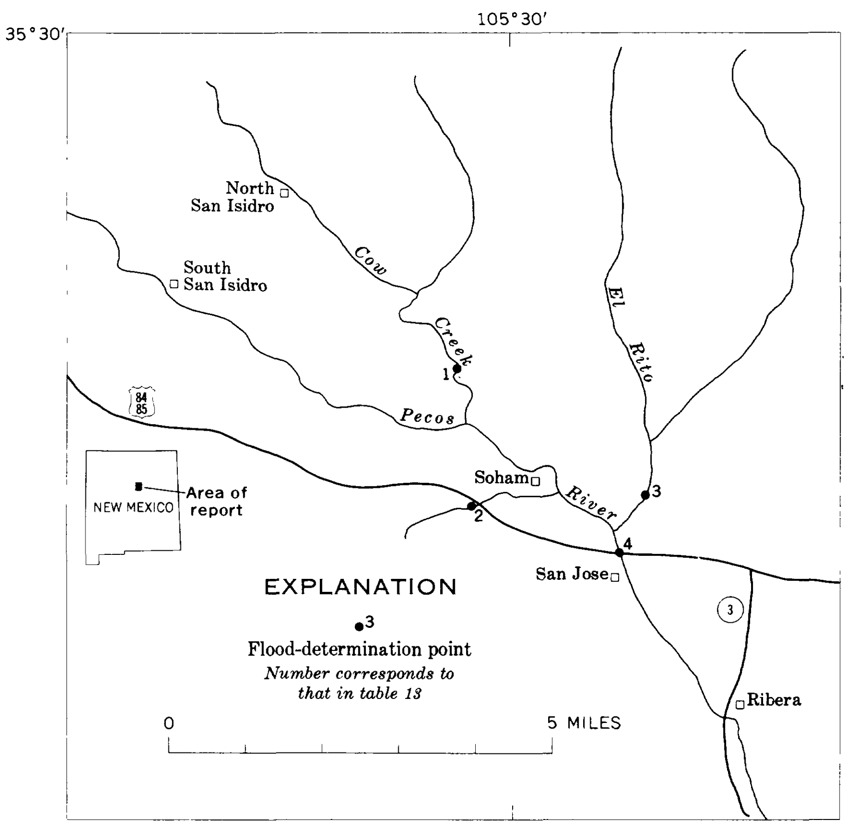



Figure 19.—Location of flood-determination points, floods of June 1, near San Jose, N. Mex.

TABLE 13.—*Flood discharges, June 1, near San Jose, N. Mex.*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods of June 1, 1963 | |
|---|---|---|---|---|
| | | | Discharge (cfs) | Recurrence interval (years) |
| 1 | Cow Creek | 130 | 1,420 | 4 |
| 2 | Pecos River tributary | <2 | 208 | (1) |
| 3 | El Rito | 37.2 | 8,070 | [2] 1.8 |
| 4 | Pecos River at San Jose | 579 | 11,400 | 12 |

[1] Undefined.
[2] Ratio of peak discharge to 50-year flood.

The discharge on Cow Creek had a recurrence interval of only 4 years, which is an event of rather frequent occurrence. Evidently, only a few square miles of the lower part of the basin contributed to the runoff. The discharge of a small tributary to the Pecos River west of Soham was measured at U.S. Highway 84–85. Frequency relations are not defined for areas as small as the basin of the tributary. However, even if the relations were defined, it does not appear that the flood on this tributary was outstanding. The peak discharge on El Rito is computed as 1.8 times the 50-year flood. The U.S. Soil Conservation Service reported that field observations indicated that an area of 5 to 6 sq mi produced most of the runoff. As the indicated frequency is based on the total drainage area of 37.2 sq mi, the rainfall on the contributing area must have been extremely intense. The area is not inhabited, and therefore no rainfall data are available.

Peak discharge of the Pecos River at San Jose, below the contributing area, indicated a recurrence interval of 12 years. Two longtime residents of San Jose gave information that this flood was the highest or the second highest since the 1904 flood, but the best information indicated that it was the second highest. One resident pointed out floodmarks that indicated the 1951 flood was about 2 feet higher in San Jose and about 3 feet higher at the bridge on U.S. Highway 84–85 than the 1963 flood. According to one resident, the 1904 flood washed out all the bridges in that locality.

At the gaging station, Pecos River near Anton Chico, about 30 miles downstream, the peak discharge was only 3,000 cfs. Contribution of the Pecos River above Cow Creek was less than 2,000 cfs.

## FLOODS OF JUNE 4–6 IN THE VICINITY OF CAMBRIDGE, OHIO

After WILLIAM P. CROSS (1964)

High-intensity cloudbursts frequently cause flash floods somewhere in Ohio. Because the high-intensity rains usually occur over small areas, representative amounts of rainfall are seldom measured by rain gages, and resulting peak discharges seldom occur at stream-gaging stations.

A series of cloudburst-type thunderstorms in the vicinity of Cambridge (fig. 20) on June 4–5 were notable for the high overnight rain catches and for the large area affected. The resulting flood on Crooked Creek west of Cambridge was outstanding. The Baltimore & Ohio Railroad bridge over Crooked Creek was destroyed, and heavily traveled U.S. Highway 40 was closed for several days because of damaged bridge approaches. Damage in the areas was more than $1 million.

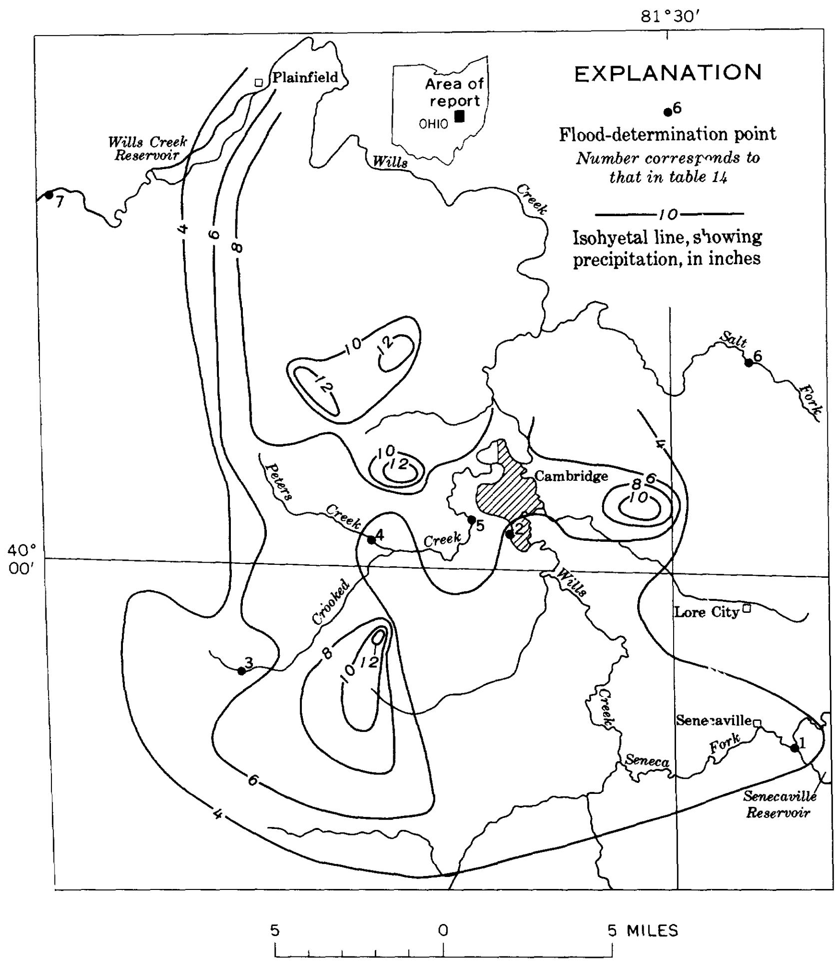



FIGURE 20.—Location of flood-determination points and isohyets for June 4–5, floods of June 4–6, in the vicinity of Cambridge, Ohio

Two rain gages near Cambridge measured more than 7 inches of rain during the night of June 4–5. Accumulated rainfall at the recording rain gage at the Cambridge sewage plant is shown in figure 21.

The isohyets in figure 20 were based on 53 unofficial measurements of rainfall and from U.S. Weather Bureau records in the vicinity. Notable features of the rainfall pattern are the several cells of 12 or more inches of rainfall. The area inside the 6-inch isohyet may have been more than 150 sq mi. Such intense rains have not been recorded in this area before. A storm in July 1913, in which nearly 12 inches of rain was measured at Newark, may have been similar, but that storm was not well documented by published records. Both the maximum point rainfall and the indicated areal average rainfalls of the 1963 storm greatly exceeded the 100-year frequency event on intensity-duration–area-frequency curves that are applicable to Ohio (U.S. Weather Bureau, 1961).

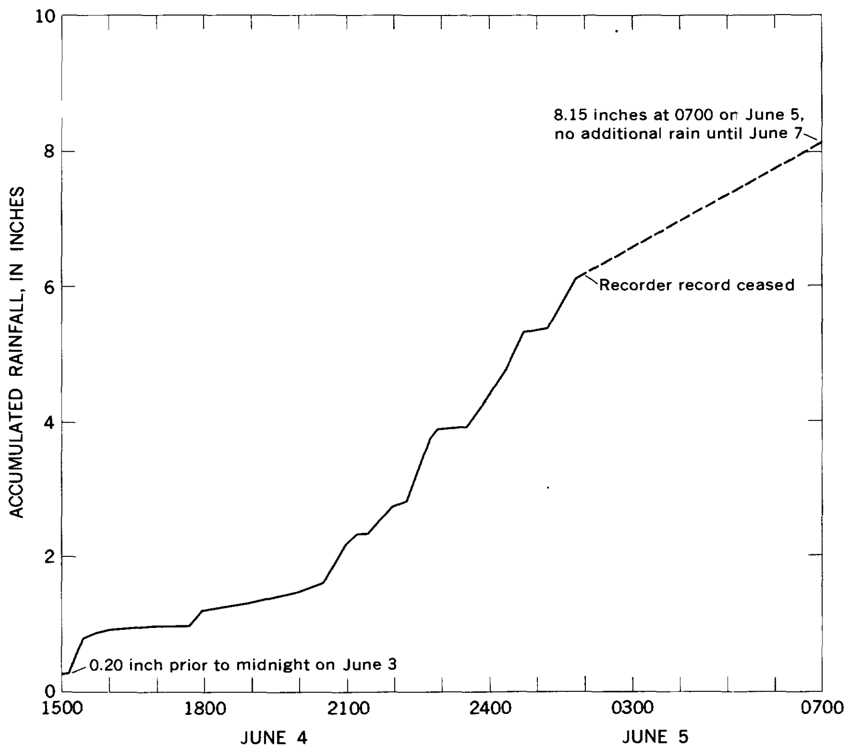



FIGURE 21.—Accumulated precipitation from recording rain gage at Cambridge sewage plant for June 4–5. Data from U.S. Weather Bureau.

Peak discharges in the flood area are shown in table 14. Peak discharges in the Crooked Creek basin were extremely high. Large overbank storage in Crooked Creek above the railroad bridge near Cambridge reduced the peak discharge; although the high discharge destroyed the bridge, it was not as spectacular as the peak discharge on Peters Creek, a tributary above the bridge. The peak discharge on Peters Creek (20,200 cfs from 9.94 sq mi) exceeded the Myers rating of any previously known peak in Ohio. The enveloping line for the maximum floods in Ohio is a 60-percent Myers-rating line, whereas the Myers rating of the Peters Creek peak of June 1963 is 64 percent. A recurrence interval could not be computed for the unusually great magnitude of the peak on Peters Creek, but the recurrence of such a large peak would be extremely rare at this site.

TABLE 14.—*Flood stages and discharges, June 4–6, in the vicinity of Cambridge, Ohio*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to June 1963: Period | Maximum floods: Prior to June 1963: Year | Maximum floods: June 1963 | Maximum floods: Gage height (feet) | Maximum floods: Discharge (cfs) |
|---|---|---|---|---|---|---|---|
| | **Muskingum River basin** | | | | | | |
| 1 | Senecaville Reservoir near Senecaville | 121 | 1938–63 | 1945 | | 25.22 | [1] 63,370 |
| | | | | | 8 | 23.97 | [1] 58,080 |
| 2 | Wills Creek at Cambridge | 406 | 1935 | 1935 | | 25.4 | ([2]) |
| | | | 1926–28, 1937–63 | 1945 | | 21.32 | 7,860 |
| | | | | | 6 | [3] 22.55 | [4] 8,500 |
| 3 | Crooked Creek near New Concord | 1.50 | | | 4 or 5 | | 1,400 |
| 4 | Peters Creek near Cambridge | 9.94 | | | 4 or 5 | | 20,200 |
| 5 | Crooked Creek at Cambridge | 56.4 | | | 4 or 5 | | ([5]) |
| 6 | Salt Fork near Cambridge | 55.6 | 1956–63 | 1963 | | 11.90 | 3,700 |
| | | | | | 5 | | 500 |
| 7 | Wills Creek Reservoir near Wills Creek | 844 | 1938–63 | 1963 | | 39.56 | [1] 32,000 |
| | | | | | 11 | 33.06 | [1] 84,190 |

[1] Storage in acre-feet.
[2] Unknown.
[3] Affected by backwater.
[4] Affected by storage.
[5] Bridge at site washed out. The discharge may have been about 12,600 cfs and rising at the time of the destruction of the bridge. After failure, the discharge could have been as high as 26,000 cfs for a short time, with 6,000 cfs or more coming out of storage from the pond above the bridge site.

Most of the runoff during June was from the storm of June 4–5; therefore, the monthly figures of runoff can be used to indicate the storm runoff pattern in the flood area. For the month of June, Seneca Fork below Senecaville Dam had an adjusted runoff of 3.11 inches; Wills Creek at Cambridge had 3.92 inches; Salt Fork near Cambridge had 1.24 inches; and Wills Creek below Wills Creek Reservoir had 4.14 inches. The runoff from the area between Cambridge and Wills Creek Reservoir, excluding Salt Fork, was about 4.8 inches from 383 sq. mi. Although the heaviest part of the storm was centered downstream from the gaging station on Wills Creek at Cambridge, the peak at the station was the highest since construction of Senecaville Dam in 1937. The flow in Seneca Fork immediately below Senecaville Dam from June 4–7 was less than 10 cfs.

## FLOODS OF JUNE IN SOUTHWESTERN IDAHO AND NORTHEASTERN NEVADA

By C. A. Thomas

Floods of an extent and severity unusual for the area, and hence of considerable hydrologic interest, occurred in the Bruneau River and tributaries and in the Owyhee River tributaries in southwestern Idaho and northeastern Nevada during the period June 4–15. The peak discharge was about 130 percent of the previous maximum in 17 years of record in the East Fork Bruneau River. Flow at Bruneau River near Hot Spring, Idaho (station 14), was exceeded during the period of record (1909–15, 1944–63) by only the flood of March 1, 1910, and correlative studies indicate that the 1963 flood was probably higher than any flow since 1910. Local residents report Sheep Creek and Marys Creek had not been higher in more than 40 years (table 15). The area of flooding and points of measurement of peak discharges are shown in figure 22.

The flooding resulted from unusually large amounts of precipitation. The U.S. Geological Survey had operated eight storage precipitation gages since 1962, and the U.S. Weather Bureau had operated five daily and two recording gages for longer periods in the flood area. Isohyetal lines based on the precipitation records are shown in figure 22 for the period May 31–June 5. Daily precipitation at the eight storage gages was estimated for the period on the basis of total catch for a longer period and daily records for the nearby observation stations. Precipitation during the 6-day period, May 31–June 5, at Mountain City, Nev., and evidently at several of the storage gages exceeded the 7-day precipitation for a 100-year return period (U.S. Weather Bureau, 1964). During the month of June, precipitation was 200 to 500 percent of normal at the U.S. Weather Bureau stations, and the antecedent precipitation was relatively heavy. Precipitation during April was about twice normal for the month, and May precipitation was well above normal. Snowmelt contributed to the runoff, especially in the Jarbidge River tributaries and in other high-altitude tributaries. Runoff from the area of lower altitudes in the basin contributed little to the flood. The area is desert or semidesert; infiltration rates are high; and runoff is negligible during many successive years.

Damage was limited to bridges, roads, and erosion of grazing land and meadow land. Bridges on the principal roads across Sheep Creek and Marys Creek were washed away, and the area served by the bridges was isolated for several weeks. Other bridges and several stretches of roads were destroyed. The flooded areas are very sparsely populated and are used principally for cattle production.

