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ARIZONA STATE LAND DEPARTMENT
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FLOODS OF SEPTEMBER 1970 IN ARIZONA, UTAH, AND COLORADO

BY R. H. ROESKE

1/2 Inches Of Rain Brings 1 Storm Causes Great Flooded
The heavy falling in the Friday night had been in weather as water had strike the racing do takes both rain-falls and by 11:30 p.m. The damal aftermath of the pled bridges holiday weekend floods came people in the move into focus Monday with reports of 13 Arizonans known dead, at least 14 missing and found dead and more than \$1 billion in damage to homes and businesses.

Flood Toll Hits 15 Search Yields 4 More Victim In Pave...
PHOENIX (AP)—Torrential rains hit central Arizona Saturday, sending flood waters spill power and about 200 miles south of Phoenix and the young...

When it rains...it rains!...
Torrential rains drenched Arizona At Least 15 Dead, Missing in Arizona, Utah Floods
The dismal aftermath of the holiday weekend floods came more into focus yesterday with reports of 13 Arizonans known dead, at least 14 missing and found dead and more than \$1 billion in damage to homes and businesses.

Record storm LASHES A Little Child Is Rescued
The Hassayampa Crests At The D...

Storm Cleanup Job Begins
about 20 miles south of Phoenix and the young...

Holiday Into Horror
By ED WIGGINS
family and friends were washed into Tonto Creek. They were Pamela Wiese, 21, and Heather Fuller, 20, both of Mesa who Brown, and Wayne Day expected to bring back about 175 men, women, and children, but only on the buses. such also ra, but in some rs had accues, spotted, of the Meanwhi Stage Line halt its bus were made. was to go in Outgoing disrupted holiday ac was receve- Continu

Labor Day Flood Takes Toll of Death and Destruction
By VINCE TAYLOR
chairman of the East Maricopa SCD. for rights of ways unavailable. A case in point, he said, is the Buck-

Disaster spurs action toward flood controls
would be tapped for \$750,000 for emergency flood damage needs. rector, and State Engineer William Price. THE BRUNT of the state's damage was fixed at Among the affected Buckeye water...

County Is Declared U.S. Disaster Area
By LEE BISHOP
The White House announced today in Washington that Flood Aftermath, Pages 9 And 19, would be tapped for \$750,000 for emergency flood damage needs. rector, and State Engineer William Price. THE BRUNT of the state's damage was fixed at Among the affected Buckeye water...

PREPARED BY THE GEOLOGICAL SURVEY
UNITED STATES DEPARTMENT OF THE INTERIOR

PHOENIX, ARIZONA
APRIL 1971

802.006

ARIZONA STATE LAND DEPARTMENT WATER-RESOURCES REPORTS

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- | No. | No. |
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| * 1. Pumpage and ground-water levels in Arizona in 1955, by P. W. Johnson, N. D. White, and J. M. Cahill: 69 p., 30 figs., 1956. | *12A. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part I, Records of ground-water supplies, by G. E. Davis, W. F. Hardt, L. K. Thompson, and M. E. Cooley: 159 p., 3 figs., 1963. |
| * 2. Annual report on ground water in Arizona, spring 1956 to spring 1957, by J. W. Harshbarger and others: 42 p., 18 figs., 1957. | *12B. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part II, Selected chemical analyses of the ground water, by L. R. Kister and J. L. Hatchett: 58 p., 2 figs., 1963. |
| * 3. Geology and ground-water resources of the Harquahala Plains area, Maricopa and Yuma Counties, Arizona, by D. G. Metzger: 40 p., 2 pls., 7 figs., 1957. | 12C. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part III, Selected lithologic logs, drillers' logs, and stratigraphic sections, by M. E. Cooley, J. P. Akers, and P. R. Stevens: 157 p., 3 figs., 1964. |
| * 4. Geology and ground-water resources of the Palomas Plain-Dendora Valley area, Maricopa and Yuma Counties, Arizona, by C. A. Armstrong and C. B. Yost, Jr.: 49 p., 3 pls., 4 figs., 1958. | 12D. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part IV, Maps showing locations of wells, springs, and stratigraphic sections, by M. E. Cooley and others: 2 sheets, 1966. |
| * 5. Annual report on ground water in Arizona, spring 1957 to spring 1958, by W. F. Hardt, J. M. Cahill, and M. B. Booher: 60 p., 19 figs., 1958. | 12E. Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part I-A, Supplemental records of ground-water supplies, by E. H. McGavock, R. J. Edmonds, E. L. Gillespie, and P. C. Halpenny: 55 p., 4 figs., 1966. |
| * 6. Annual report on ground water in Arizona, spring 1958 to spring 1959, by W. F. Hardt, R. S. Stulik, and M. B. Booher: 61 p., 18 figs., 1959. | 13. Desert floods—a report on southern Arizona floods of September 1962, by D. D. Lewis: 13 p., 18 figs., 1963. |
| * 7. Annual report on ground water in Arizona, spring 1959 to spring 1960, by W. F. Hardt, R. S. Stulik, and M. B. Booher: 89 p., 22 figs., 1960. | *14. Basic ground-water data of the Willcox basin, Graham and Cochise Counties, Arizona, by S. G. Brown, H. H. Schumann, L. R. Kister, and P. W. Johnson: 93 p., 15 figs., 1963. |
| * 8. Geology and ground-water resources of the McMullen Valley, Maricopa, Yavapai, and Yuma Counties, Arizona, by William Kam: 72 p., 17 figs., 1961. | *15. Annual report on ground water in Arizona, spring 1962 to spring 1963, by N. D. White, R. S. Stulik, E. K. Morse, and others: 136 p., 47 figs., 1963. |
| 9. Hydrologic data and drillers' logs, Papago Indian Reservation, Arizona, by L. A. Heindl and O. J. Cosner, with a section on chemical quality of the water by L. R. Kister: 116 p., 3 figs., 1961. | 16. Effects of ground-water withdrawal in part of central Arizona projected to 1969, by N. D. White, R. S. Stulik, and C. L. Rauh: 25 p., 7 figs., 1964. |
| *10. Annual report on ground water in Arizona, spring 1960 to spring 1961, by N. D. White, R. S. Stulik, E. K. Morse, and others: 93 p., 32 figs., 1961. | |
| *11. Annual report on ground water in Arizona, spring 1961 to spring 1962, by N. D. White, R. S. Stulik, and others: 116 p., 35 figs., 1962. | |

(Continued on inside back cover)

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FLOODS OF SEPTEMBER 1970 IN ARIZONA, UTAH, AND COLORADO

BY R. H. ROESKE

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Labor Day Flood Takes Toll of Death and Destruction

Disaster spurs action toward flood controls

By VINCE TAYLOR
Central Arizona Press

family and friends were washed
into Tonto Creek. They were
Pamela Weese, 21, and Heather
Fulter, 20, both of Mesa who
Brown, and Wayne Day expected
to bring back about 175 men,
women, and children, but only
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County Is Declared U.S. Disaster Area

By LEE BISHOP
The White House announced
today in Washington that
Flood Aftermath,
Pages 9 And 19,
would be tapped for \$750,000
for emergency flood damage
needs.
rector and State Engineer
William Price
THE BRUNT of the state's
damage was first
Among the affected
Duckeye water
not yet available

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FLOODS OF SEPTEMBER 1970 IN ARIZONA, UTAH, AND COLORADO

By

R. H. Roeske

Introduction

Record floods occurred in Arizona, southeastern Utah, and southwestern Colorado on September 4-7, 1970 (fig. 1). The floods resulted from heavy rainfall caused by the interaction of cold air from the northwest and extremely moist tropical air from the south. The floods took the lives of 25 persons and caused millions of dollars in property damage. Parts of Arizona and Colorado were declared disaster areas by President Nixon and were thereby eligible for Federal relief funds. On September 12-14, another lesser storm caused flooding in southeastern Utah and southwestern Colorado.

This preliminary report presents a brief discussion of the floods and a tabulation of preliminary peak stages and discharges (table 1). A more detailed report including hydrographs and detailed estimates of damage will be prepared later.

Acknowledgments

This report summarizes the work of several agencies. The National Weather Service furnished rainfall data, prepared an isohyetal map, and furnished a meteorological summary. The U. S. Forest Service furnished rainfall, runoff, and flood-damage information. The Office of Emergency Preparedness furnished information on flood damage. The newspapers of Arizona and southwestern Colorado were reviewed for descriptions of the floods.

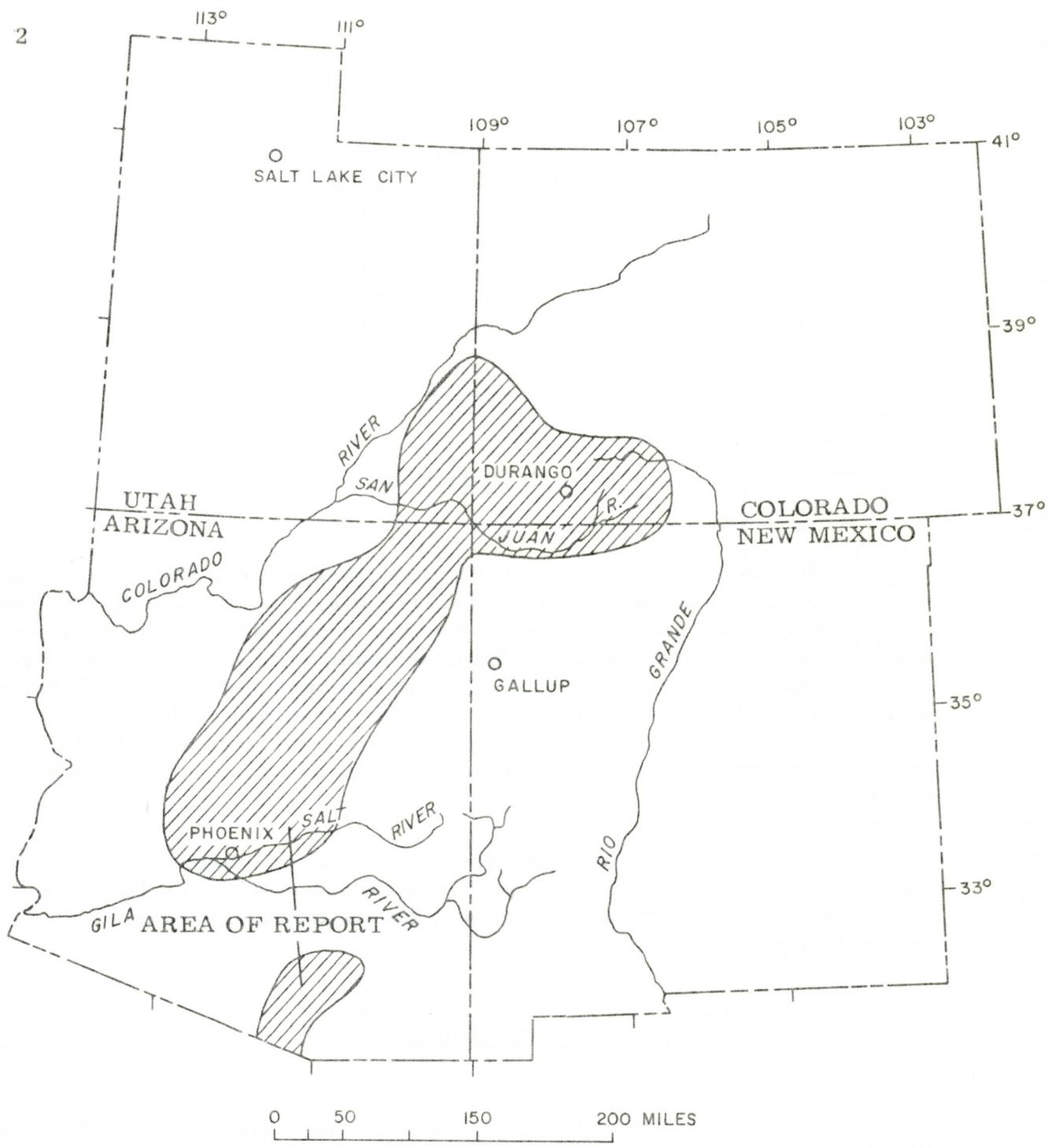


FIGURE 1. -- AREA OF REPORT.

The Storm

The conditions that led to the storm of September 4-6, 1970, began to develop on September 2, when moist tropical air flowed into southern Arizona as a result of tropical storm Norma located off the tip of Baja California. The moist air continued to build up and spread, and by September 4 clouds had spread over all of Arizona and into southern Utah and southwestern Colorado, and rain showers had started over most of the area. In Arizona heavy rainfall was concentrated near the international boundary southwest of Tucson (fig. 2). On September 5, a cold front entered Arizona from the northwest and strong southerly winds developed over the State. The combination of the upward motion of the air ahead of the cold front and the orographic lifting of the moisture-laden tropical air on the south side of the mountains in Arizona, along the Mogollon Rim, and in the mountains of Utah and Colorado led to extremely heavy rains in central Arizona (fig. 2), southeastern Utah, and southwestern Colorado (fig. 3). The heavy rains began early on September 5 and continued most of the day as the front moved across Arizona. In southwestern Colorado heavy rains began the morning of September 5 and continued into the following day as the northern part of the front advanced into Colorado. The southern part of the front had slowed and weakened, and rain continued in southern Arizona on September 6.

The heaviest rainfall occurred in the mountainous areas of central Arizona. Numerous precipitation stations recorded 5 to 8 inches of rainfall in 24 hours, and one station recorded 11.40 inches, which is an alltime record for 24-hour precipitation in Arizona. Several stations recorded intensities of more than 3 inches in 4 hours.

The amount of rainfall in northeastern Arizona was low, but in southwestern Colorado and extreme southeastern Utah total rainfall for 12 hours exceeded 4 or 5 inches in many places. The total precipitation in several places in southwestern Colorado approached or exceeded previous record 24-hour total precipitation for the locations. A rancher near the Utah-Colorado line reported 6.0 inches of rain in 12 hours on September 5. This is a new 12-hour and 24-hour precipitation record for the State of Utah.

A similar storm, but of lesser magnitude, struck southeastern Utah and southwestern Colorado September 12-14, 1970. The largest total 3-day precipitation reported for this storm was 4.83 inches, and the largest 24-hour total reported was 2.84 inches.