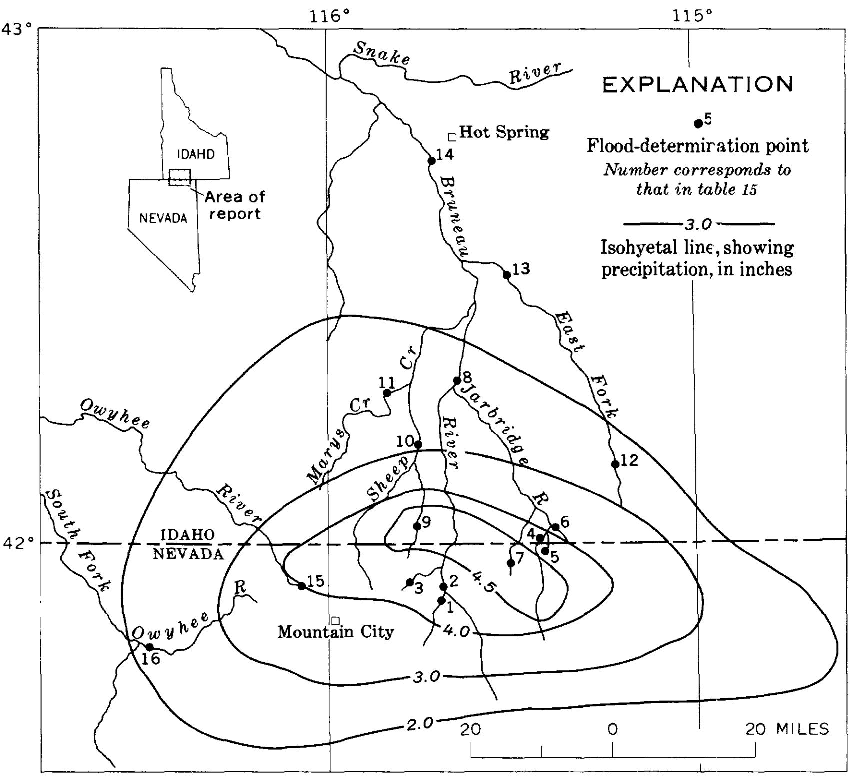



FIGURE 22.—Location of flood-determination points and isohyets for May 31–June 5, floods of June 1963, in southwestern Idaho and northeastern Nevada.

TABLE 15.—*Flood stages and discharges, June 1963, in southwestern Idaho and northeastern Nevada*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to June 1963 — Period | Year | June 1963 | Gage height (feet) | Discharge — Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Bruneau River basin** | | | | | | | |
| 1 | Meadow Creek near Rowland, Nev | 58.0 | | | 4 | 14.93 | 940 | (1) |
| 2 | Bruneau River near Rowland, Nev | 374 | 1913–18, 1962 | 1962 | | 13.0 | 2,120 | |
| 3 | McDonald Creek near Rowland, | | | | 4 | 11.70 | 1,270 | (1) |
| | Nev | 10.8 | | | 4 | 9.42 | 60 | (1) |
| 4 | Jarbidge River near Murphy Hot Springs, Idaho | 56.8 | 1962 | 1962 | | 6.88 | 447 | |
| | | | | | 15 | 7.25 | 460 | (1) |
| 5 | Buck Creek near Jarbidge, Nev | 25.8 | | | 6 | 19.82 | 276 | (1) |
| 6 | East Fork Jarbidge River near Three Creek, Idaho | 84.6 | 1929–32, 1954–63 | 1962 | | 4.95 | 693 | |
| | | | | | 15 | 5.34 | 676 | (1) |
| 7 | Columbet Creek near Jarbidge, Nev | 3.40 | | | 6 | 7.96 | 32 | (1) |
| 8 | Bruneau River near Grasmere, Idaho | 1,040 | | | 8 | 20.7 | 2,600 | (1) |
| 9 | Cat Creek near Rowland, Nev | 9.56 | | | 4 | 4.66 | 34 | (1) |
| 10 | Sheep Creek near Grasmere, Idaho | 215 | | | 4 | 22.9 | 2,760 | 40+ |
| 11 | Marys Creek near Grasmere, Idaho | 145 | | | 4 | 23.0 | 1,770 | 40+ |
| 12 | East Fork Bruneau River near Three Fork, Idaho | 210 | 1955–60, 1962 | 1957 | | 7.43 | 451 | |
| | | | | | 8 | 8.21 | 665 | 20+ |
| 13 | East Fork Bruneau River near Hot Spring, Idaho | 620 | 1911–14, 1949–63 | 1957 | | 7.12 | 463 | |
| | | | | | 8 | 8.29 | 619 | 20+ |
| 14 | Bruneau River near Hot Spring, Idaho | 2,630 | 1909–15, 1944–63 | 1910 | | 13.0 | 6,500 | |
| | | | | | 5 | 11.66 | 5,990 | 30+ |
| | **Owyhee River basin** | | | | | | | |
| 15 | Owyhee River above China diversion dam near Owyhee, Nev | 458 | 1939–63 | 1952 | | 10.07 | 2,710 | |
| | | | | | 5 | 9.61 | [2]1,760 | (1) |
| 16 | South Fork Owyhee River near Whiterock, Nev | 1,080 | 1955–63 | 1957 | | 7.17 | 3,420 | |
| | | | | | 5 | 7.55 | 3,830 | (1) |

[1] Not determined.
[2] Area above Wild Horse Dam, 209 sq mi, noncontributing.

## FLOODS OF JUNE IN NEBRASKA

By H. D. BRICE

Record-breaking flood discharges occurred June 5 in Tekamah Creek basin (fig. 23) as the result of heavy localized rainfall. The greatest observed rainfall was at the U.S. Weather Bureau gage at Herman, Nebr., where 5.0 inches fell during the 2-day period, June 4–5. Greater amounts may have fallen in Tekamah Creek basin, a short distance north of Herman. The magnitude of the peak discharges from three small areas in the basin ranged from 1.0 to 1.5 times the previous maximum peaks in 14 years of record, and the recurrence interval of the peak from each area was greater than 50 years (table 16).

Damage was predominantly by erosion of stream banks and cropland.

Flooding on June 24–25 in several adjoining basins in east-central Nebraska (fig. 23) was the most severe in local history. The peak discharges for the 18 sites listed in table 16 attest to the magnitude of the 1963 flood peaks in relation to earlier known flood peaks.

The amount of rainfall that caused the flooding is illustrated by figure 24, adapted from a map prepared by the Corps of Engineers, Omaha District, from data collected by that agency, the U.S. Weather Bureau, the U.S. Geological Survey, and the Lincoln Telephone Company and from local residents. These data were supplemented by records from recording rain gages operated at David City

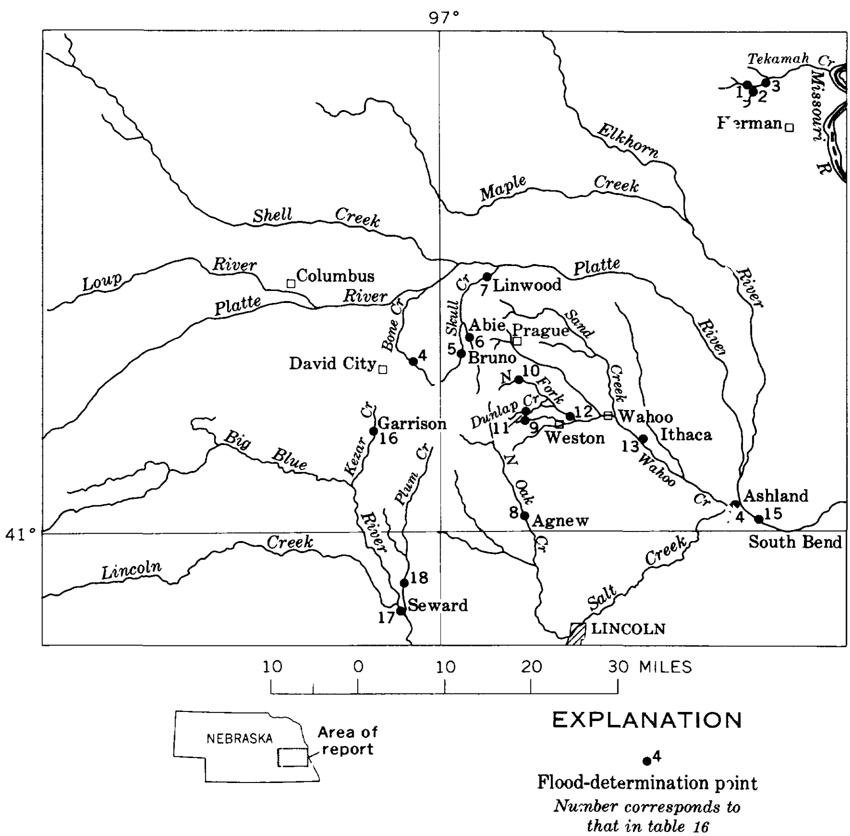



FIGURE 23.—Location of flood-determination points, June 5 and June 24–25, in east-central Nebraska.

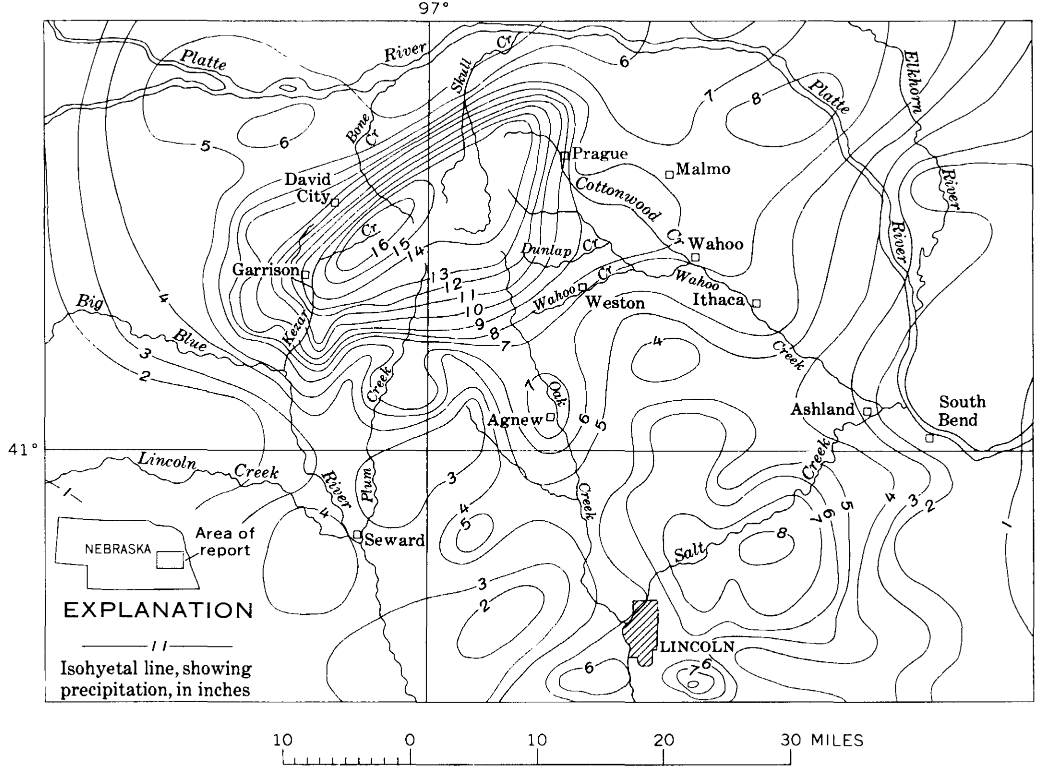



**Figure 24.—Isohyetal map for storm of June 23–24 in east-central Nebraska. Adapted from map prepared by Corps of Engineers, Omaha District.**

TABLE 16.—*Flood stages and discharges, June 5 and June 24–25, in east-central Nebraska*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to June 1963 — Period | Prior to June 1963 — Year | June 1963 | Gage height (feet) | Discharge — Cfs | Discharge — Ratio to 50-year flood |
|---|---|---|---|---|---|---|---|---|
| | **Tekamah Creek basin** | | | | | | | |
| 1 | South Branch Tekamah Creek near Craig | 2.54 | 1950–63 | 1950 | | 21.3 | 2,580 | |
| | | | | | 5 | 18.91 | 2,570 | 1.26 |
| 2 | South Branch Tekamah Creek tributary near Tekamah | 4.08 | 1950–63 | 1950 | | 19.3 | 1,800 | |
| | | | | | 5 | 18.20 | 2,750 | 1.04 |
| 3 | South Branch Tekamah Creek near Tekamah | 9.73 | 1950–63 | 1954 | | 20.17 | 3,130 | |
| | | | | | 5 | 22.33 | 4,560 | 1.06 |
| | **Platte River basin** | | | | | | | |
| 4 | Bone Creek near David City | 9.60 | | | 24 | | 20,900 | 3.02 |
| 5 | Skull Creek near Bruno | 8.25 | | | 24 | | 20,400 | 3.17 |
| 6 | East Branch Skull Creek near Abie | 26.3 | | | 24 | | 32,400 | 2.57 |
| 7 | Skull Creek near Linwood | 72.0 | | | 24 | | 74,800 | 3.40 |
| 8 | North Oak Creek at Agnew | 88.4 | | | 24 | | 27,800 | 1.13 |
| 9 | Wahoo Creek tributary near Weston | .31 | 1950–63 | 1951 | | 13.90 | 550 | |
| | | | | | 24 | 19.05 | 923 | [1] 39 |
| 10 | North Fork Wahoo Creek near Prague | 15.2 | 1951–63 | 1951, 1959 | | [2] | 12,800 | |
| | | | | | 24 | 31.90 | 15,900 | 1.79 |
| 11 | Dunlap Creek near Weston | 8.90 | 1950–63 | 1951 | | 16.74 | 4,130 | |
| | | | | | 24 | 22.10 | 13,800 | 1.98 |
| 12 | North Fork Wahoo Creek at Weston | 43.7 | 1951–63 | 1951 | | | 9,600 | |
| | | | | | 24 | 25.82 | 81,400 | 4.95 |
| 13 | Wahoo Creek at Ithaca | 272 | 1910–63 | 1959 | | 23.22 | 45,300 | |
| | | | | | 24 | 22.93 | 77,400 | 1.68 |
| 14 | Salt Creek near Ashland | 1,640 | 1947–63 | 1951 | | 14.72 | 46,200 | |
| | | | | | 25 | 14.82 | 87,000 | [1] 19 |
| 15 | Platte River near South Bend | 85,500 | 1881–1963 | 1960 | | [3] 12.45 | 124,000 | |
| | | | | | 25 | 10.62 | 119,000 | [1] 50 |
| | **Kansas River basin** | | | | | | | |
| 16 | Kezar Creek near Garrison | 43.5 | | | 24 | | 43,600 | 14.5 |
| 17 | Big Blue River at Seward | 1,070 | 1954–63 | 1957 | | 22.34 | 15,300 | |
| | | | | | 25 | 21.81 | 15,000 | [1] 30 |
| 18 | Plum Creek near Seward | 88.2 | | | 24 | | 20,200 | 4.34 |

[1] Recurrence interval, in years.
[2] Not determined.
[3] At different site and datum.

and Malmo that show that most of the 9.71 and 8.75 inches recorded at those sites, respectively, fell within the 6-hour period between 0300 and 0900 hours on June 24.

A local resident southeast of David City observed 16.5 inches of rainfall of which 12.7 inches fell between 0510 and 0910 hours, and 3.7 inches fell prior to 0510 hours on June 24. Because of the nearness of this site (sec. 32, T. 15 N., R. 3 E., Butler County) to the recording gage at David City, it is reasonable to assume that part of the 3.7 inches fell between 0300 and 0500 hours; thus, the total rainfall at this site was between 13 and 16 inches during the 6 hours from 0300 to 0900 hours. This is about three times the 100-year 6-hour rainfall designated by the U.S. Weather Bureau (1961) as the point rainfall that may be expected to recur in this vicinity on an average of once in 100 years.

Also of hydrologic significance is the large area, about 15 miles wide and 30 miles long, between David City and Malmo (fig. 24) that received rainfall ranging from 6 to 16.5 inches in approximately 6 hours. Estimating the recurrence interval for such an event is far beyond the limitations of presently available data.

Peak discharges for the June 24–25 flood at the 15 sites listed in table 16 are the most outstanding of those determined within the storm area. Runoff at three sites exceeded 2,000 cfs per sq mi, and at 10 sites it equaled or exceeded 1,000 cfs per sq mi. Exceptionally high runoff rates were 2,977 cfs per sq mi from the 0.31-sq mi area upstream from the gage on Wahoo Creek tributary near Weston and 1,863 cfs per sq mi from the 43.7-sq mi drainage area of North Fork Wahoo Creek at Weston.

Local residents of some areas described the flooding as the most severe of any they could remember. Twenty-five cities and villages and more than 600 families suffered property loss. Three lives were lost by drowning. This toll might have been higher had not private boat owners rescued many persons from the tops of stranded cars and from second-story house levels, and had not Nebraska Air National Guard helicopters rescued several farm families after flood waters surrounding their homes.

The village of Linwood, near the mouth of Skull Creek, was especially hard hit when 65 of its 72 buildings were severely damaged. Some buildings were carried as far as two blocks from their foundations by what was described as "a 4-foot wall of water."

Eight counties were declared disaster areas and thus became eligible to receive Federal aid for repair and rehabilitation work and for crop damage. More than 200 bridges in these eight counties were destroyed or damaged in various degrees, and many miles of roadways on flood plains were damaged by scour of the road bed and shoulders or by loss of gravel or crushed-stone surfacing material. In Lancaster County alone, nine bridges were lost, and highway and bridge damage was estimated to be $237,000.

More than 96,000 acres of cropland was inundated in Saunders County, and the total for the eight-county area was estimated to be several times that amount. Crop loss in Butler County reportedly was confined to low land along about 100 miles of stream channels where numerous small lakes were formed when floodwater filled undrained depressions on the flood plains.

Crop recovery was, however, evaluated as excellent. Topsoil loss by erosion on upland areas may be expected to have a far-reaching effect on future crops.