Description of Floods

Southern Arizona

The floods in southern Arizona began on September 4, when heavy rains near the town of Sasabe on the Mexican border caused flooding in the Los Robles Wash drainage basin. In the upper part of the basin at Altar Wash near Three Points (fig. 4, No. 56) the flood destroyed the State highway bridge and the gaging station. The peak discharge here was 22,000 cfs (cubic feet per second). The flood overtopped the gage and State highway bridge on Brawley Wash near Three Points (fig. 4, No. 57) and halted traffic for several hours. As the flood moved downstream it spread over wide areas of desert and farmland and was reduced in magnitude. The discharge at Los Robles Wash near Marana (fig. 4, No. 59) was only 4,320 cfs as compared to a peak of about 32,000 cfs in 1962.

The Tucson area received only moderate amounts of rainfall, but in the nearby mountains more than 8 inches of rainfall was reported; the greatest amount occurred on September 6. Sabino Creek near Tucson (fig. 4, No. 53) had a record peak discharge of 7,550 cfs. Adjacent basins had very little runoff and as the flood moved downstream into Rillito Creek the peak was reduced considerably.

Central Arizona

Heavy rainfall on the mountainous areas of central Arizona resulted in sudden large floodflows in Tonto, Sycamore, Oak, and Beaver Creeks, and the East Verde and Hassayampa Rivers. The floods claimed the lives of 23 persons and caused millions of dollars in property damage. Peak discharges of several hundred cubic feet per second per square mile were measured at numerous stations. At several stations the peak discharge exceeded that of a hundred-year flood.

In the Tonto Creek basin many vacationers were spending the Labor Day weekend at cabins or camping along Tonto Creek, a normally pleasant mountain stream. Rainfall began in the upper Tonto Creek basin late on September 4, continued through the morning of the 5th, and became very intense in the afternoon. The resulting flood was described in the September 8 issue of the Mesa Tribune as follows:

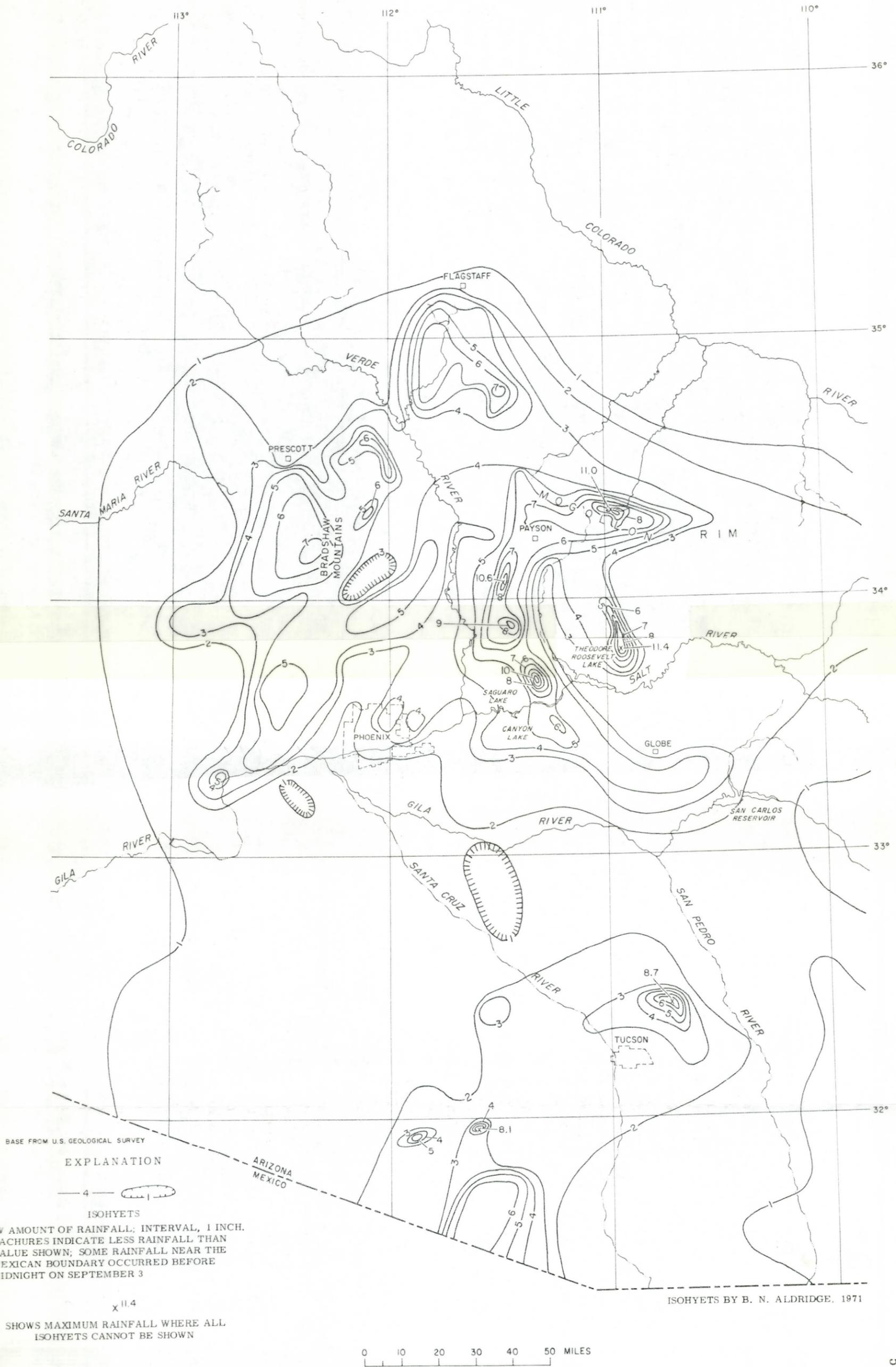


FIGURE 2. --RAINFALL, SEPTEMBER 4-6, 1970, IN SOUTHERN AND CENTRAL ARIZONA.

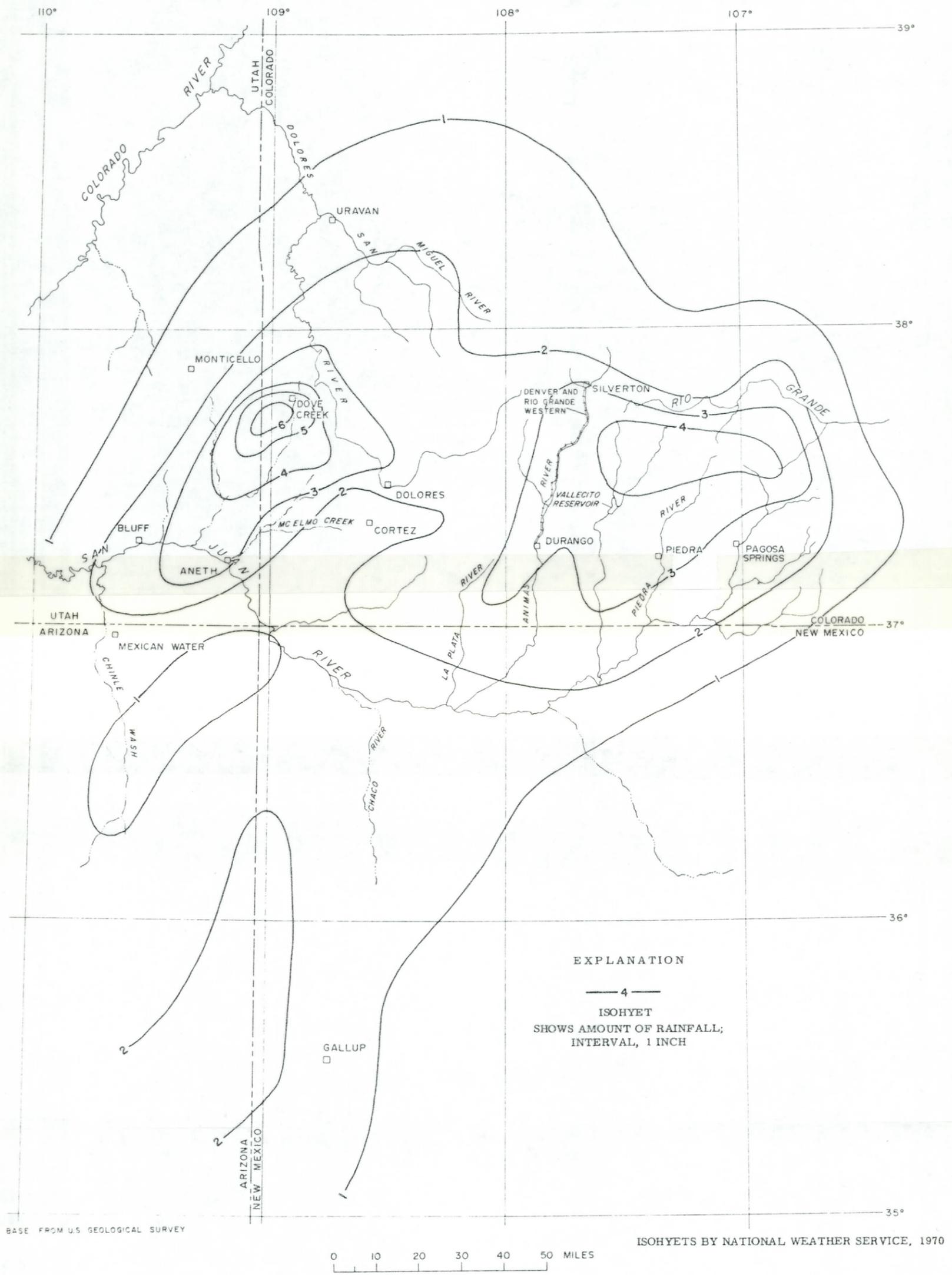


FIGURE 3. --RAINFALL, SEPTEMBER 5-6, 1970, IN NORTHEASTERN ARIZONA, SOUTHEASTERN UTAH, AND SOUTHWESTERN COLORADO.



FIGURE 4. -- LOCATION OF SITES WHERE FLOOD DATA WERE COLLECTED FOR FLOODS OF SEPTEMBER 4-7, 1970, IN ARIZONA.

"Between 3:30 p.m. and 4 p.m. Tonto Creek exploded into a churning, boiling mass of water, rocks and full grown pine trees and crested at over 30 feet in depth in the flat spots.

"Campers, trucks, cars, trailers and cabins were blown over and sucked into the fury of the avalanche of water. Whole families disappeared into the wall of water along with their cars and trucks."

Fifteen persons were drowned in Tonto and Christopher Creeks, as house trailers, campers, and automobiles were swept away and cabins were washed off their foundations and destroyed. Several hundred persons were stranded in the Payson area when roads and bridges were washed out. The electricity was cut off in some areas when powerline poles were washed away. The fish hatchery on Tonto Creek was damaged and 70,000 pounds of fish were lost.

A peak flow of 18,400 cfs from an area of 24.0 square miles was measured by slope-area methods in Tonto Creek at Kohl's Ranch (fig. 4, No. 61). This flow, combined with 11,900 cfs from Christopher Creek (fig. 4, No. 62) and a large flow from Haigler Creek, resulted in a peak flow of 46,300 cfs at Tonto Creek near Gisela (fig. 4, No. 64). Rye Creek near Gisela (fig. 4, No. 65) had a peak flow of 44,400 cfs. The peak flows on Tonto Creek and Rye Creek were displaced by only about 2 hours but the peaks were of extremely short duration. Therefore, two separate peaks of nearly equal stage occurred at Tonto Creek above Gun Creek near Roosevelt (fig. 4, No. 67). The discharge at the higher stage was 53,000 cfs, which is the highest discharge recorded since the station was established at this site in 1940. The records from two old staff gages at downstream sites indicate this might be the highest peak since the early 1900's. All flow from Tonto Creek was stored in the Salt River reservoirs.

In the Cherry Creek basin east of Tonto Creek large flows came from the extreme upper end of the basin and from a small area along the west side of the basin. Peaks at the gaging stations on Cherry Creek were of a magnitude that will occur frequently.

Flooding extended over the Mogollon Rim a short distance into the headwaters of Chevelon and Clear Creeks but reservoirs on both creeks prevented extremely high flows from reaching the lower parts of the basins. However, the flows from these creeks contributed to the flooding along the Little Colorado River as discussed later.

Sycamore Creek, west of Tonto Creek, received at least 7 inches of rain over most of the upper part of the drainage and as much as 10 inches was recorded at one station during the storm period. The peak discharge of Sycamore Creek near Fort McDowell (fig. 4, No. 96) was 24,200 cfs. The flood washed out sections of State highway 87 between Phoenix and Payson and a bridge over Sycamore Creek, stranding hundreds of motorists in the Payson area. Three persons were killed as a result of the flooding in Sycamore Creek.

The East Verde River, with headwaters along the Mogollon Rim, had a peak discharge of 23,500 cfs at the gaging station near Childs (fig. 4, No. 87). Beaver Valley, a community of summer homes on the East Verde River about 6 miles north of Payson, suffered extensive damage from washouts and from deposition of sediment and debris.

In the area between Camp Verde and Flagstaff, intense rains fell on the headwaters of Oak and Beaver Creeks. More than 6 inches of rain fell over a large part of the area. Much of this area is covered intensively by precipitation and streamflow stations of the U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station. South of the area, the West Clear Creek drainage received only moderate rainfall. Oak Creek near Cornville (fig. 4, No. 71) had a flood peak of 24,700 cfs. The peak discharge is approximately equal to that of March 1938, which, reportedly, is the highest flood since at least 1885.

Motorists and campers were stranded in Oak Creek Canyon near Sedona due to rock and mud slides and pavement washouts. Damage to roads, bridges, and culverts was common throughout the area.

The Verde River received little runoff upstream from Oak Creek, but with Oak Creek, Beaver Creek, and East Verde River contributing large floodflows, the peak on the Verde River above Horseshoe Dam (fig. 4, No. 89) was 67,500 cfs, the highest peak since 1951. All the floodflow from the Verde River above Horseshoe Dam was stored in the Verde River reservoirs.