The total property damage from this severe flood was estimated by the U.S. Weather Bureau (1965) to have been $13 million.

## FLOODS OF JUNE 15–17 IN NORTH-CENTRAL WYOMING

By Kenneth B. Rennick

In north-central Wyoming, runoff from snowmelt started early in June, and streamflows were generally in their recession phase when rains began on June 14. The rains caused rapid melting of the remaining snowpacks, and the consequent runoff caused flooding in the area shown in figure 25. The form of the precipitation varied from steady

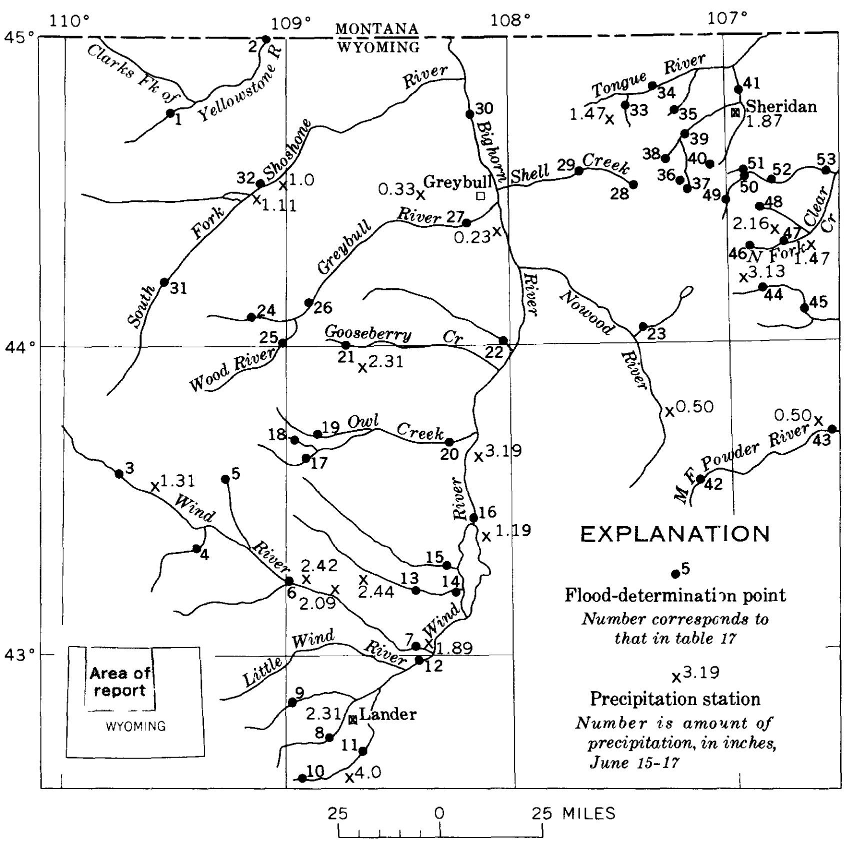



Figure 25.—Location of flood-determination points and precipitation sites, floods of June 15–17, north-central Wyoming.

gentle rainfall to locally intense storms on scattered mountain areas. Rainfall amounts ranged from about 0.5 inch at lower elevations to unofficial amounts of more than 4 inches in areas of intense storms; the rapid runoff and floods were caused by the rain falling on melting snow. Steady rain fell on the upper Wind River basin in the southwestern part of the flood area. Intense storms occurred in the south over streams tributary to the Wind River, in the east-central part over the Big Horn Mountains, and in the northwest on the upper basins of the Greybull and Shoshone Rivers. Peak discharges at most gaging stations in the flood area exceeded those for the periods of record (see table 17). The areas of heaviest runoff were in the southern tributaries to the Wind River, in upper Clear Creek and tributaries, and in the upper Tongue River basin.

TABLE 17.—*Flood stages and discharges in the Yellowstone River basin, June 15–17, in north-central Wyoming*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to June 1963: Period | Prior to June 1963: Year | June 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yr) |
|---|---|---|---|---|---|---|---|---|
| 1 | Sunlight Creek near Painter | 135 | 1918–63 | 1918 | | 5.8 | 4,000 | |
| | | | | | 15 | 3.34 | 1,230 | 3 |
| 2 | Clarks Fork Yellowstone River at Chance, Mont | 1,154 | 1921–63 | 1928 | | [1] 6.5 | 10,900 | |
| | | | | | 16 | 7.03 | 7,860 | 2 |
| 3 | Wind River near Dubois | 232 | 1946–63 | 1956 | | 5.66 | 1,910 | |
| | | | | | 15 | 5.05 | 1,390 | <2 |
| 4 | Dinwoody Creek above lakes near Burris | 88.2 | 1958–63 | 1959 | | 4.17 | 876 | |
| | | | | | 16 | 4.57 | 1,270 | 2 |
| 5 | Crow Creek near Tipperary | 30 | | | 15 | 4.80 | 340 | ([2]) |
| 6 | Wind River near Crowheart | 1,891 | 1927 | 1927 | | ([2]) | 13,000 | |
| | | | 1946–63 | 1957 | | 9.08 | 11,400 | |
| | | | | | 16 | 9.16 | 13,000 | 4 |
| 7 | Wind River at Riverton | 2,309 | 1906, 1908, 1911–63 | 1935 | | 8.15 | 13,300 | |
| | | | | | 17 | 9.49 | 9,050 | ([2]) |
| 8 | Middle Popo Agie River below The Sinks near Lander | 87.5 | 1960–63 | 1961 | | 4.68 | 1,010 | |
| | | | | | 16 | 7.69 | 4,180 | [3] 1.27 |
| 9 | North Popo Agie River near Milford | 98.4 | 1946–63 | 1952 | | 6.59 | 2,060 | |
| | | | | | 16 | 9.44 | 4,500 | [3] 1.26 |
| 10 | Little Popo Agie River near Atlantic City | 5.99 | 1958–63 | 1958 | | | 138 | |
| | | | do | 1962 | | [4] 3.07 | | |
| | | | | | 16 | 2.61 | 135 | ([2]) |
| 11 | Little Popo Agie River near Lander | 125 | 1946–63 | 1952 | | 5.83 | 1,160 | |
| | | | | | 16 | 6.64 | 2,010 | 16 |
| 12 | Little Wind River near Riverton | 1,851 | 1941–63 | 1962 | | 10.13 | 1[illegible],300 | |
| | | | | | 17 | 10.85 | 14,700 | ([2]) |
| 13 | Fivemile Creek near Riverton | 356 | 1950–58, 1960–63 | 1950 | | 11.0 | 1,690 | |
| | | | | | 15 | 10.04 | 1,440 | 4 |
| 14 | Fivemile Creek near Shoshoni | 418 | 1923 | 1923 | | ([2]) | 3,500 | |
| | | | 1941–42, 1949–63 | 1962 | | 7.85 | 3,390 | |
| | | | | | 15 | 6.43 | 2,070 | 7 |
| 15 | Muddy Creek near Shoshoni | 332 | 1923–63 | 1923 | | ([2]) | 16,300 | |
| | | | 1949–63 | 1951 | | 7.50 | 1,430 | |
| | | | | | 15 | 7.10 | 1,410 | 2 |

See footnotes at end of table.

TABLE 17.—*Flood stages and discharges in the Yellowstone River basin, June 15–17, in north-central Wyoming*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to June 1963: Period | Maximum floods: Prior to June 1963: Year | Maximum floods: June 1963 | Maximum floods: Gage height (feet) | Maximum floods: Discharge: Cfs | Maximum floods: Discharge: Recurrence interval (yr) |
|---|---|---|---|---|---|---|---|---|
| 16 | Wind River below Boysen Reservoir | 7,701 | 1951–63 | 1951 | | 11.90 | 11,100 | |
| | | | | | 21 | 10.69 | [5] 8,490 | (2) |
| 17 | South Fork Owl Creek near Anchor | 86.3 | 1940–43, 1959–63 | 1941 | | 7.59 | 1,940 | |
| | | | | | 15 | 4.04 | 908 | 4 |
| 18 | Middle Fork Owl Creek above Anchor | 33.6 | 1959–63 | 1962 | | 5.72 | 538 | |
| | | | | | 15 | 3.61 | 146 | <2 |
| 19 | North Fork Owl Creek below Cup Creek near Anchor | 60 | 1962–63 | 1962 | | 2.04 | 626 | |
| | | | | | 15 | (2) | 1,370 | 18 |
| 20 | Owl Creek near Thermopolis | 478 | 1911–12, 1915–17, 1932, 1938–63 | 1944 | | 5.61 | 1,190 | |
| | | | | | 15 | 8.73 | 7,030 | [3] 1.07 |
| 21 | Gooseberry Creek at Dickie | 95.0 | 1958–63 | 1962 | | 3.45 | 275 | |
| | | | | | 15 | 5.66 | 1,130 | 14 |
| 22 | Fifteen Mile Creek near Worland | 518 | 1951–63 | 1952 | | [1] 5.77 | 3,300 | |
| | | | | | 15 | 3.54 | 577 | <2 |
| 23 | Tensleep Creek near Tensleep | 247 | 1911–12, 1915–24, 1944–63 | 1924 | | 7.05 | 2,890 | |
| | | | | | 16 | 6.23 | 2,230 | 4 |
| 24 | Greybull River near Pitchfork | 282 | 1946–49, 1951–63 | 1957 | | 6.98 | 5,700 | |
| | | | | | 15 | 7.68 | 8,610 | 21 |
| 25 | Wood River at Sunshine | 194 | 1946–63 | 1952 | | | 2,260 | |
| | | | | | 15 | 7.00 | 5,080 | 19 |
| 26 | Greybull River at Meeteetse | 681 | 1897, 1903, 1921–63 | 1937 | | [1] 7.47 | 1[illegible],500 | |
| | | | | | 15 | 9.20 | 13,600 | [3] 1.23 |
| 27 | Greybull River near Basin | 1,115 | 1930–63 | 1957 | | 5.90 | 9,300 | |
| | | | | | 16 | 8.83 | 1[illegible] 400 | [3] 2.01 |
| 28 | Shell Creek above Shell Creek Reservoir | 23.1 | 1957–63 | 1961 | | 6.18 | 870 | |
| | | | | | 15 | 7.84 | 1,870 | (2) |
| 29 | Shell Creek near Shell | 145 | 1941–63 | 1945 | | 7.49 | 3,020 | |
| | | | | | 15 | 6.09 | 2,320 | 3 |
| 30 | Bighorn River at Kane | 15,765 | 1923–63 | 1923 | | [1] 14.8 | (2) | |
| | | | 1929–63 | 1935 | | [1] 11.10 | 25,200 | |
| | | | | | 17 | 10.62 | [4] 24,200 | (2) |
| 31 | South Fork Shoshone River near Valley | 297 | 1957–58, 1960–63 | 1962 | | 6.66 | 4,850 | |
| | | | | | 15 | 8.83 | 6,610 | [3] 1.40 |
| 32 | Shoshone River below Buffalo Bill Reservoir | 1,538 | 1918 | 1918 | | (2) | 18,700 | |
| | | | 1921–63 | 1928 | | [1] 10.62 | [5] 14,700 | |
| | | | | | 21 | 9.33 | [5] 8,860 | (2) |
| 33 | South Fork Tongue River near Dayton | 85.0 | | (2) | | 6.36 | (2) | |
| | | | 1946–63 | 1956 | | 5.62 | 1,120 | |
| | | | | | 15 | 6.24 | 1,670 | 12 |
| 34 | Tongue River near Dayton | 204 | 1919–29, 1941–63 | 1944 | | 6.45 | 3,400 | |
| | | | | | 15 | 5.42 | 2,630 | 8 |
| 35 | Wolf Creek at Wolf | 37.8 | 1944–63 | 1944 | | 5.0 | 1,100 | |
| | | | | | 15 | 4.60 | 1,130 | [3] 1.28 |
| 36 | [illegible]st Goose Creek near Big Horn | 20.3 | 1954–63 | 1957 | | | 580 | |
| | | | do | 1961 | | 4.21 | | |
| | | | | | 15 | 3.59 | 1,230 | 28 |
| 37 | Cross Creek above Big Horn Reservoir | 9.29 | 1961–63 | 1961 | | (2) | [5] 149 | |
| | | | | | 15 | 6.02 | [5] 285 | (2) |

See footnotes at end of table.

TABLE 17.—*Flood stages and discharges in the Yellowstone River basin, June 15-17, in north-central Wyoming*—Continued

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to June 1963: Period | Maximum floods: Prior to June 1963: Year | Maximum floods: June 1963 | Maximum floods: Gage height (feet) | Maximum floods: Discharge: Cfs | Maximum floods: Discharge: Recurrence interval (yr) |
|---|---|---|---|---|---|---|---|---|
| 38 | West Goose Creek near Big Horn | 24.4 | 1954–63 | 1956 | | | [5] 582 | |
| | | | do | 1957 | | 4.45 | | |
| | | | | | 15 | 5.37 | [5] 1,030 | (2) |
| 39 | Goose Creek near Sheridan | 120 | 1930–63 | 1937 | | 4.89 | 1,900 | |
| | | | | | 15 | 5.83 | 3,160 | (2) |
| 40 | Little Goose Creek in canyon near Big Horn | 55 | 1941–63 | 1946 | | 6.13 | 1,080 | |
| | | | | | 15 | 6.78 | 1,350 | 14 |
| 41 | Goose Creek below Sheridan | 392 | 1942–63 | 1962 | | 5.66 | 4,100 | |
| | | | | | 16 | 7.82 | 5,450 | (2) |
| 42 | Middle Fork Powder River near Barnum | 46 | 1962–63 | 1962 | | 4.17 | 488 | |
| | | | | | 15 | 12.6 | 7,110 | [3] 8.33 |
| 43 | Powder River near Kaycee | 980 | 1923–63 | 1923 | | 18 | (2) | |
| | | | 1934–36, 1938–63 | 1941 | | 12.57 | 5,230 | |
| | | | | | 15 | 5.98 | 1,270 | <2 |
| 44 | North Fork Crazy Woman Creek below Spring Draw near Buffalo | 51.7 | 1949–63 | 1949 | | 5.42 | 610 | |
| | | | | | 15 | 5.83 | 1,020 | 7 |
| 45 | North Fork Crazy Woman Creek near Greub | 174 | 1950–63 | 1962 | | 9.05 | 1,050 | |
| | | | | | 16 | 7.05 | 632 | (2) |
| 46 | North Fork Clear Creek near Buffalo | 29 | 1950–63 | 1952 | | [4] 4.91 | | |
| | | | do | 1952 | | | 407 | |
| | | | | | 15 | 3.95 | 675 | (2) |
| 47 | Clear Creek near Buffalo | 120 | 1894, 1896–99, 1917–27, 1938–63 | 1962 | | 5.29 | 1,390 | |
| | | | | | 15 | 6.19 | 3,420 | [2] 1.09 |
| 48 | Rock Creek near Buffalo | 60 | 1941–63 | 1944 | | 8.05 | | |
| | | | do | 1945 | | | 1,810 | |
| | | | | | 15 | 7.98 | 1,860 | [3] 1.26 |
| 49 | South Piney Creek at Willow Park | 33.6 | 1946, 1948–57, 1960–63 | 1957 | | [1] 4.79 | 649 | |
| | | | | | 15 | 4.68 | [5] 1,620 | [3] 1.07 |
| 50 | South Piney Creek near Story | 70.5 | 1951–63 | 1957 | | 4.00 | [5] 1,350 | |
| | | | | | 15 | | [5] 2,090 | (2) |
| | | | | | 15 | [6] 5.30 | | |
| 51 | North Piney Creek near Story | 37.7 | 1951–63 | 1956 | | 4.57 | 1,230 | |
| | | | | | 15 | 5.04 | 1,820 | [3] 1.94 |
| 52 | Piney Creek at Kearney | 106 | 1903–06, 1911–17, 1919–23, 1924–63 | 1944 | | 5.32 | [5] 2,570 | |
| | | | | | 15 | 6.05 | [5] 3,410 | (2) |
| 53 | Piney Creek at Ucross | 267 | 1917–63 | 1929 | | 10.9 | (2) | |
| | | | 1917–23, 1950–63 | 1923 | | 6.0 | [5] 2,580 | |
| | | | | | 16 | 7.33 | [5] 3,570 | 13 |

[1] At different site and datum.
[2] Unknown.
[3] Ratio of peak discharge to 50-year flood.
[4] Affected by backwater from ice.
[5] Affected by storage in reservoir or reservoirs.
[6] Affected by backwater from slide.

One death, a small boy who drowned in the city of Sheridan, was attributed to the flood. Property damage was heavy in the cities of Lander and Sheridan where many homes and businesses were flooded. Near Greybull many farm homes were flooded, and irrigation structures were destroyed or severely damaged. Three stream-gaging structures were destroyed by the floods.

## FLOOD OF JUNE 16 IN UPPER DUCHESNE RIVER, UTAH

On June 16, failure of a dam on Little Deer Creek, a tributary to the upper Duchesne River, caused a record-breaking flood in Deer Creek and for many miles downstream in the Duchesne River (fig. 26). The dam apparently failed before the water reached the spillway crest. The 1,000 acre-feet of water that was estimated to have been impounded at the time of failure was released in a short period of about 20 minutes.