Heavy rains on September 5 in the Bradshaw Mountains and surrounding areas led to the flooding of the Agua Fria and Hassayampa Rivers. As much as 7 inches of rain was reported for the storm period at several stations. At Agua Fria River near Mayer (fig. 4, No. 101) the peak stage was about 3 feet above the previous maximum, but farther downstream local residents reported that floods of equal magnitude had occurred several times in recent years. All the runoff upstream from Waddell Dam was stored in Lake Pleasant. The Agua Fria River gained several thousand cubic feet per second of runoff between Lake Pleasant and the mouth of New River. The

peak flows from the upper end of New River were the highest since records began in 1960 but the peak discharge decreased rapidly downstream. Above Skunk Creek the discharge of New River was less than the maximum of record. Downstream, the discharge was about equal to the previous maximum during the period of gaging-station operation but was much less than the estimated 38,000 cfs for the flood in 1943. One person was drowned in New River when his car stalled in a road crossing.

The Hassayampa River at Box damsite near Wickenburg (fig. 4, No. 111) had a peak of 58,000 cfs, which is more than twice the previous known maximum of 27,000 cfs, which occurred in 1927 and in 1951.

In the upper part of the Hassayampa River basin, at least one home, which had been in existence for over 100 years, was washed away completely. Extensive flood damage occurred at Wickenburg but no lives were lost. The sewage plant was flooded and a sewerline running to the plant was washed away, allowing raw sewage to run into the river. Several homes and a number of house trailers were destroyed, leaving about 50 persons homeless. Ranches along the river were flooded and buildings, livestock, vehicles, and trees were swept away. Electricity was cut off in part of the area when powerline poles were washed away.

In Scottsdale more than 250 homes were evacuated due to flooding when drainage channels overflowed and breaks occurred in irrigation canals. A funnel cloud reportedly touched ground in Scottsdale during the storm and damaged a number of roofs along its path. Many streets in Phoenix were closed due to flooding and homes and businesses were flooded.

Heavy rains in Buckeye and northward caused extensive flooding. The Roosevelt Irrigation Canal 3 miles north of Buckeye overflowed and flooded fields and homes. Homes and businesses in Buckeye were flooded and many homes in the area were evacuated. The Buckeye waterplant was flooded and the contamination of city wells was reported. Railroad tracks were washed out both east and west of Buckeye. Several deep wells caved in and many irrigation canals were washed out.

Northeastern Arizona

Rainfall in northeastern Arizona generally was about 1 to 2 inches. Runoff indicates that rainfall may have been greater in the higher elevations of northeastern Arizona but data are too scarce to provide a true measure of rainfall in the area.

Large flows from the Puerco River caused flooding along the Little Colorado River at Holbrook on September 6. The peak on the Little Colorado River at Holbrook (fig. 4, No. 43) was 20,000 cfs, which is only one-third of the peak discharge of 1923. Farther downstream, flows from Chevelon and Clear Creeks increased the flow in the Little Colorado River and caused flooding at Winslow. At Holbrook 120 persons were evacuated from their homes, and at Winslow about 200 homes were surrounded by water when dikes along the Little Colorado River were breached.

Dinnebito Wash, which drains from Black Mesa into the Little Colorado River, had an extremely high flood peak, but no rainfall data for the mesa are available. Chinle Wash near Mexican Water (fig. 5, No. 41) reached a peak of 9,880 cfs on September 7, which is the highest flow in at least 20 years and is nearly three times the previous maximum, which occurred in 1964.

Southeastern Utah and Southwestern Colorado

The floods of September 5 and 6 in southeastern Utah and southwestern Colorado occurred in the upper Rio Grande basin and in the Dolores River basin in Colorado and in the San Juan River basin in Colorado and Utah. Considerable damage was caused to roads, bridges, utilities, irrigation systems, and private property; many people as well as livestock were isolated by rapidly rising floodwaters. Much of the damage to homes and private property occurred along the Animas River and in the vicinity of Vallecito Reservoir in Colorado. At Silverton, Colorado, the sewage disposal system was damaged by flooding. The Denver and Rio Grande Western Railroad sustained heavy losses due to roadbed and track washouts in many stretches of the narrow-gage line between Durango and Silverton. Residents of a nursing home at Durango were evacuated because of flood danger. Two persons were drowned near Aneth, Utah, when their vehicle plunged into McElmo Creek where a bridge had washed out. Considerable crop and farmland damage was reported in the area between Cortez and Dove Creek, Colorado, and near Bluff, Utah. The water supply for the community of Dove Creek was cut off when a recently completed pipeline from the Dolores River was washed out.

Floodflows on the Dolores River were less than record peak flows. The Dolores River at Dolores (fig. 5, No. 4) peaked at 5,180 cfs compared to the peak of record of 10,000 cfs in October 1911. The San Miguel River at Uravan (fig. 5, No. 8) reached a new record peak of 8,910 cfs, surpassing the previous high of 6,690 cfs in April 1958.

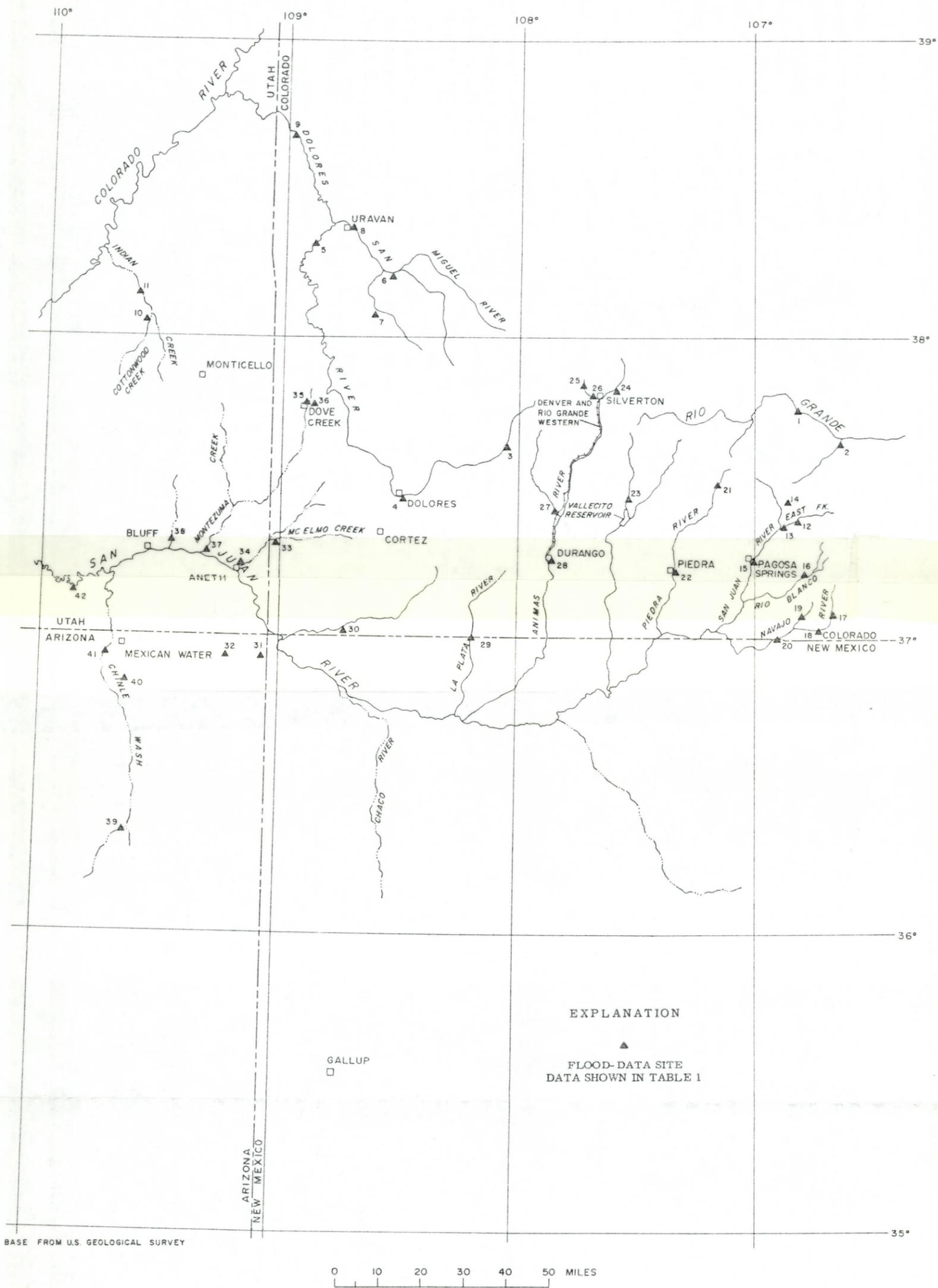


FIGURE 5. --LOCATION OF SITES WHERE FLOOD DATA WERE COLLECTED FOR FLOODS OF SEPTEMBER 5-6, 12-14, 1970, IN NORTHEASTERN ARIZONA, SOUTHEASTERN UTAH, AND SOUTHWESTERN COLORADO.

In the San Juan River basin record flood peaks occurred at several sites in Colorado and Utah. The Rio Blanco near Pagosa Springs, Colorado (fig. 5, No. 16), reached a peak discharge of 2,500 cfs, the highest peak discharge since the record began in 1935, and the Piedra River near Piedra, Colorado (fig. 5, No. 22), reached a peak of 7,980 cfs, the highest since the record began in 1938. At Durango the Animas River (fig. 5, No. 28) peaked at 11,600 cfs. The two highest flood discharges known at this site are 20,000 cfs in June 1927 and 25,000 cfs in October 1911. In Utah flood peaks on McElmo Creek near Bluff (fig. 5, No. 34) and Montezuma Creek near Bluff (fig. 5, No. 37) far exceeded any previous floods in the eleven years of record at these sites. On the San Juan River near Bluff (fig. 5, No. 42) the peak discharge of 52,000 cfs on September 6 has been exceeded only three times since 1914.

Floods occurred again September 12-14, 1970, in the same areas of Utah and Colorado, and record flood peaks occurred at several sites, but generally flood peaks were lower than those of September 5-6, 1970. The East Fork San Juan River above Sand Creek, near Pagosa Springs, Colorado (fig. 5, No. 12), reached a peak of 2,030 cfs, which is the highest peak discharge since the record began in 1956. The Navajo River at Banded Peak Ranch, Colorado (fig. 5, No. 17), reached a record peak of 1,350 cfs, surpassing the previous high of 1,340 cfs in May 1941 and the September 6 peak of 1,200 cfs. Cottonwood Creek near Monticello, Utah (fig. 5, No. 10), reached the highest peak discharge since the record began in 1949.

No reports of damages by the floods of September 12-14 were found. Probably whatever damages resulted were small in comparison with the destruction caused by the earlier floods.

Table 1. - Summary of flood stages and discharges

No	Permanent station number	Stream and place of determination	Drainage area (sq mi)	Maximum previously known				Maximum September 1970 ^{1/}		
				Period	Year	Gage height (feet)	Discharge (cfs)	Date	Gage height (feet)	Discharge (cfs)
Rio Grande basin										
1	08217500	Rio Grande at Wagonwheel Gap, Colo.	780	1951-70	1957	5.38	4,870	6	5.84	4,660
2	08219500	South Fork Rio Grande at South Fork, Colo.	216	1910-70	1911	9.7	8,000	6	5.61	2,040
Dolores River basin										
3	09165000	Dolores River below Rico, Colo.	105	1952-70	1952	6.15	2/2,120	6	5.88	1,860
4	09166500	Dolores River at Dolores, Colo.	556	1895-1970	1911	3/10.2	10,000	6	9.04	5,180
5	09169500	Dolores River at Bedrock, Colo.	1,910	1917-22	1920	8.0	-----	6	7.15	5,710
6	09175500	San Miguel River at Naturita, Colo.	1,080	1917-29, 1940-70	1942	9.80	5,460 7,100	13	5.63	2,610
7	09175900	Dry Creek near Naturita, Colo.	85.9	1966-70	1967	4.64	506	5	8.31	5,660
8	09177000	San Miguel River at Uravan, Colo.	1,550	1954-62	1958	3/11.75	6,690	6	12.6	8,910
9	09179500	Dolores River at Gateway, Colo.	4,350	1936-54	1941	11.33	15,400	6	7.7	6,350
10	09187000	Cottonwood Creek near Monticello, Utah.	115	1949-70	1959	-----	2,210	12	-----	3,500
11	09187500	Indian Creek above Harts Draw, near Monticello, Utah.	258	1949-57	1957	9.21	3,120	12	-----	4,400
San Juan River basin										
12	09339900	East Fork San Juan River above Sand Creek, near Pagosa Springs, Colo.	64.1	1956-70	1957	6.32	1,210	14	6.75	2,030
13	09340000	East Fork San Juan River near Pagosa Springs, Colo.	86.9	1935-70	1941	4.84	2,070	6	5.08	1,900
14	09341200	Wolf Creek near Pagosa Springs, Colo.	14.0	1968-70	-----	-----	-----	6	2.67	585