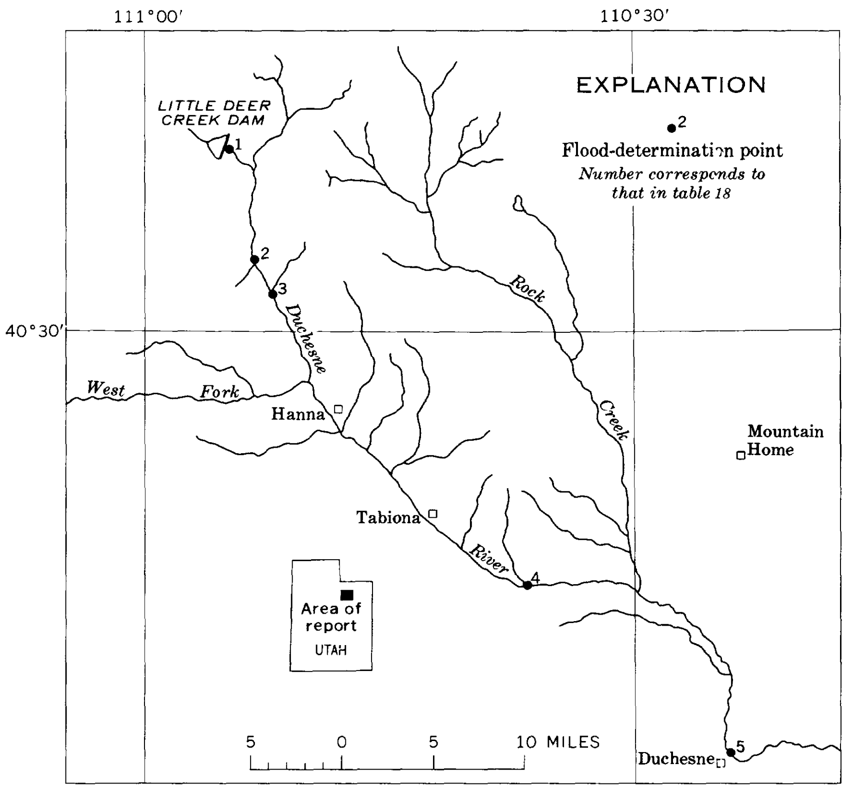



**FIGURE 26.**—Location of flood-determination points, flood of June 16, in upper Duchesne River, Utah.

There was very little inflow to the Duchesne River from other tributaries, and the flood peak was rapidly reduced from an estimated discharge of 47,000 cfs below the dam to 2,980 cfs at Duchesne (table 18).

The movement of the peak discharge of this flood cannot be compared with a peak from normal storm runoff, and relation to recurrence interval is impractical because of the unnatural cause of the flood.

The peak discharge on the Duchesne River from the mouth of Deer Creek to Hanna was of a magnitude difficult to describe or to compare with other known unusually great peaks in this area. The probability of a flood of this magnitude to recur in this reach of the Duchesne River is extremely small.

TABLE 18.—*Flood stages and discharges, June 16, in upper Duchesne River, Utah*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to June 1963: Period | Prior to June 1963: Year | June 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Green River basin** | | | | | | | |
| 1 | Damsite on Little Deer Creek | | | | 16 | | [1] 47,000 | |
| 2 | Duchesne River, sec. 22, T. 2 N., R. 9 W., Uinta meridian, 10 miles northwest of Hanna | 19 | | | 16 | | 38 700 | |
| 3 | Duchesne River near Hanna | 78 | 1922–23, 1929–30, 1946–63 | 1953 | | [2] 5.65 | 1,500 | |
| | | | | | 16 | 12.38 | 17,500 | [3] 12.6 |
| 4 | Duchesne River near Tabiona | 352 | 1919–63 | 1921 | | | 2,500 | |
| | | | | | 16 | 7.97 | 5,260 | [3] 1.7 |
| 5 | Duchesne River at Duchesne | 660 | 1917–63 | 1922 | | [2] 8.65 | 4,420 | |
| | | | | | 16 | 4.68 | 2,980 | 2 |

[1] Estimated by Utah Water and Power Board.
[2] Site and datum then in use.
[3] Ratio of peak discharge to 50-year flood.

After the floodwater emptied into the Duchesne River and arrived at the point of indirect measurement, 10 miles northwest of Hanna (station 2), it was still 38,700 cfs. The drainage area at station 2 was estimated to be 19 sq mi, and a 50-year natural flood at this point would be about 480 cfs.

At Duchesne River near Hanna (drainage area, 78 sq mi), about 2 miles below station 2, the peak discharge was reduced to 17,500 cfs, principally because of channel and overbank storage. The low probability of the recurrence of this peak is illustrated by the fact that a 50-year natural flood at this point is 1,370 cfs.

After the great reduction of the peak discharge in the Duchesne River from 17,500 cfs at the gaging station near Hanna to 5,260 cfs at the gaging station near Tabiona, it was still more than twice the previous maximum in a 45-year period of record and was 1.7 times a 50-year flood. The peak discharge near Hanna was 17,500 cfs, but the mean for the day was only 630 cfs, a daily mean discharge which indicates that the flood peak was very sharp and of relatively short duration.

One person drowned in the flood, and damage to bridges and other property was more than $100,000.

## FLOOD OF JUNE 29 ON GIANT OF THE VALLEY MOUNTAIN NEAR ST. HUBERTS, N.Y.

By F. Luman Robison and Charles L. O'Donnell

An intense cloudburst struck in the vicinity of Giant of the Valley Mountain near St. Huberts in the Adirondacks (fig. 27) on June 29. After an hour, 3.75 inches of rain was observed in a rain gage near the base of the mountain. The storm lasted for an hour and a half and produced 4.25 inches. At Keene Valley, about 4 miles away, only 0.25 inch of rain fell. It appeared that the core of the deluge was concentrated in an area about 1 mile square centered on Giant of the Valley Mountain. The unusually high intensity of the storm is evident when compared with the estimated expectancy for this area of a 100-year 1-hour rainfall of 2.4 inches (U.S. Weather Bureau, 1961).

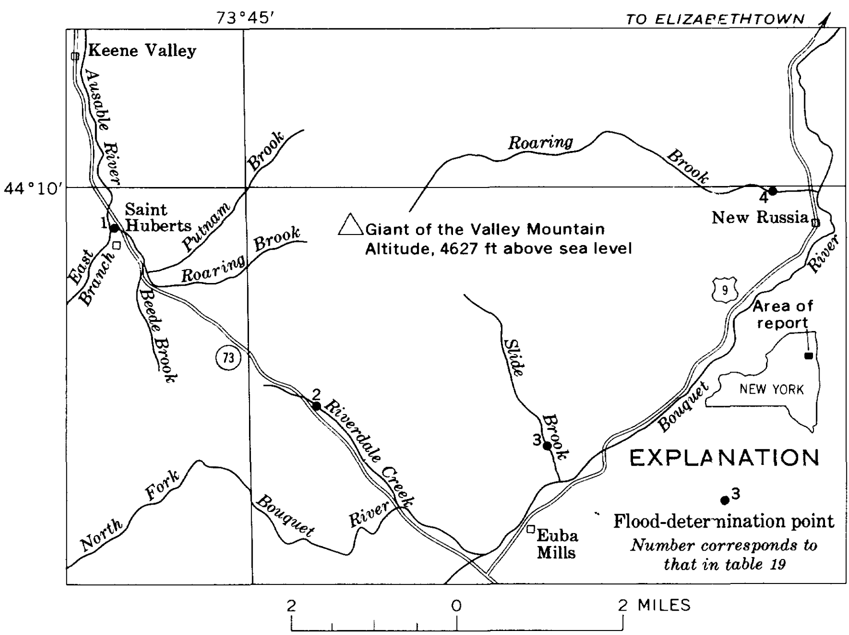



FIGURE 27.—Location of flood-determination points, floods of June 29, on Giant of the Valley Mountain, N.Y.

The unusually heavy rain on the mountainsides triggered several landslides. The mass of water, mud, boulders, and uprooted trees rushing down the mountain gouged out new channels, wrecked cottages and automobiles. and flooded sections of State Highway 73. About 20 campers and motorists were forced to abandon four automobiles on the road and were marooned for the night at three homes in the area surrounded by the flood. It was reported that at the height of the storm 60 automobiles were trapped in the knee-deep mud on the highway. Damage in the area was estimated to be tens of thousands of dollars.

To evaluate the peak runoff per square mile, indirect measurements of peak discharges of June 29 were made at sites on four streams. (See table 19 below.)

TABLE 19.—*Flood stages and discharges, June 29, on Giant of the Valley Mountain, N.Y.*

| No. | Stream and place of determination | Drainage area (sq mi) | Discharge | | |
|---|---|---|---|---|---|
| | | | Cfs | Cfs per sq mi | Ratio of peak discharge to 50-year flood |
| 1 | Beede Brook at St. Huberts | 7.70 | 1,530 | 199 | 1.42 |
| 2 | Riverdale Creek near St. Huberts | .73 | 479 | 656 | (1) |
| 3 | Slide Brook at Euba Mills | 2.48 | 1,120 | 452 | (1) |
| 4 | Roaring Brook near New Russia | 9.03 | 1,750 | 194 | 2.66 |

[1] Undetermined.

## FLOODS OF JULY 16–17 IN THE VICINITY OF HOT SPRINGS, ARK.

After R. C. GILSTRAP and R. C. CHRISTENSEN (1964)

Heavy rains occurred in the Hot Springs area (fig. 28) during July 12–17. The total for the 6-day period ranged from 1.40 inches at Alum Fork to 14.31 inches at Blakely Mountain Dam.

Rains of July 12–15, although scattered throughout the Hot Springs area, were heavy in spots; 5.00 inches fell at Blakely Mountain Dam, and 3.80 inches fell at Hot Springs on July 14. Runoff was not heavy after these intense rains, but wetting of the soil induced high rates of runoff from the rains of the next 2 days.

Table 20 shows the daily totals of precipitation at eight U.S. Weather Bureau stations from July 12 to 17.

The most intense precipitation in the storm area fell during the early morning of July 16. At the recording precipitation station at Blakely Mountain Dam, 6.1 inches of rain fell in the 1½-hour period from 0545 to 0715 hours. Figure 29 shows the cumulative precipitation during the morning of July 16 for stations at Blakely Mountain Dam, Carpenter Dam, and Remmel Dam. Intensities of precipitation such as those shown in fig. 29 are very rare. A rainfall of 4.6 inches in 2

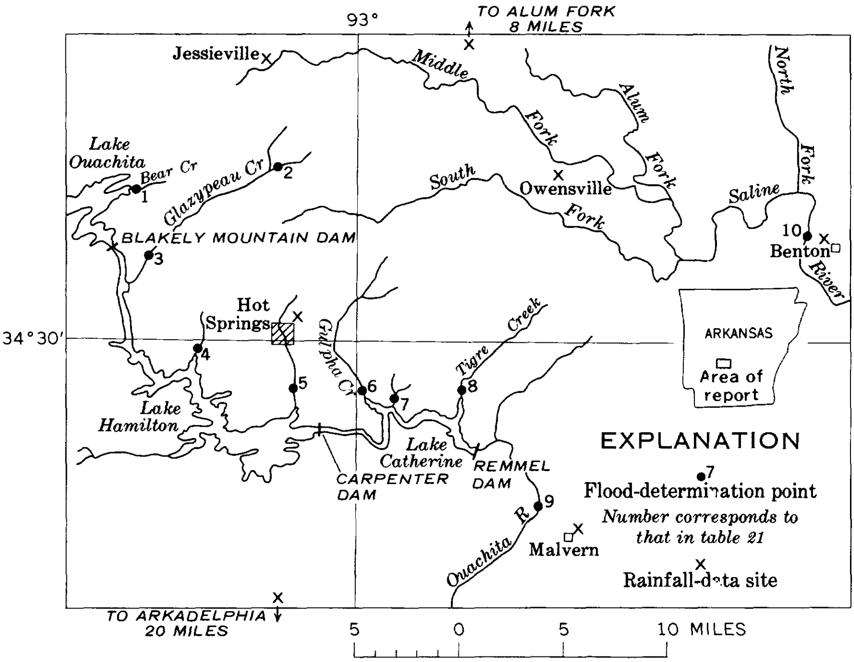



FIGURE 28.—Location of flood-determination points and rainfall-data sites, floods of July 16–17, in the vicinity of Hot Springs, Ark.

TABLE 20.—*Precipitation at Weather Bureau stations, July 12–17, in the vicinity of Hot Springs, Ark.*

| Station | Time of observation | Precipitation, in inches | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | July | | | | | | | |
| | | 12 | 13 | 14 | 15 | 12–15 | 16 | 17 | 12–17 |
| Arkadelphia | 0700 | 0.20 | 0.22 | 2.10 | 1.03 | 3.55 | 0.07 | 0 | 3.62 |
| Alum Fork | 1700 | .54 | 0 | .78 | 0 | 1.32 | .08 | 0 | 1.40 |
| Jessieville | 0700 | 0 | .45 | 2.01 | 2.90 | 5.36 | 2.10 | 1.80 | 9.26 |
| Blakely Mountain Dam | 0800 | 0 | .15 | 5.00 | .27 | 5.42 | 7.35 | 1.54 | 14.31 |
| Hot Springs, 1 mile north-northeast | 1700 | .85 | .09 | 3.80 | 0 | 4.74 | 8.35 | 0 | 13.09 |
| Malvern | 1700 | 0 | .39 | 1.93 | 0 | 2.32 | 5.20 | 0 | 7.52 |
| Benton | 0600 | 0 | 0 | 1.25 | .40 | 1.65 | .56 | .14 | 2.35 |
| Owensville | 0800 | 0 | 1.00 | 2.01 | .47 | 3.48 | .69 | .05 | 4.22 |

hours or 3.7 inches in 1 hour in the Hot Springs area has a recurrence interval of 100 years.

The heavy rains on July 16 produced extremely high floods on small streams in the vicinity of Hot Springs. Flooding occurred principally on the tributaries to the Ouachita River from Lake Ouachita to Malvern and on the headwaters of the South Fork Saline River; minor floods occurred on the headwaters of the Middle Fork Saline River.

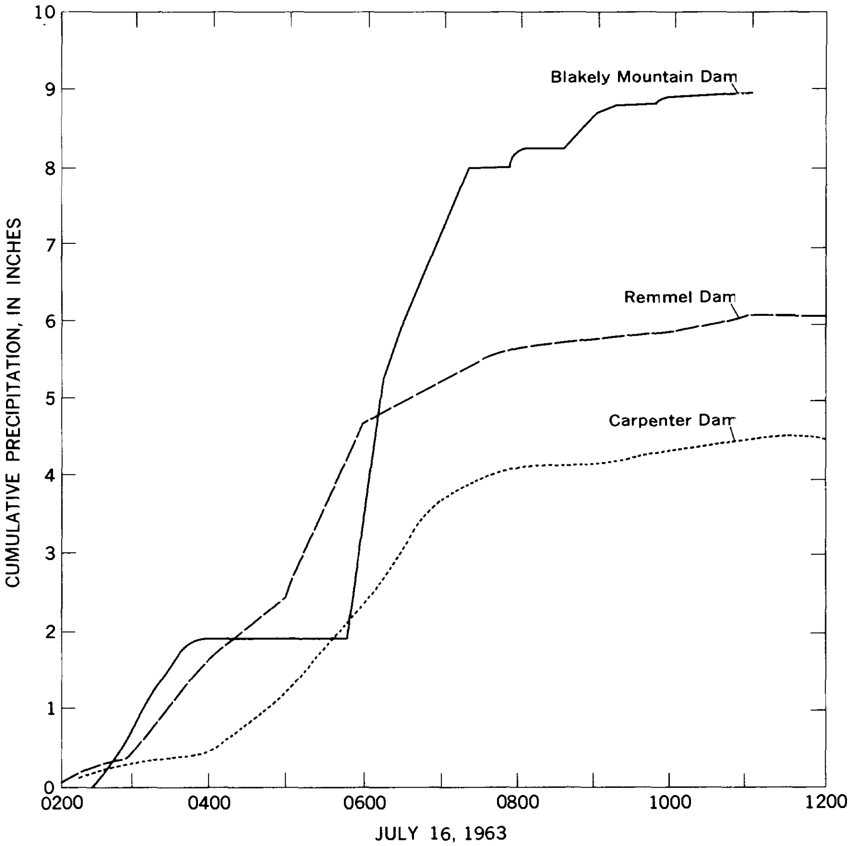



FIGURE 29.—Cumulative precipitation in the vicinty of Hot Springs, Ark. From U.S. Weather Bureau data.

Flooding on the Saline River was from the South and Middle Forks and had a moderate peak discharge of 6,850 cfs at Benton. The peak discharge on Ouachita River near Malvern was 53,800 cfs, and this was all generated from 457 sq. mi. of drainage area below Blakely Mountain Dam.

The flow in the Ouachita River is controlled by three reservoirs: Lake Ouachita, formed by Blakely Mountain Dam; Lake Hamilton, formed by Carpenter Dam; and Lake Catherine, formed by Remmel Dam. Runoff above Blakely Mountain Dam was stored in Lake Ouachita, and the only discharge from the lake during July 14–20 was leakage through the gates of about 20 cfs.

Table 21 shows the high rate of runoff in small streams in the storm area. The maximum rate of runoff determined was 1,940 cfs per sq. mi.

from a drainage area of 1.25 sq. mi. on Potash Sulphur Creek near Hot Springs. The peak discharge from a small drainage area of 0.8 sq. mi. on Bear Creek was 1,470 cfs, which is a rate of 1,840 cfs per sq. mi.

The peak discharges in the small streams were of rare occurrence and will seldom be equaled. Sufficient data are available to determine that the peak discharges in Glazypeau Creek at Mountain Pine and in Gulpha Creek near Hot Springs were 2.26 and 2.19 times, respectively, as great as a 50-year flood.

The discharges on the Ouachita River near Malvern and on the Saline River at Benton had short recurrence intervals.

TABLE 21.—*Flood stages and discharges, July 16–17, in the vicinity of Hot Springs, Ark.*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to July 1963: Period | Year | July 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (years) |
|---|---|---|---|---|---|---|---|---|
| | | | **Red River basin** | | | | | |
| 1 | Bear Creek near Mountain Pine | 0.8 | | | 16 | | 1,470 | ([1]) |
| 2 | Glazypeau Creek at Mountain Valley | 4.3 | 1961–63 | 1962 | | 10.36 | 560 | |
| | | | | | 16 | 12.41 | 2,110 | ([1]) |
| 3 | Glazypeau Creek at Mountain Pine | 29 | | | 16 | | 26,600 | [2] 2.26 |
| 4 | Bull Bayou tributary near Hot Springs | 2.5 | | | 16 | | 2,450 | ([1]) |
| 5 | Hot Springs Creek at Hot Springs | 5.81 | 1956 | 1956 | | | 4,350 | |
| | | | | | 16 | | 4,900 | ([1]) |
| 6 | Gulpha Creek near Hot Springs | 50 | 1956 | 1956 | | | 21,100 | |
| | | | | | 16 | | 36,800 | [2] 2.19 |
| 7 | Potash Sulphur Creek near Hot Springs | 1.25 | | | 16 | | 2,430 | ([1]) |
| 8 | Tigre Creek near Hot Springs | 9.3 | | | 16 | | 13,700 | ([1]) |
| 9 | Ouachita River near Malvern | 1,562 | 1903–04, 1923–63 | 1923 | | 30.3 | 140,000 | |
| | | | | | 16 | 21.03 | [3] 53,800 | [3] 14 |
| 10 | Saline River at Benton | 569 | 1927 | 1927 | | 30.5 | ([1]) | |
| | | | 1938–63 | 1939 | | 26.0 | 67,000 | |
| | | | | | 17 | 12.86 | 6,850 | <2 |

[1] Not determined.
[2] Ratio to 50-year flood.
[3] Affected by reservoirs; from 457 sq mi below Blakely Mountain Dam.

Extensive property damage was caused by the flood. A large part of the downtown area of Hot Springs was flooded by Hot Springs Creek, which normally flows through storm sewers under and parallel to Central Avenue. Numerous cars were washed from the streets by the floodwaters, and traffic through Hot Springs was temporarily halted. Some business establishments that were damaged by floodwaters were closed for about 2 weeks. Several homes along Gulpha and Glazypeau Creeks, the trailer camp on Gorge Creek, and a church camp on the South Fork Saline River were evacuated during the flood. Numerous washouts occurred on county roads, bridges, and railroads. Total property damage from the flood was more than $2 million, about equally divided between Hot Springs and the adjacent areas of Garland County.

## FLOOD OF JULY 23 AT HARTSELLE, ALA.

An intense thunderstorm late in the evening of July 23 produced heavy rainfall in the Hartselle area. The Tennessee Valley Authority (1963) reported on the storm and the resulting flood in detail. The following description of the flood is based on the TVA report and on streamflow data collected by a U.S. Geological Survey field party.

The heaviest rainfall occurred within the city limits of Hartselle. Rainfall amounts of 3.5 to 9.1 inches in a 90-minute period were reported within a 3-mile radius of the center of town. There was no official measurement of rainfall at Hartselle, but six unofficial measurements were obtained from a bucket survey in the area. Rainfall catches are shown in figure 30.

Several small streams in the Hartselle area reached record stages, according to information furnished by local residents. Town Branch, a tributary to Shoal Creek, which flows through the downtown business district, flooded 75 buildings, some of them to a depth of 41 inches. A local resident stated that the flood on Town Branch was about 18 inches higher than a flood that occurred about 25 years ago. Shoal Creek, which flows through southeast Hartselle, did not have unusually high stages east of town, but downstream from Town Branch, the crest stage of July 23, 1963, was 4.9 feet higher than the December 29, 1954, high water.

Indirect measurements of peak runoffs were made at the three locations shown in figure 30, and peak flows are shown in table 22.

Flood damage was confined mainly to the downtown business district. The Alabama State Civil Defense Department estimated that damage to business establishments in downtown Hartselle amounted to $2 million. The town was designated a disaster area by the Federal Small Business Administration.

TABLE 22.—*Peak discharges, July 23, at Hartselle, Ala.*

| No. | Stream and place of determination | Drainage area (sq mi) | Peak discharge | |
|---|---|---|---|---|
| | | | Cfs | Cfs per sq mi |
| 1 | Unnamed tributary to Shoal Creek at State Highway 36, 2.5 miles east of Hartselle | 0.23 | 198 | 860 |
| 2 | Unnamed tributary to Shoal Creek at State Highway 36, 1.1 miles northeast of Hartselle | 1.03 | 1,180 | 1,145 |
| 3 | Town Branch 600 ft upstream from mouth at Hartselle | 1.60 | [1] 980 | 610 |

[1] Does not include an estimated 20-cfs peak flow that was diverted from Town Branch watershed into Village Branch through a ditch in the Louisville & Nashville Railroad cut.

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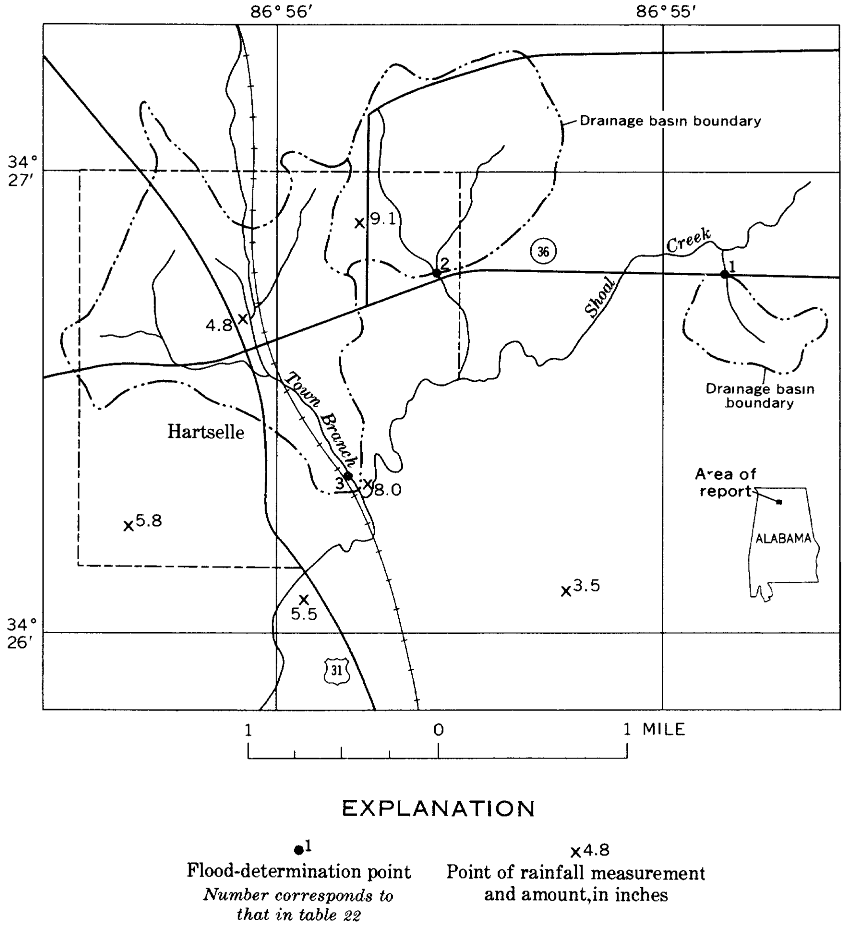


FIGURE 30.—Location at flood-determination points and precipitation-data sites, floods of July 23, at Hartselle, Ala.

## FLOODS OF AUGUST 7 IN BUFFALO, N.Y.

By F. LUMAN ROBISON

The most severe rainstorm in 18 years in western New York dropped 3.8 inches of rain in the Buffalo area on July 29 (fig. 31). About 2,000 basements in the residential section of South Buffalo were flooded. Estimates of damage ranged from $500,000 to $1.5 million.

Only 9 days later, on August 7, rains of near-record magnitude again fell over western New York. A cold front from Canada joined warm air moving across the Great Lakes and produced a storm that dropped 3.88 inches of rain in 5 hours on Buffalo and its suburbs.

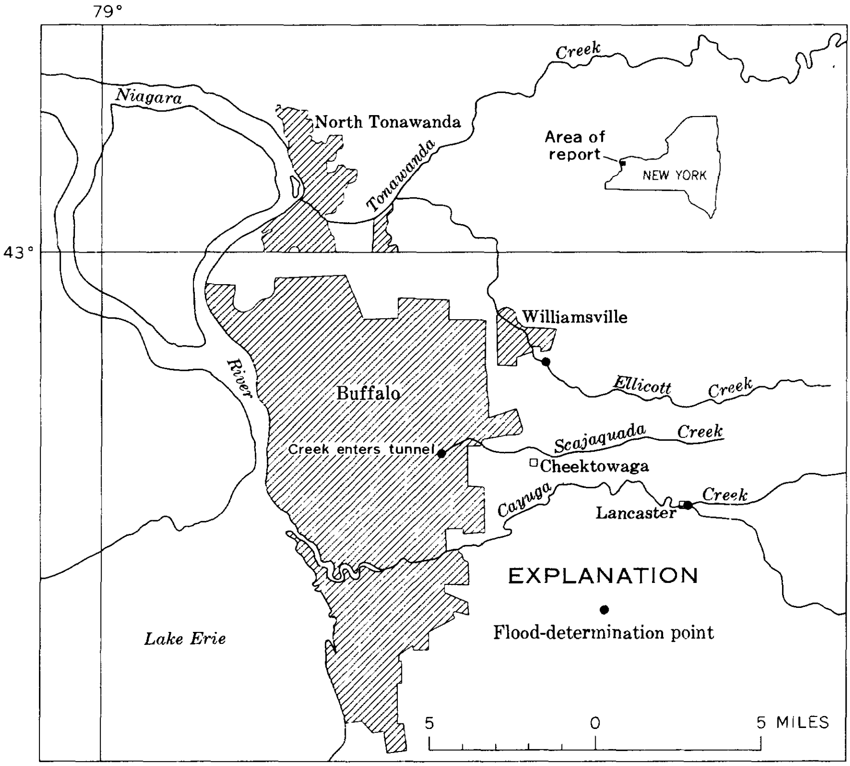


FIGURE 31.—Location of flood-determination point, flood of August 7, at Buffalo, N.Y.

The greatest 24-hour rainfall recorded at Buffalo since at least 1871 was 4.28 inches in August 1893, and the greatest 6-hour rainfall since at least 1890 was 3.54 inches in August 1944. New rainfall-intensity records for August were established when 1.75 inches fell in 1 hour and 2.25 inches fell in 2 hours. The intensity of the storm rainfall exceeded the 100-year storm intensity.

The peak discharge at the gaging station on Scajaquada Creek on August 7 was 2,620 cfs. The previous maximum recorded peak, in a short period of record beginning in 1958, was 1,150 cfs in 1959.

An indication of the small area of the storm is the unit peak discharge of 167 cfs per sq mi in Scajaquada Creek, whereas the unit peak discharge at the gaging stations on Ellicott Creek, adjacent basin to the north, and on Cayuga Creek, adjacent basin to the south, were 4 cfs per sq mi and 6 cfs per sq mi, respectively.

Flooding was general throughout Buffalo, and traffic was greatly disrupted. The suburbs of Cheektowaga and Lancaster were especially hard hit; streets and underpasses were inundated, and many automobiles were submerged and ruined. Telephone service was disrupted in much of the area for various periods of time. Hundreds of residents left their homes and were given refuge in Red Cross shelters.

A short section of the Niagara branch of the New York State Thruway was under water and impassible for a short time; the Scajaquada Expressway was flooded, and traffic was halted for about 12 hours.

The area was declared a disaster area by Federal and State authorities. The Internal Revenue Service established a special taxpayer assistance section to aid persons to claim casualty losses in income tax returns, and the Small Business Administration opened a field office to grant low-interest long-term loans to flood victims.

The Mayor of Buffalo estimated damage in the city at $28 million to homes and businesses and $7 million to streets and public buildings.

The Buffalo District of the Corps of Engineers estimated the damage from direct overflow and backup from Scajaquada Creek at about $500,000. A report prepared by the Corps of Engineers (1963) states, "Although the flooding was widespread and affected thousands of residential and commercial units, very little of the damage was the result of direct overflow from an established water course. The intensity and volume of the rainfall created flooding situations whereever there was a low spot, long before the runoff reached Scajaquada Creek or even one of the major storm sewers. * * * High-water marks indicated that to a large extent the flooding was caused by the inability of the local drainage system to carry the amount of inflow from the storm. As soon as the water ponded in the streets it entered the sanitary sewers, either through the manhole covers or the vent pipes, and flooded the cellars connected to them. * * * Although the major source of damage in the flooded area came from storm sewers and other drainage outlets that were not adequate to carry the runoff from the August 7 storm, this does not mean that the sewers were inadequately designed. It is felt that any town or city subjected to a similar storm would have suffered flooding."

## FLOODS OF AUGUST 10 AT ALBUQUERQUE, N. MEX.

By G. L. Haynes, Jr.

An airmass-type thunderstorm produced high-intensity rainfall over Albuquerque, N. Mex., in the late afternoon and evening of August 10. The isohyetal pattern shown in figure 32 is based on 48 reports of total rainfall by the Albuquerque Cooperative Rainfall Observer Network and is probably among the most comprehensive for this type thunderstorm.

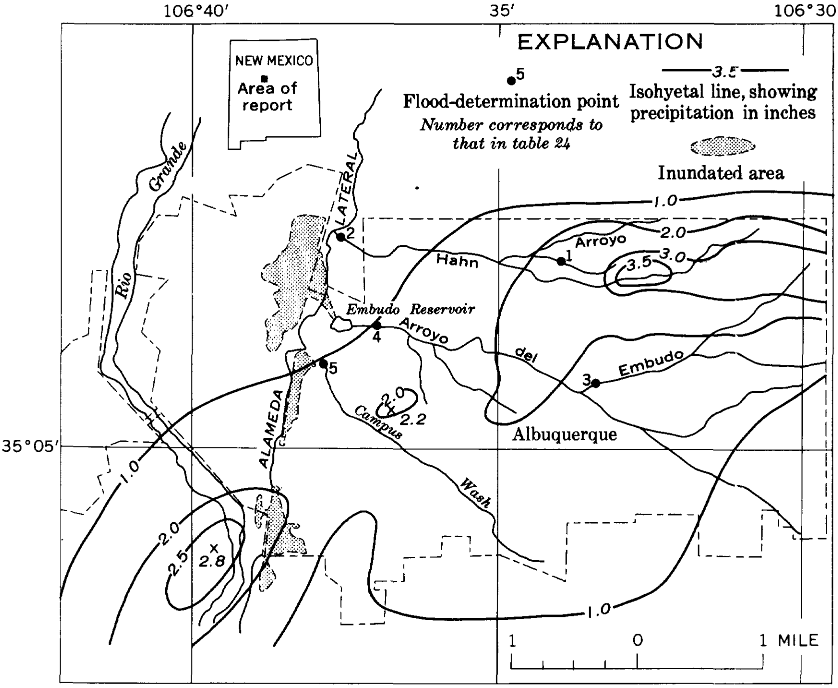


FIGURE 32.—Location of flood-determination points and isohyets for August 10, floods of August 10, at Albuquerque, N. Mex.

The two recording rainfall gages in the city were on the outskirts of the storm and did not record amounts of rainfall representative of the flood-producing storm. Two observers, a meteorologist with the Sandia Corporation and an engineer with the Corps of Engineers, in the area of heaviest rainfall, obtained frequent readings during the storm. These valuable intensity data (table 23) are plotted as curves of accumulated rainfall in figure 33. Light winds aloft caused only slow horizontal movement of the storm, and therefore heavy localized rain resulted. During the 20-minute period between 1817 and 1837 hours, 2.05 inches of rain fell at one of the sites. The recurrence interval of such a storm is great; in the Albuquerque area the 100-year 30-minute storm is 1.5 inches and the 100-year 60-minute storm is 2.0 inches (U.S. Weather Bureau, 1961).

Precipitation was heaviest in Northeast Heights of Albuquerque where the runoff concentrated in Arroyo del Embudo and Hahn Arroyo. Swiftly moving floodwater extensively damaged urban property in this area; the damage comprised destruction of walls, erosion of yards, sediment deposition, and water damage to interiors of homes.