15	09342500	San Juan River at Pagosa Springs, Colo.	298	1910-70	1911	17.8	25,000	6	9.02	6,580
16	09343000	Rio Blanco near Pagosa Springs, Colo.	58.0	1935-70	1957	-----	2/1,600	6	3.72	2,500
17	09344000	Navajo River at Banded Peak Ranch, Colo.	69.8	1936-70	1941	7.02	2/1,340	14	4.50	1,350
18	09344300	Navajo River above Chromo, Colo.	96.4	1956-70	1957	5.95	2/1,340	14	8.28	(4)
19	09345500	Little Navajo River at Chromo, Colo.	-----	1935-52	1941	4.32	2/399	6	-----	132
20	09346000	Navajo River at Edith, Colo.	172	1935-70	1942	6.55	2/2,840	14	5.54	1,370
21	09347200	Middle Fork Piedra River near Pagosa Springs, Colo.	32.2	1970	-----	-----	-----	6	4.39	2,520
22	09349500	Piedra River near Piedra, Colo.	371	1938-70	1957	8.60	2/6,870	6	7.92	7,980
23	09352900	Vallecito Creek near Bayfield, Colo.	72.1	1962-70	1965	3.43	1,530	6	6.51	7,050
24	09357500	Animas River at Howardsville, Colo.	55.9	1935-70	1949	4.36	2/1,980	6	3.65	1,170
25	09358900	Mineral Creek above Silverton, Colo.	11.0	1968-70	-----	-----	-----	5	4.50	754
26	-----	Mineral Creek below Bear Creek at Silverton, Colo.	51.7	-----	-----	-----	-----	5	-----	3,070
27	09361000	Hermosa Creek near Hermosa, Colo.	172	1912-14, 1919-29, 1939-70	1927 1941	3/8.50	2,980	6	4.20	1,700
28	09361500	Animas River at Durango, Colo.	692	1895-1970	1911	11.0	25,000	6	8.83	11,600
29	09366500	LaPlata River at Colorado-New Mexico State line.	331	1920-70	1927	11.36	4,750	6	4.75	672
30	09371000	Mancos River near Towaoc, Colo.	550	1920-43 1951-70	1941	7.30	5,300	6	8.50	4,530
31	09371100	Teec Nos Pos Wash near Teec Nos Pos, Ariz.	16.0	1967-70	1967	7.14	750	12	9.44	1,400
32	09371200	Tsintah Wash near Teec Nos Pos, Ariz.	24.5	1968-70	1968	4.38	603	12	9.68	2,100
33	09372000	McElmo Creek near Colorado-Utah State line	350	1951-70	1967	7.58	3,040	5	8.13	2,880
34	09372200	McElmo Creek near Bluff, Utah	720	1959-70	1962	10.88	1,140	5	-----	13,100
35	-----	Dove Creek at Dove Creek, Colo.	8.45	-----	-----	-----	-----	5	-----	830
36	-----	Big Canyon Creek near Dove Creek, Colo.	10.7	-----	-----	-----	-----	5	-----	2,400
37	09378600	Montezuma Creek near Bluff, Utah.	1,200	1959-70	1964	16.70	1,500	5	-----	40,700
38	09378650	Recapture Creek near Bluff, Utah.	203	-----	-----	-----	-----	5	-----	4,240
39	09379030	Black Mountain Wash near Chinle, Ariz.	80.7	1963-70	1968	8.14	1,560	5	6.72	1,020
40	09379080	Chinle Wash tributary near Rock Point, Ariz.	2.5	1964-70	1967	3.84	25	5	5.70	220
41	09379200	Chinle Wash near Mexican Water, Ariz.	5/3,660	1950-70	1964	-----	3,280	7	7.5	9,880
42	09379500	San Juan River near Bluff, Utah	23,000	1914-70	1927	32.0	2/70,000	6	-----	52,000
Little Colorado River basin										
43	09397000	Little Colorado River at Holbrook, Ariz.	5/11,300	1870-1970	1923	-----	60,000	6	13.95	20,000
44	09397500	Chevelon Creek below Wildcat Canyon, near Winslow, Ariz.	5/275	1949-70 1947-70	1968 1952	12.55 18.2	24,200 19,800	5	13.58	11,100
45	09398000	Chevelon Creek near Winslow, Ariz.	5/994	1916-19, 1929-70	1952	19.8	25,300	6	17.54	8,010
46	09398500	Clear Creek below Willow Creek, near Winslow, Ariz.	5/321	1947-70	1952	21.5	16,400	5	20.90	15,300
47	09399400	Jacks Canyon Creek near Winslow, Ariz.	285	1969-70	-----	-----	No flow	5	3.56	3
48	09400200	Steamboat Wash tributary near Ganado, Ariz.	.5	1963-70	1964	8.28	383	5	8.23	370
49	09400650	Sinclair Wash at Flagstaff, Ariz.	8.18	1944-70	-----	-----	-----	5	19.3	401
50	09401000	Little Colorado River at Grand Falls, Ariz.	5/21,200	1923-70	1923	47.0	120,000	6	15.6	11,400
51	09401100	Dinnebito Wash near Oraibi, Ariz.	261	1968-70	1969	4.64	5,890	5	10.0	28,900
52	09402000	Little Colorado River near Cameron, Ariz.	5/26,500	1947-70	1952	20.7	24,900	7	14.54	12,600