TABLE 23.—*Accumulated rainfall observed at two locations, August 10, in northeastern Albuquerque, N. Mex.*

| *2924 Avenida Nevada NE.* | | *9804 San Gabriel NE.* | |
|---|---|---|---|
| *Time* | *Amount (inches)* | *Time* | *Amount (inches)* |
| 1810 | Rain began | 1815 | Rain began |
| 1817 | 0. 35 | 1835 | 1. 30 |
| 1825 | 1. 25 | 1845 | 2. 30 |
| 1834 | 2. 00 | 1855 | 2. 50 |
| 1837 | 2. 40 | 1910 | 2. 60 |
| 1849 | 3. 16 | 1925 | 2. 70 |
| 1925 | 3. 33 | 1955 | 2. 80 |
| 2200 | 3. 50 | 2030 | 2. 90 |
| | | 2200 | 3. 00 |

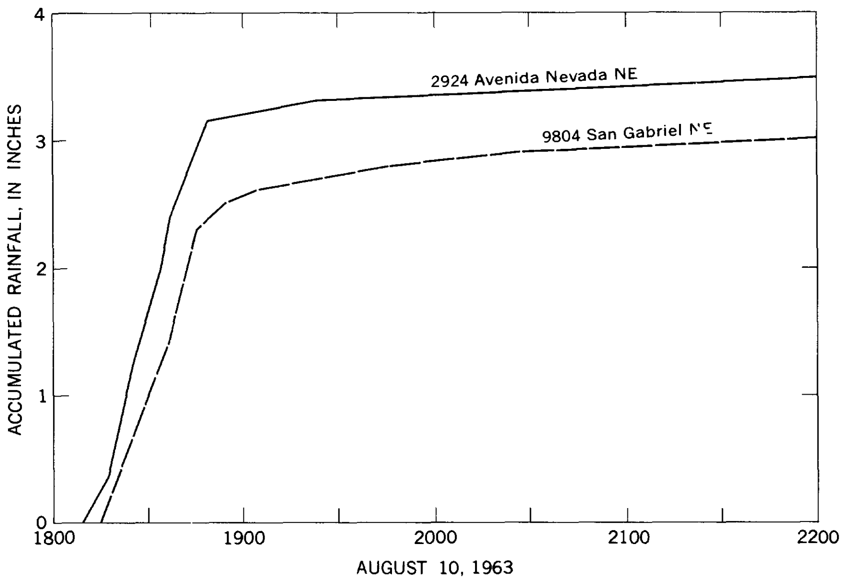


FIGURE 33.—Accumulated rainfall at two locations, August 10, in northeastern Albuquerque, N. Mex.

Recently constructed drainage structures proved inadequate, and flows were forced out of the channels and over the roads. Road surfacing was swept away; culverts were undermined; and railings and walkways were damaged. Heavy deposition of silt in Hahn Arroyo completely obstructed some culverts.

Water from Embudo Reservoir, capacity 425 acre-feet, spilled and eroded about 3,700 cubic yards of the earth spillway. Spill from the reservoir combined with flow of Hahn Arroyo and inundated about 490 acres in the north-central part of the city; the flooding caused severe damage to homes and business establishments.

Runoff in the south-central and southeastern part of the city collected in Campus Wash, washed out the crossing at Edith Boulevard NE., and inundated about 115 acres in a valley area of commercial warehouses, city yards, and old houses. Extensive sediment deposition caused major damage in this area.

Runoff from the airport mesa in the southern part of the city flowed down Gibson Boulevard and Miles Road into the valley area of south-central Albuquerque. The flooded area here was the most extensive since 1929 and covered about 275 acres. Major damage to homes, business establishments, and the railroad occurred in this area.

No lives were lost, but a Red Cross survey determined that 1,250 families were affected by the flood. Five hundred families received direct aid.

The Corps of Engineers estimated the amount of damage caused by the flood. The amounts also include damage caused by the storms of August 12 and 13 when up to 0.5 inch of rain fell. Since the damage caused by the subsequent storms was probably relatively minor, the total amounts for the three storms are given in the following tabulation:

| *Type of damage* | *Losses* |
|---|---|
| Property | $1,175,000 |
| Transportation | 483,000 |
| Other | 217,000 |
| Total | $1,875,000 |

Indirect measurements of discharge were made on a tributary of Hahn Arroyo, on Hahn Arroyo near the mouth, at two sites on Arroyo del Embudo, and on Campus Wash (fig. 32). Discharges for the 1961 flood on Hahn Arroyo and Arroyo del Embudo are included in table 24 for comparison with the 1963 peaks.

The flood frequencies indicate the relative magnitude of the peak discharges at the sites. However, the relationships from which the frequencies were computed were developed for nonurbanized areas in New Mexico. Runoff characteristics for urbanized areas differ markedly from those for nonurbanized areas; therefore, the underlying relationships may afford only a relative basis for comparison of the peaks.

Relationships have not been defined for areas as small as that of the Hahn Arroyo tributary, but the unit runoff of 2,840 cfs per sq mi for the peak is extremely high. Peak discharges for 1963 on Hahn Arroyo and Arroyo del Embudo greatly exceed those for 1961. Recurrence intervals for the 1963 peaks are defined as about 3½ times as great as 50-year floods near the Alameda lateral. On Arroyo del Embudo the recurrence intervals for the peak discharges indicate that the flood

TABLE 24.—*Flood stages and discharges, August 10, at Albuquerque, N. Mex.*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to August 1963: Period | Prior to August 1963: Year | August 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence[1] interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| 1 | Hahn Arroyo tributary between Stardust Dr. and Louisiana Blvd | 0.50 | | | 10 | | 1,420 | (2) |
| 2 | Hahn Arroyo | 7.6 | 1961 | 1961 | | | 935 | |
| | | | | | 10 | | [3] 4,100 | [4] 3.7 |
| 3 | Arroyo del Embudo between Pennsylvania St. and Hendola Dr | 14.6 | | | 10 | | 1,470 | 35 |
| 4 | Arroyo del Embudo upstream from Princeton Dr | 34.1 | 1961 | 1961 | | | 3,620 | |
| | | | | | 10 | | 8,840 | [4] 3.5 |
| 5 | Campus Wash upstream from Edith Blvd | 7.3 | | | 10 | | [5] 640 | 6 |

[1] Computed from relationships for nonurbanized areas in New Mexico.
[2] Undefined.
[3] At site downstream; drainage area, 8.5 sq mi.
[4] Ratio of peak discharge to 50-year flood.
[5] Part of flow intercepted by storm sewers.

increased in magnitude downstream. This apparent trend is contrary to the precipitation pattern and may be explained by the fact that an undetermined amount of flow from the drainage area above the upstream measuring site bypassed the site as it flowed down Menaul Boulevard, Northwestern Boulevard, and Indian School Road. This flow reentered the main channel at two points below the site.

The peak discharge on Campus Wash had a recurrence interval of only 6 years, an event of rather frequent occurrence. An unknown amount of the flow from this drainage area is intercepted by storm sewers. A suitable site could not be found from which to measure the flow from the airport mesa.

## FLOODS OF AUGUST 14–22 IN CENTRAL ARIZONA

By B. N. ALDRIDGE

Throughout Arizona, thunderstorms were frequent during August. On several occasions runoffs in excess of 1,500 cfs occurred in small isolated areas. Meteorologic conditions during the period August 14–22 were especially conducive to the formation of thunderstorms, and most of the State received heavy amounts of precipitation. During this period thunderstorms caused damage of nearly $4 million in Arizona. Most of this, $3.6 million, occurred in the Glendale and Prescott areas. The remainder resulted from flooding of highways near Payson, flooding of streets, businesses, and homes in Globe, Winslow, and the Mesa-Apache Junction area, and flooding in several other small areas.

Data on precipitation, runoff, and damages are lacking for most of the smaller floods, so only the three major areas affected by flooding during this period are discussed in this report: Glendale, August 16–17; Prescott, August 16 and 19; and Payson, August 22.

#### FLOODS OF AUGUST 16–17 IN GLENDALE-MARYVALE AREA

Severe flooding occurred in Glendale and in the northwestern section of Phoenix, known as Maryvale, as a result of a rain that started at 2215 hours on August 16 and lasted until 0420 hours on August 17. A recording rain gage near the center of Glendale registered 5.25 inches of rain in the 6-hour period. An open can in the back of a pick-up truck that was parked nearby caught nearly 6 inches of rain. U.S. Weather Bureau Technical Bulletins 28 and 40 indicate a frequency of over 100 years for such rainfall. Five gages located in Glendale and Maryvale recorded more than 3.4 inches of rain. Rain fell over a fairly large area. An isohyetal map prepared by the Corp of Engineers shows 440 sq mi within the 0.5 inch isohyet, but the flooding resulted generally from sheet flow that originated within the 3-inch isohyet between the Arizona Canal and the Grand Canal (fig. 34).

The flood occurred in a highly developed commercial and residential area located on an alluvial slope. There are no defined channels in the area, and water moving in a southwesterly direction through depressions and streets spread out over much of Glendale and Maryvale. Most of the damage resulted from water that was ponded in low spots behind railroad and highway embankments. The worst flooding occurred along the northeast side of the Atchison, Topeka and Santa Fe Rail-

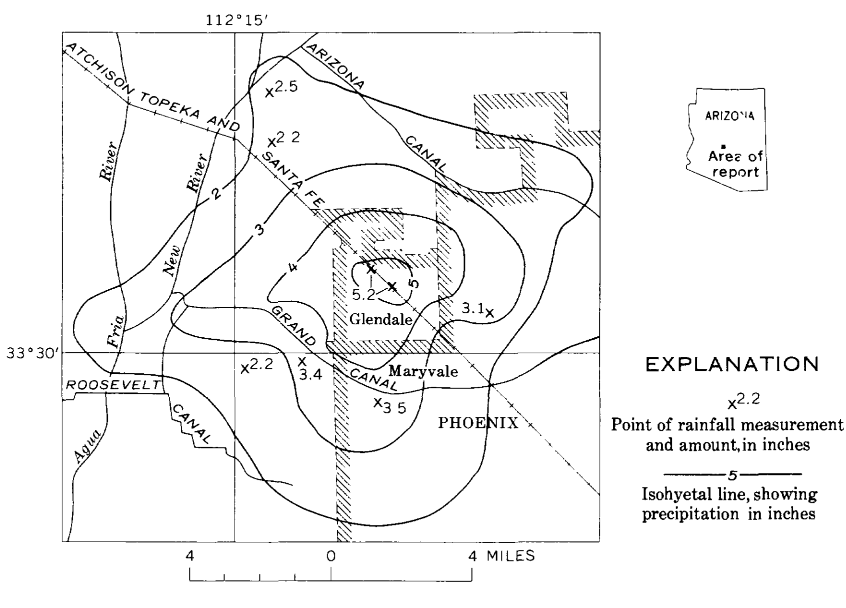


FIGURE 34.—Location of rainfall-data sites, floods of August 16–17, in Glendale-Maryvale, Ariz.

way tracks, which, except for two small trestles and a few drains, formed a complete barrier to the flow, and north of Grand Canal, which served as an outlet for floodwaters. Along Grand Avenue, which parallels the railway tracks, almost all business establishments in a 6-mile stretch were flooded. Behind Grand Canal about 2 sq mi of residential area was flooded to depths of 2 or 3 feet. In a few places dikes along the south side of Grand Canal broke and allowed water to flow into areas to the south, but only minor flooding occurred.

The total flooded area amounted to about 10 sq mi, of which slightly less than 3 sq mi was developed for urban uses.

Because of the terrain, measurements of discharge from any definable drainage could not be made. Grand Canal, which has a capacity of about 800 cfs, was flowing bankfull below the flood area; however, none of this water reached New River, as it was diverted southward through a lateral toward Roosevelt Canal. (See figure 34.)

Another storm cell centered near the upper part of the New River basin. The New River near Black Canyon gaging station, 25 miles north of the flood area, had a peak discharge of 4,620 cfs at 2400 hours on August 16; however, this peak did not contribute to the flooding in Glendale as it was almost completely dissipated by the time it reached the mouth of the New River. The peak flow in the Agua Fria River just below New River was estimated as 100 cfs.

Estimates of damage (table 25) by the Corps of Engineers, Los Angeles District, totaled $2,900,000.

TABLE 25.—*Estimate of damage from the flood of August 16–17, 1963, in Glendale and Phoenix (Maryvale), Ariz.*

[Data furnished by Corps of Engineers, Los Angeles District]

| Type of property | Physical damage | Emergency costs and business losses | Total |
|---|---|---|---|
| Glendale: | | | |
| Residential | $87,000 | $9,000 | $96,000 |
| Commercial and industrial | 138,000 | 32,000 | 170,000 |
| Public | 1,000 | 0 | 1,000 |
| Railroad | 1,000 | 0 | 1,000 |
| Utilities, Highways and streets, Irrigation works | 133,000 | 16,000 | 149,000 |
| Agriculture | 38,000 | 4,000 | 42,000 |
| Subtotal | 398,000 | 61,000 | 459,000 |
| Phoenix (Maryvale): | | | |
| Residential | 1,910,000 | 190,000 | 2,100,000 |
| Commerical and industrial | 24,000 | 7,000 | 31,000 |
| Public | 10,000 | 2,000 | 12,000 |
| Railroad | 1,000 | 0 | 1,000 |
| Utilities | 21,000 | 3,000 | 24,000 |
| Highways and streets | 25,000 | 5,000 | 30,000 |
| Irrigation works | 92,000 | 5,000 | 97,000 |
| Agriculture | 124,000 | 12,000 | 136,000 |
| Subtotal | 2,207,000 | 224,000 | 2,431,000 |
| Grand total | 2,605,000 | 285,000 | 2,890,000 |

### FLOODS OF AUGUST 16 AND 19 IN PRESCOTT

There were several rainstorms in Prescott during the early part of August, but none of these was of sufficient magnitude to cause flooding. Heavy rainfall began with a thunderstorm about noon on August 16. By 1330 hours, this storm had drenched most of the west side of Prescott and the surrounding mountains with 3 to 4 inches of rain, according to records collected by several local residents. The official U.S. Weather Bureau station at the airport, northeast of town, reported only 0.16 inch. Similar low readings were reported by residents along the east side of town. In the evening between 1800 and 2000 hours a second storm centered over the same area. Most observers reported between 1 and 2 inches during this second storm, but one reported 3.8 inches.

Between 1830 and 2045 hours on August 19, several residents of the area west of Granite Creek reported over 3 inches of rain; some reported almost 5 inches. Several persons indicated that the heaviest concentration of rainfall was near Thumb Butte, which rises sharply from the foothills west of town, but there are no rainfall data from that area. The rainfall along the east side of town again was much lighter than that to the west.

Much of the area around Prescott consists of exposed granite ridges. These impervious surfaces allow most of the rainfall to run off as surface water, which concentrates quickly because of the steep valley slopes. The heavy runoff from the August 16 storm filled the narrow constricted channels and overflowed onto adjacent residential and business properties. Following the afternoon storm of August 16, Butte and Miller Creeks were out of their banks from 1330 to 1530 hours and caused the closing of Miller Valley Road and many streets. Manzanita, Aspen, and Willow Creeks were also flooding. Miller Valley Road was closed again for 2½ hours that evening as a result of a second storm.

The storms of August 16 soaked the ground and filled potholes. Therefore, practically all the rain from the August 19 storm ran off as surface water; the runoff caused the creeks to run much higher than during the previous floods. In some places the streams were several hundred feet wide during the peak, whereas before the floods the channels were only 20 or 30 feet wide. Water from Miller and Butte Creeks flowed over Miller Valley Road for 4½ hours at depths up to 3 feet. Granite Creek ran bankfull through town and flooded several homes below the mouth of Miller Creek. The August 16 flood had widened the channel of Miller Creek just above Butte Creek several feet; the widening allowed the larger discharge of August 19 to pass at approximately the same stage as that of August 16. Other creeks were flowing much higher on August 19 than on August 16. On August 19, Manzanita Creek flowed over U.S. Highway 89, but it had not done so on August 16.

Peak discharges during the August 19 flood were measured by indirect methods at eight sites and estimated at one. These sites are shown in figure 35, and the discharges are given in table 26. No indirect measurements were made of the floods of August 16 because the August 19 peaks destroyed the flood marks left by the earlier flood.

According to local residents, the storms of August 16 and 19 were the most severe and intense thunderstorms that they could remember in 30 to 65 years, but several long-time residents said higher floods had occurred as a result of spring snowmelt. The last big flood occurred in 1937, but no accurate comparison of this flood with the 1963 flood could be made for the tributaries. At the discontinued gaging station on Granite Creek near Prescott the peak discharge during the 1937 flood had been less than half what it was in 1963. Other high floods occurred in 1891, 1916, and 1917 or 1918.

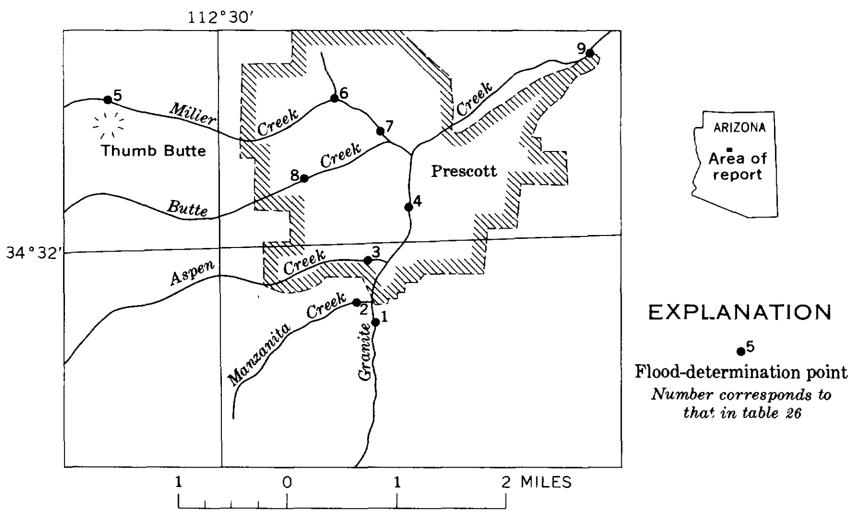


FIGURE 35.—Location of flood-determination points, floods of August 16–19, in Prescott, Ariz.

Even though higher floods may have occurred, none caused as much damage as the floods of August 1963. During the last 20 years, narrow strips of land between the stream channels and the steep-sloped granite ridges have been developed into urban property; the channels have been constricted; and sewerlines and waterlines have been placed in the creekbed. Several homes and business establishments were damaged by the flood, and considerable personal property was destroyed.

TABLE 26.—*Flood stages and discharges in the Gila River basin during flood of August 19 in Prescott, Ariz.*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to August 1963: Period | Prior to August 1963: Year | August 1963 | Gage height (feet) | Discharge: Cfs | Discharge: Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| 1 | Granite Creek above Manzanita Creek at Prescott | 9.9 | ---- | ---- | 19 | ---- | 30 | ([1]) |
| 2 | Manzanita Creek at mouth at Prescott | 2.20 | ---- | ---- | 19 | ---- | 1,280 | ([1]) |
| 3 | Aspen Creek ¼ mile above mouth at Prescott | 4.99 | ---- | ---- | 19 | ---- | 1,160 | ([1]) |
| 4 | Granite Creek at Goodwin Street at Prescott | 17.2 | ---- | ---- | 19 | ---- | 2,750 | ([1]) |
| 5 | Miller Creek 3 miles above mouth and 1½ miles west of Prescott | 2.64 | ---- | ---- | 19 | ---- | 1,310 | ([1]) |
| 6 | Miller Creek 1 mile above mouth at Prescott | 4.75 | ---- | ---- | 19 | ---- | 1,580 | ([1]) |
| 7 | Miller Creek above Butte Creek at Prescott | 6.60 | ---- | ---- | 19 | ---- | 2,960 | ([1]) |
| 8 | Butte Creek ¾ mile above mouth at Prescott | 3.65 | ---- | ---- | 19 | ---- | 1,830 | ([1]) |
| 9 | Granite Creek 1½ miles northeast of Prescott | 39 | 1932-47 | 1937 | ---- | 9.20 | 2,900 | ---- |
| | | | ---- | ---- | 19 | 12.4 | 6,660 | 50 |

[1]Not determined.

The floods washed out several road crossings, about 2 miles of sewerline, and an unknown amount of water line, they dislodged manholes and damaged or plugged another 12 miles of sewerline. Three smaller floods between August 21 and August 30 caused additional damage, but separate damage figures for the various floods are not available. The total estimate of damage (table 27) by the Corps of Engineers, Los Angeles District, was $546,000.

More detailed information on this flood can be found in a U.S. Geological Survey open-file report by B. N. Aldridge (1963).

TABLE 27.—*Estimates of damage resulting from the floods of August 16 and 19 in Prescott, Ariz.*

[Data furnished by Corps of Engineers, Los Angeles District]

| Location and type of property | Physical damage | Emergency costs and business losses [1] | Total |
|---|---|---|---|
| Miller Creek: | | | |
| Residential | $95,700 | $14 300 | $110,000 |
| Commercial and industrial | 10,300 | 1,400 | 11,700 |
| Other | 10,500 | 0 | 10,500 |
| Butte Creek: | | | |
| Residential | 17,200 | 2,600 | 19,800 |
| Other | 900 | 0 | 900 |
| Aspen Creek: | | | |
| Residential | 27,600 | 4 200 | 31,800 |
| Other | 400 | 0 | 400 |
| Granite Creek: | | | |
| Residential | 19,200 | 2,900 | 22,100 |
| Other | 14,500 | 0 | 14,500 |
| Manzanita Creek: Other | 500 | 0 | 500 |
| Subtotal | 196,800 | 25,400 | 222,200 |
| City streets and bridges | 35,000 | 6,000 | 41,000 |
| Sanitary facilities | 245,000 | 25,000 | 270,000 |
| Water supply system | 800 | 400 | 1,200 |
| Gas distribution system | 1,000 | 200 | 1,200 |
| Electrical system | 1,500 | 200 | 1,700 |
| Telephone system | 3,500 | 500 | 4,000 |
| City cleanup | 3,200 | 800 | 4,000 |
| Flood fighting, disaster relief, and such | | 600 | 600 |
| Total | 486,800 | 59,100 | 545,900 |

[1] No detailed analysis was made of business losses. The estimates included herein are based on observations in other areas.

## FLOOD OF AUGUST 22 NEAR PAYSON

Between 0030 hours and 0630 hours on August 22, a storm centered over the upper portion of Rye Creek, south of Payson, dropped 3 to 4 inches of rain over an area that is about 15 miles in diameter. Amounts of rainfall at several gages in the area are shown in figure 36; however, none of these gages is in the area of most intense rain, which was apparently on the ridge between Rye Creek and East Verde River. The owner of the H Bar Ranch indicated that the rain appeared to be much heavier on the ridge than at the ranch.

This was the highest flood at the H Bar in the 51 years that it has been in existence. There is no comparative information at other sites except at Tonto Creek above Gun Creek near Roosevelt (station 5) where the peak was the sixth highest since records began in 1941.

Except for Payson, most of the flood area is underdeveloped, and damage was fairly light. The only major damage occurred along Rye Creek which washed out 60 feet of a bridge on State Highway 87 and cut a large channel through the H Bar Ranch. Damage at the ranch was confined to loss of soil and fences. Payson was isolated for about 2 hours as all roads into town were blocked by slides or washouts, but these roads were quickly repaired.

Peak discharge at the flood-determination points (fig. 36) are given in table 28.

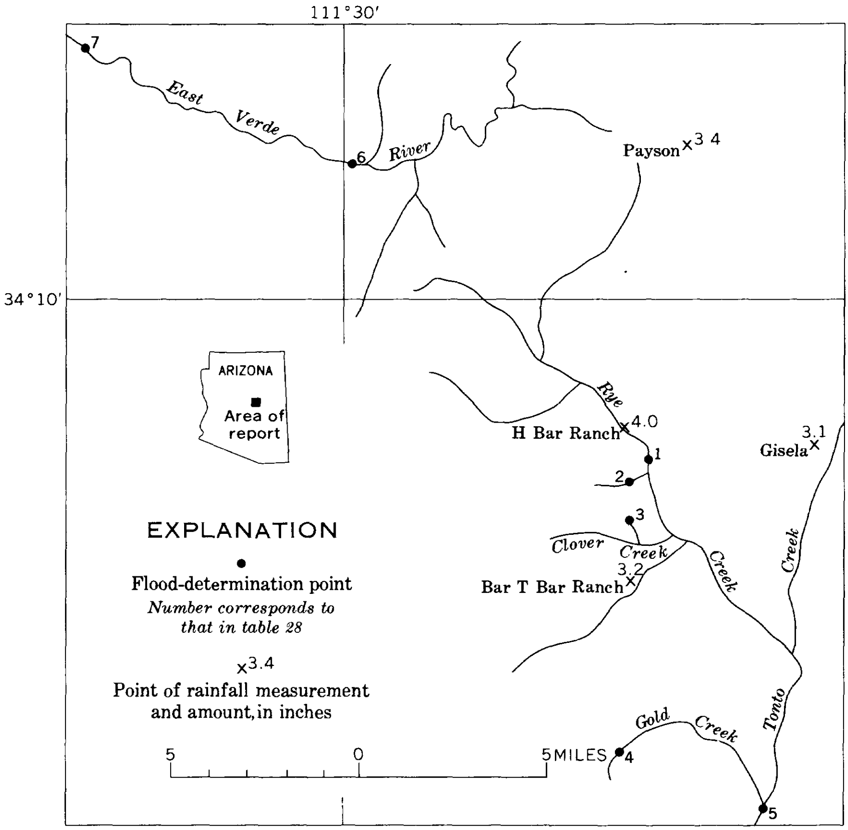


FIGURE 36.—Location of flood-determination points and rainfall-data sites, floods of August 22, near Payson, Ariz.

TABLE 28.—*Flood stages and discharges in the Gila River basin during flood of August 22 near Payson, Ariz.*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to August 1963: Period | Year | August 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yr) |
|---|---|---|---|---|---|---|---|---|
| 1 | Rye Creek 8 miles south of of Payson | 66.4 | [1] 1912–63 | ... | 22 | ... | 14,300 | 50 |
| 2 | Boone Moore Wash at State Highway 87, 9 miles south of Payson | 3.10 | ... | ... | 22 | ... | 1,240 | (2) |
| 3 | Clover Wash tributary at State Highway 87, 9 miles south of Payson | .89 | ... | ... | 22 | ... | 355 | (2) |
| 4 | Gold Creek near Payson | 6.52 | ... | ... | 22 | 7.75 | 1,370 | (2) |
| 5 | Tonto Creek above Gun Creek near Roosevelt | 675 | 1940–63 | 1952 | ... | 16.55 | 45,400 | ... |
| | | | ... | ... | 22 | 11.90 | 19,700 | 9 |
| 6 | East Verde River near Payson | 272 | 1961–63 | 1961 | ... | 6.64 | 1,640 | ... |
| | | | ... | ... | 22 | 15.5 | 9,950 | 12 |
| 7 | East Verde River near Childs | 317 | 1961–63 | 1961 | ... | 6.87 | 1,340 | ... |
| | | | ... | ... | 22 | 16.0 | 11,400 | 12 |

[1] From information furnished by local resident.
[2] Not determined.

## FLOODS OF AUGUST 20 IN FOURMILE RUN, FAIRFAX COUNTY, VA.

By DANIEL G. ANDERSON

The August 20 flood in Fourmile Run was by far the most severe of any recorded at the U.S. Geological Survey gaging station since it was established in 1951. Urbanization effects very likely contributed to the severity of this flood. Fourmile Run is located a few miles southwest of Washington, D.C., and has a drainage area of 14.4 sq mi at the U.S. Geological Survey gaging station.

Heavy rain fell in the metropolitan Washington, D.C., area during the late evening of August 19 and early morning of August 20. More than 3 inches of rain fell over the central part of Washington, and the amount decreased outward from this area of heavy rainfall. Although a rather large amount of rain fell, flooding was of little consequence. Although the storm was more or less independent of a second storm during the evening of August 20, as evidenced by the clear skies during the day between the storms, the rainfall of August 19 probably did much to soak the ground and augment flooding from the high-intensity storm during the evening of August 20.

The second storm began about 1850 hours and ended about 2200 hours Eastern Standard Time. The most intense rainfall occurred between 1900 and 2000 hours when 2.5 inches of rainfall was recorded at the U.S. Geological Survey gaging station on Fourmile Run. The

U.S. Weather Bureau [1] stated that an average of 3.1 inches of rain fell over the drainage basin. The total runoff computed by U.S. Geological Survey was 2.23 inches for a runoff-rainfall ratio of 72 percent. This unusually high ratio probably is the result of wet antecedent soil conditions, very high intensity rainfall, and the effects of urbanization. The U.S. Weather Bureau [1] has described the second storm in great detail, and the discussion generally will not be repeated here. Figure 37 was prepared from their isohyetal map. They reported a maximum 1-hour rainfall of 4.82 inches at First and O Streets, SE., Washington, D.C., which is greater than any previously recorded for that duration at the official U.S. Weather Bureau gage at 24th and M Streets, NW.

The peak discharge in Fourmile Run at the gaging station was 11,700 cfs. This is about three times the magnitude of the previous maximum (3,600 cfs, Aug. 26, 1961) since the establishment of the station in 1951. Another significant peak-discharge measurement (2,690 cfs from 2.06

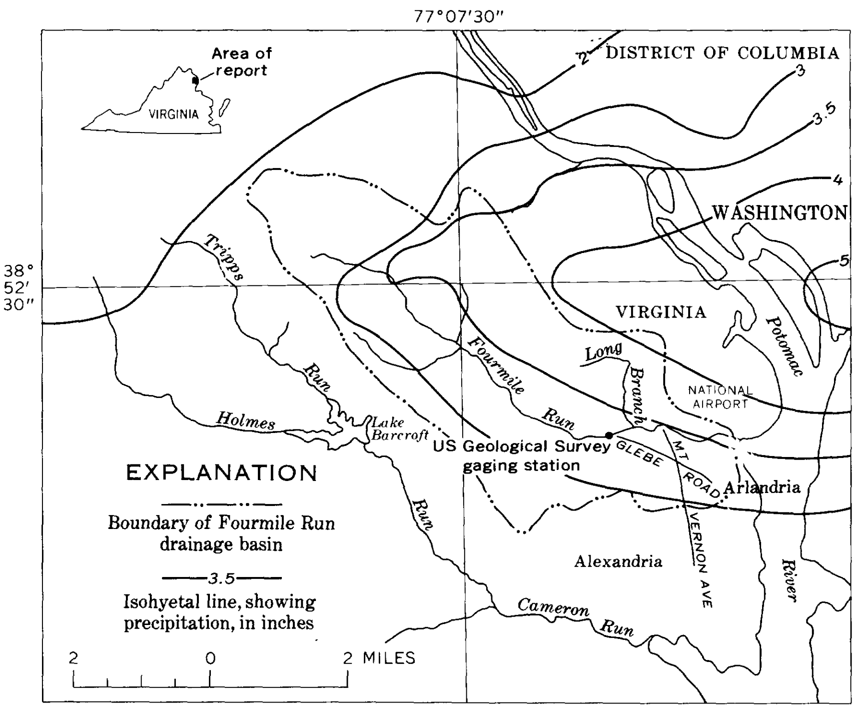


FIGURE 37.—Isohyets for 1200 e.s.t. August 20 to 1200 e.s.t. August 21. Most of the rain fell in 3 hours. Floods of August 20 in Fourmile Run, Fairfax County, Va. Precipitation data from U.S. Weather Bureau.

[1] U.S. Weather Bureau, 1964, The intense rainstorm of August 19–21, 1963, at Washington, D.C.: Ms. of U.S. Weather Bur., April 1964.

sq mi) for August 20 was made near the mouth of Long Branch at Shirley Highway. Long Branch is a tributary to Fourmile Run that drains an area to the north of Arlandria.

The greatest damage from Fourmile Run occurred in Arlandria, a northern section of Alexandria adjacent to Arlington County. Water was 4 to 5 feet deep just south of Fourmile Run on Mount Vernon Avenue. The flooded area extended about four blocks between Fourmile Run and Glebe Road and inundated about eight blocks containing 19 apartment buildings (about 100 apartments were flooded), 31 business establishments, and eight houses. Also damaged were several duplexes and about 500 automobiles. One motorist drowned in Long Branch. The U.S. Weather Bureau estimated that damage from Fourmile Run was $1.2 million in Arlandria, which was declared a disaster area.

Several other areas also suffered inconveniences and damage. Traffic was halted or slowed in many places. National Airport was closed for 3 hours. There were numerous problems, serious to the individuals concerned, such as water in basements and collapse of retaining walls and sidewalks.

The gaging-station records for Fourmile Run indicate some rather significant changes in runoff pattern since the installation of the U.S. Geological Survey gage in 1951. The lag time (time lapse from centroid of precipitation excess to the centroid of runoff) was computed as 2.6 hours from records prior to 1955, while the lag time was computed as 1.3 hours from records after 1961. Thus, water drained from the basin in about half the time in 1963 as compared to the early 1950's. Likewise, a partial-duration flood-frequency analysis for records prior to 1960 indicates the mean annual flood to be about 1,500 cfs while a similar analysis for records subsequent to 1961 indicates the mean annual flood to be about 3,000 cfs. By definition, the mean annual flood is expected to be equaled or exceeded on the average of once every 2.33 years. No periodicity is implied.

It appears that the increased urbanization in the Fourmile Run drainage basin during the past 20 years has had much to do with the foregoing changes in streamflow parameters. The construction of paved areas has tended to reduce infiltration, and the grading of land and construction of drainageways (ditches, gutters, and sewers) has removed storage and has accelerated runoff. This is in evidence by the 72-percent runoff for August 20 and the 1.3-hour lag time. The maximum rainfall intensity-duration combination on August 20 was coincident with the lag time, and, when combined with the large depth of rainfall, the stage was set for a severe flood in Fourmile Run. That more rain fell in the downstream area of Fourmile Run than in the upstream area (fig. 37) tended to make the flood greater than that expected from the average rainfall depth in the basin.

The recurrence interval of the August 20 flood peak probably is slightly less than 100 years, under the present condition of urbanization. Increased basin imperviousness and reduced channel storage may tend to further increase the flood peak magnitudes.

Many other nearby streams flooded their banks but caused only minor damage. The drainage basins of those streams either received less rainfall, as indicated in figure 37, or their drainageways could more readily handle the discharge.

## FLOODS OF SEPTEMBER 17 IN SOUTHWESTERN ARIZONA

By B. N. ALDRIDGE

The storm which struck Yuma, Ariz., on the evening of September 17 was the worst in 24 years. During this storm, rainfall around Yuma ranged from 1.9 to 3.4 inches. The U.S. Weather Bureau gage at Yuma recorded 2.04 inches in 1 hour, which is the highest intensity ever recorded at that station. Total rainfall during this storm was nearly equal to the yearly average for the area.

The storm covered most of southern California and western Arizona. Nearly every precipitation station in the south coastal basins and southeast desert basins of California and in Yuma County, Ariz., recorded at least an inch of rain. Amounts of recorded precipitation in Yuma County are shown in figure 38, but rain gages are sparse and greater amounts of rainfall may have occurred in parts of the county. Most of the damage from the resulting floods occurred in a strip along the Colorado River from Blythe, Calif., to Yuma, Ariz. Some crops in the Imperial Valley of California were damaged directly by the storm.

In Yuma a few streets were damaged as water rushed toward low areas where it was ponded to depths of 3 or 4 feet, and large amounts of silt were deposited in homes, businesses, and automobiles. The water was pumped from the area after it had stood for a day. About 30 families were evacuated. All highways out of Yuma, including U.S. Highway 80 and U.S. Highway 95, were blocked temporarily by floods and slides.

Highways and county roads in a narrow strip along the western edge of Arizona were damaged in several spots, but no major damage occurred at any one place.

In the Gila Valley, cotton and alfalfa crops were flooded to depths of 4 feet by the Gila River. Some of the water that flooded this area came from the Gila Drain Canal, which burst its levees and allowed water to flow into the old river bed.

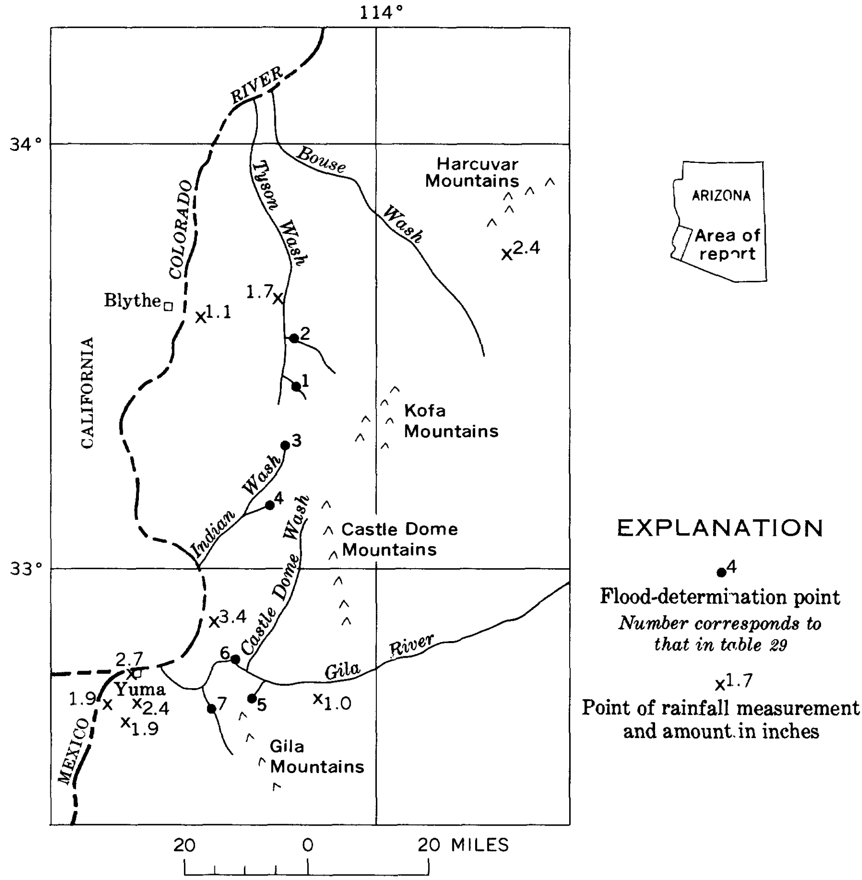


FIGURE 38.—Location of flood-determination points and rainfall-data sites, floods of September 17, in southwestern Arizona.

Estimates by various agencies of the damage total about $200,000. The total could have been higher as there is no satisfactory record of damage to individual homes and personal property.

Most of the area between the Colorado River and a line through the Gila, Castle Dome, Kofa, and Harcuvar Mountains had fairly heavy runoff. Table 29 gives peak stages and discharges at flood-determination sites shown in figure 38. The peak flows in Tyson Wash and in Bouse Wash were considered too small to warrant a measurement. The peak in each of these washes was estimated as 4,500 cfs at U.S. Highway 60.

TABLE 29.—*Flood stages and discharges, September 17, in southwestern Arizona*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to September 1963, Period | Prior to September 1963, Year | September 1963 | Gage height (feet) | Discharge, Cfs |
|---|---|---|---|---|---|---|---|
| | **Tyson Wash basin** | | | | | | |
| 1 | Tyson Wash tributary near Quartzsite | 13.7 | | | 17 | 2.54 | 554 |
| 2 | French Creek 4½ miles south of Quartzsite | 61.5 | | | 17 | | 1,810 |
| | **Indian Wash basin** | | | | | | |
| 3 | Indian Wash 30 miles south of Quartzsite | 1.41 | | | 17 | | 450 |
| 4 | Indian Wash tributary near Yuma | 2.4 | | | 17 | 4.44 | 72 |
| | **Gila River basin** | | | | | | |
| 5 | Ligurta Wash at Mohawk | .78 | | | 17 | 6.81 | 1,590 |
| 6 | Gila River near Dome | 57,850 | 1903–63 | 1916 | | (1) | [2] 200,000 |
| | | | 1929–63 | 1932 | | 16.8 | 20,700 |
| | | | | | 17 | 16.2 | [3] 4,820 |
| 7 | Fortuna Wash 16 miles east of Yuma | 23.3 | | | 17 | | 6,430 |

[1] Not determined.
[2] Daily discharge.
[3] From drainage area of probably less than 200 sq mi.

The peak flow of Gila River near Dome (station 6; drainage area, 57,850 sq. mi.) 4,820 cfs, is minimal when compared with previous floods that have occurred on this river, but when compared with other summer floods and with floods that have occurred since construction of several major dams, it becomes much more significant. The discharge during this flood was the highest that has occurred since 1941 and the highest to occur in any summer during the period of continuous record which began in 1929. Higher summer floods occurred prior to 1929, but these originated at least in part in the large watershed above Gillespie Dam (drainage area, 49,650 sq mi); but the 1963 flood originated entirely in the lower reaches of the river and mainly in the Castle Dome Wash area. There was no flow past the gaging station on the Gila River below Painted Rock Dam (drainage area, 50,910 sq mi) during the September 17 flood.

## FLOODS OF SEPTEMBER 17–19 IN SOUTHEASTERN TEXAS

At 0900 hours on September 16, a low pressure center was observed about 275 miles south of Galveston. This low pressure system developed rapidly into Hurricane Cindy and entered the Texas coast between Galveston and Port Arthur at 0700 hours on September 17.

Hurricane Cindy caused no deaths or injuries, and only minor property damage can be attributed to wind or tide. However, flood waters entered nearly 4,000 homes, and total property damage was estimated at $11.6 million. Agricultural losses were relatively low, about $500,000, because more than 80 percent of the rice crop had been harvested when the hurricane struck.

The torrential rainfall ranged from about 15 to 20 inches for a 3-day period on about 1,500 sq mi in the downstream reaches of the Sabine and the Neches Rivers, with a maximum of 23.5 inches at Deweyville. The 24-hour total at Deweyville was 20.60 inches. The rarity of the storm is indicated by the fact that the 100-year 3-day rainfall in the area is about 16 inches (U.S. Weather Bureau, 1964), and the 100-year 24-hour rainfall is about 13 inches (U.S. Weather Bureau, 1961). Point-rainfall totals for the period September 17–19 are shown in figure 39.

Maximum peak discharge for the year occurred at all stream-gaging stations in the flood area, and four stations recorded peak discharges for the period of record (table 30). The stream-gaging station, Hillebrandt Bayou near Lovell Lake (station 5), recorded a peak discharge about 1.3 times the 50-year flood.

TABLE 30.—*Flood stages and discharges, September 17–22, in southeastern Texas*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to September 1963: Period | Year | September 1963 | Gage height (feet) | Discharge: Cfs | Recurrence interval (yrs) |
|---|---|---|---|---|---|---|---|---|
| | **Sabine River basin** | | | | | | | |
| 1 | Cypress Creek near Buna | 69.2 | 1952–63 | 1955 | | 11.95 | 3,800 | |
| | | | | | 18 | 13.28 | 7,100 | 42 |
| 2 | Cow Bayou near Mauriceville | 83.3 | 1940–63 | 1958 | | [1] 16.71 | 4,300 | |
| | | | | | 19 | 18.15 | 4,600 | 7 |
| | **Neches River basin** | | | | | | | |
| 3 | Village Creek near Kountze | 861 | 1884–1963 | 1915 | | 34 | ([2]) | |
| | | | 1924–27, 1939–63 | 1940 | | 27.6 | 67,200 | |
| | | | | | 18 | 14.19 | 4,630 | <2 |
| | **Taylor Bayou basin** | | | | | | | |
| 4 | Taylor Bayou near Labelle | 262 | 1941–63 | 1961 | | [1] 11.51 | [3] 7,560 | |
| | | | | | 20 | [1] 11.78 | | |
| | | | | | 22 | | 9,590 | 6 |
| 5 | Hillebrandt Bayou near Lovell Lake | 128 | 1941–63 | 1961 | | [1] 11.56 | [3] 9,100 | |
| | | | | | 18 | | 15,000 | [4] 1.32 |
| | | | | | 19 | 12.34 | | |

[1] Affected by backwater.
[2] Not determined.
[3] Occurred on different date than maximum stage.
[4] Ratio of peak discharge to 50-year flood.

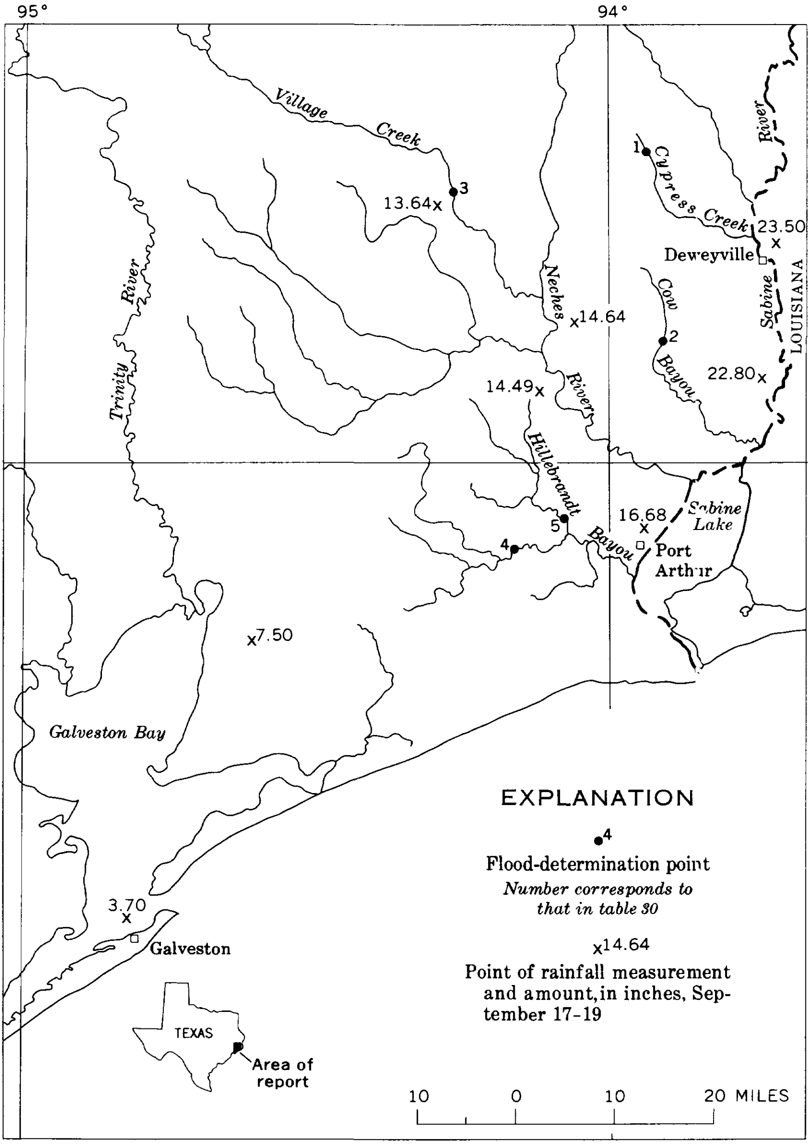


FIGURE 39.—Location of flood-determination points and rainfall-data sites, floods of September 17–19, in southeastern Texas.

## FLOODS OF SEPTEMBER 23 IN SOUTHEASTERN WASHINGTON

A severe thunderstorm on September 23 in the eastern half of Whitman County in southeastern Washington (fig. 40) produced unusually high rates of runoff from small drainage areas on three streams near

Colfax. U.S. Weather Bureau records for the station at Colfax showed precipitation of 0.70 inch on September 23. Local residents stated that the storm lasted less than 15 minutes and because of this short duration the extreme runoff and damage was limited to small drainage areas. A few small culverts were washed out, but the major damage was due to soil erosion and crop washout.

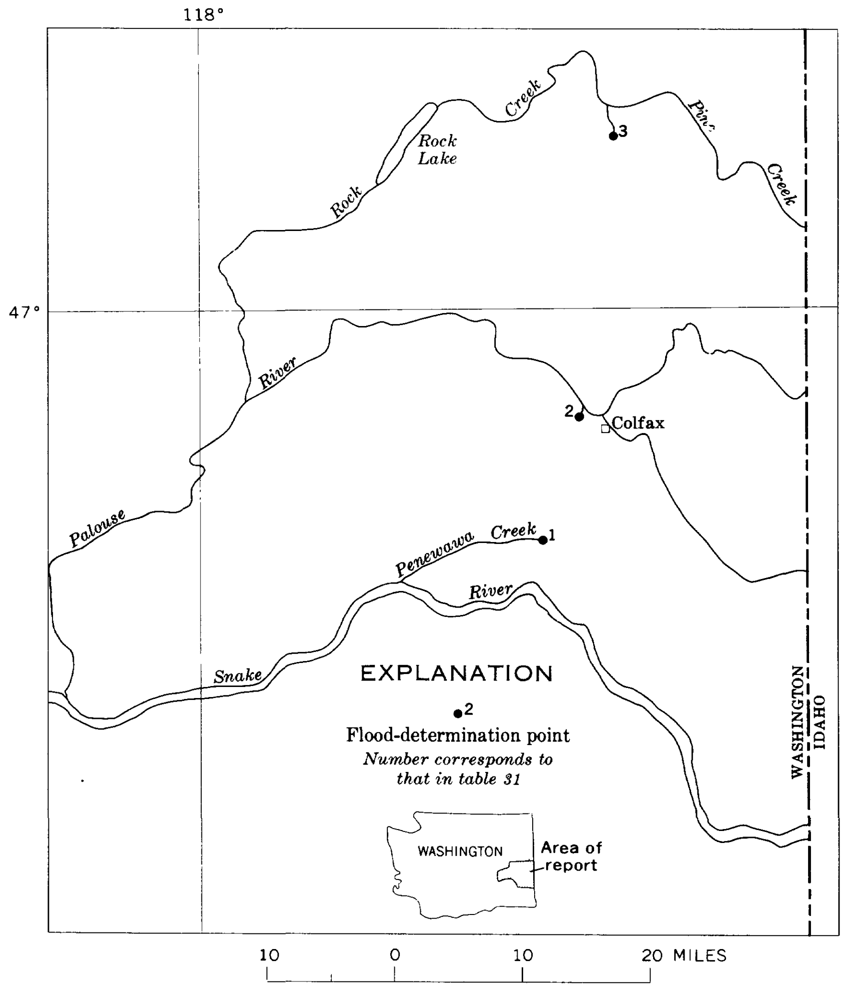


FIGURE 40.—Location of flood-determination points, floods of September 23, in southeastern Washington.

Three measurements of peak discharge were made. A summary of peak stages and discharges is given in table 31. The drainage areas at the sites are 3.30 sq mi or smaller. There was no significant rise in stage on the larger streams in that area, but the recurrence intervals for the floods at the three listed sites are 40 years or greater.

TABLE 31.—*Flood stages and discharges in the Penewawa Creek basin, September 23, in southeastern Washington*

| No. | Stream and place of determination | Drainage area (sq mi) | Maximum floods: Prior to September 23 — Period | Year | September 1963 | Gage height (feet) | Discharge — C's | Recurrence interval (yr) |
|---|---|---|---|---|---|---|---|---|
| 1 | Penewawa Creek near Almota | 3.30 | | | 23 | | 178 | [1] 1.06 |
| 2 | Palouse River tributary at Colfax | 2.10 | 1955–63 | 1963 | | 21.82 | 180 | |
| | | | | | 23 | 22.12 | 183 | 40 |
| 3 | Pine Creek tributary near McCoy | 3.12 | | | 23 | | 1,110 | [1] 2.58 |

[1] Ratio of peak discharge to 50-year flood.

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# INDEX

[Italic page numbers indicate major references]

# Floods of 1963 in the United States

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# CONTENTS

[Letters designate the separately published chapters]