See footnotes at end of table.

Table 1. --Summary of flood stages and discharges--Continued

No.	Permanent station number	Stream and place of determination	Drainage area (sq mi)	Maximum previously known				Maximum September 1970 ^{1/}		
				Period	Year	Gage height (feet)	Discharge (cfs)	Date	Gage height (feet)	Discharge (cfs)
Gila River basin										
53	09484000	Sabino Creek near Tucson, Ariz.	35.5	1932-70	1966	9.65	6,400	6	10.21	7,550
54	09484500	Tanque Verde Creek at Tucson, Ariz.	219	1940-70	1965	7.89	12,200	6	6.57	7,340
55	-----	Bailey Wash near Sasabe, Ariz.	30.4	-----	-----	-----	-----	4	-----	12,900
56	09486800	Altar Wash near Three Points, Ariz.	460	1966-70	1966	10.40	10,700	4	13.85	22,000
57	09487000	Brawley Wash near Three Points, Ariz.	776	1962-70	1962	13.0	-----	4	15.8	13,200
58	-----	Brawley Wash at Mile Wide Road near Tucson, Ariz.	1,077	1962-70	1962	-----	38,800	4	-----	6,140
59	09487250	Los Robles Wash near Marana, Ariz.	1,170	1962-70	1962	-----	32,000	5	9.27	4,320
60	09497980	Cherry Creek near Globe, Ariz.	200	1965-70	1965	12.3	6,620	6	9.62	4,300
61	-----	Tonto Creek below Kohl's Ranch, Ariz.	24.0	-----	-----	-----	-----	5	-----	18,400
62	-----	Christopher Creek near Kohl's Ranch, Ariz.	24.4	-----	-----	-----	-----	5	-----	11,900
63	09498600	Christopher Creek tributary near Kohl's Ranch, Ariz. ....	.66	1965-70	1965	4.65	54	5	9.84	265
64	09498800	Tonto Creek near Gisela, Ariz.	430	1964-70	1965	19.0	30,000	5	29.2	46,300
65	09498870	Rye Creek near Gisela, Ariz.	122	1965-70	1965	9.0	8,130	5	29.0	44,400
66	09498900	Gold Creek near Payson, Ariz.	6.52	1963-70	1963	7.75	1,370	5	11.90	2,800
67	09499000	Tonto Creek above Gun Creek, near Roosevelt, Ariz.	675	1940-70	1952	16.55	45,400	5	18.2	53,000
68	-----	Slate Creek near Sunflower, Ariz.	4.40	-----	-----	-----	-----	5	-----	4,480
69	09501300	Tortilla Creek at Tortilla Flat, Ariz.	24.3	1942-70	1966	9.3	6,660	5	11.4	5,700
70	09504400	Munds Canyon tributary near Sedona, Ariz.	1.19	1963-70	1965	6.91	222	5	10.9	670
71	09504500	Oak Creek near Cornville, Ariz.	357	1885-1970	1938	6/23	-----	5	16.49	24,700
72	09504800	Oak Creek tributary near Cornville, Ariz. ....	.05	1963-70	1969	6.51	53	5	6.02	47
73	09505200	Wet Beaver Creek near Rimrock, Ariz.	111	1961-70	1965	11.62	6,150	5	12.41	7,670
74	-----	Beaver Creek Watershed No. 13 (U.S. Forest Service).	1.42	1963-70	1967	3.50	363	5	4.91	1,550
75	-----	Beaver Creek Watershed No. 10 (U.S. Forest Service).	.89	1963-70	1965	2.42	122	5	4.32	980
76	-----	Beaver Creek Watershed No. 7 (U.S. Forest Service).	3.18	1963-70	1965	3.50	363	5	6.8	2,260
77	09505250	Red Tank Draw near Rimrock, Ariz.	49.4	1957-70	1965	7.62	2,010	5	12.69	10,500
78	-----	Woods Canyon near Sedona, Ariz.	16.7	1962-70	1969	5.71	2,710	5	7.93	3,990
79	-----	Bar M Canyon near Sedona, Ariz.	25.7	1962-70	1966	-----	2,770	5	9.35	4,100
80	-----	Beaver Creek Watershed No. 8 (U.S. Forest Service).	2.82	1963-70	1965	3.70	437	5	4.99	1,220
81	09505300	Rattlesnake Canyon near Rimrock, Ariz.	24.6	1957-70	1969	9.52	2,160	5	11.5	3,590
82	09505350	Dry Beaver Creek near Rimrock, Ariz.	142	1960-70	1969	9.98	10,600	5	14.16	26,600
83	09505600	Dirty Neck Canyon near Clints Well, Ariz.	3.42	1964-70	1965	5.59	115	5	7.65	200
84	09505800	West Clear Creek near Camp Verde, Ariz.	241	1964-70	1965	8.3	6,510	5	5.42	1,050
85	09507600	East Verde River near Pine, Ariz.	6.65	1961-70	1967	3.82	1,350	5	6.01	2,820
86	09507700	Webber Creek above West Fork Webber Creek, near Pine, Ariz.	4.92	1959-70	1961	3.13	399	5	4.36	1,220
87	09507980	East Verde River near Childs, Ariz.	328	1961-70	1965	-----	17,000	5	19.2	23,500
88	09508300	Wet Bottom Creek near Childs, Ariz.	37	1967-70	1967	11.00	5,990	5	13.18	-----
89	09508500	Verde River below Tangle Creek, above Horseshoe Dam, Ariz.	5/5,872	1925-70	1938	19.0	7/100,000	6	18.85	67,500
90	09510070	West Fork Sycamore Creek above McFarland Canyon, near Sunflower, Ariz.	4.58	1965-70	1965	4.45	430	5	5.50	1,700
91	09510080	West Fork Sycamore Creek near Sunflower, Ariz.	9.8	1961-70	1965	6.75	698	5	9.50	3,480
92	09510100	East Fork Sycamore Creek near Sunflower, Ariz.	4.49	1961-70	1965	5.07	330	5	9.5	1,940
93	09510150	Sycamore Creek near Sunflower, Ariz.	53.4	1961-70	1967	8.61	7,650	5	22.0	16,100
94	09510170	Camp Creek near Sunflower, Ariz.	2.6	1963-70	1963	4.96	391	5	2.55	136
95	09510180	Rock Creek near Sunflower, Ariz.	15	1963-70	1965	6.80	1,900	5	6.26	1,470
96	09510200	Sycamore Creek near Fort McDowell, Ariz.	165	1959-70	1959	15.0	15,800	5	20.2	24,200
97	09511300	Verde River near Scottsdale, Ariz.	5/6,600	1961-70	1965	12.75	31,300	5	11.32	14,500
98	09512100	Indian Bend Wash near Scottsdale, Ariz.	142	1961-70	1967	3.12	2,000	5	2.35	1,070
99	09512150	Indian Bend Wash at Thomas Road, at Scottsdale, Ariz.	-----	1961-70	1967	3.0	1,500	5	3.72	3,200
100	-----	Ash Creek near Dugas, Ariz.	118	-----	-----	-----	-----	5	-----	9,000
101	09512500	Agua Fria River near Mayer, Ariz.	588	1940-70	1941	-----	13,000	5	14.90	19,800
102	09512800	Agua Fria River near Rock Springs, Ariz.	1,130	1970	-----	-----	-----	5	21.48	40,100
103	09513650	Agua Fria River at El Mirage, Ariz.	5/1,637	1963-70	1967	4.05	3,200	5	4.60	5,000
104	09513780	New River near Rock Springs, Ariz.	67.3	1962-70	1967	10.7	10,600	5	13.0	18,600
105	09513800	New River at New River, Ariz.	85.7	1960-70	1967	9.12	12,600	5	9.98	19,500
106	09513820	Deadman Wash near New River, Ariz.	11.1	1959-70	1959	7.0	1,850	5	5.58	1,630
107	09513835	New River at Bell Road, near Peoria, Ariz.	187	1963, 1965-70	1967	13.5	14,600	5	11.03	11,900
108	09513860	Skunk Creek near Phoenix, Ariz.	64.6	1960-70	1964	10.48	11,500	5	12.24	9,650
109	09513910	New River near Glendale, Ariz.	323	1943-70	1943	-----	38,000	5	9.12	19,200
110	09513970	Agua Fria River at Avondale, Ariz.	5/2,013	1961-70	1967	6.7	19,800	6	11.29	20,000

See footnotes at end of table.

Table 1. --Summary of flood stages and discharges-- Continued

No.	Permanent station number	Stream and place of determination	Drainage area (sq mi)	Maximum previously known				Maximum September 1970 ^{1/}		
				Period	Year	Gage height (feet)	Discharge (cfs)	Date	Gage height (feet)	Discharge (cfs)
Gila River basin--Continued										
111	09515500	Hassayampa River at Box damsite, near Wickenburg, Ariz.	417	1921-70	1951	18.3	27,000	5	34.6	58,000
112	09515800	Hartman Wash near Wickenburg, Ariz.....	5.57	1963-70	1967	8.05	2,600	5	7.00	1,600
113	09518500	Hassayampa River near Morristown, Ariz....	774	1939-47, 1954-58, 1964-70	1965	11.6	9,280	5	19.05	47,500
114	09517000	Hassayampa River near Arlington, Ariz.....	1,470	1961-70	1964	^{3/} 6.05	6,500	5	12.60	39,000

^{1/} Provisional figures.

^{2/} The maximum flood known occurred in 1911; stage and discharge at this site are unknown.

^{3/} Site and datum then in use.

^{4/} Backwater from diversion dam, discharge not available.

^{5/} Includes some noncontributing area, or discharge is materially affected by storage or regulation in reservoirs above station.

^{6/} Peak stage at upstream side of bridge; gage is located on downstream side.

^{7/} Peak of 1891 probably exceeded 150,000 cfs.

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No.

17. Effects of ground-water withdrawal, 1954-63, in the lower Harquahala Plains, Maricopa County, Arizona, by R. S. Stulik: 8 p., 5 figs., 1964.
- *18. Basic ground-water data for western Pinal County, Arizona, by W. F. Hardt, R. E. Cattany, and L. R. Kister: 59 p., 4 figs., 1964.
19. Annual report on ground water in Arizona, spring 1963 to spring 1964, by N. D. White, R. S. Stulik, E. K. Morse, and others: 60 p., 27 figs., 1964.
20. Hydrologic and drill-hole data, San Xavier Indian Reservation and vicinity, Pima County, Arizona, by L. A. Heindl and N. D. White: 48 p., 3 figs., 1965.
21. Basic hydrologic data for San Simon basin, Cochise and Graham Counties, Arizona, and Hidalgo County, New Mexico, by N. D. White and C. R. Smith: 42 p., 4 figs., 1965.
22. Bibliography of U.S. Geological Survey water-resources reports, Arizona, 1891 to 1965, compiled by the Arizona District, Water Resources Division, U. S. Geological Survey: 59 p., 1965.
- *23. Geohydrology of the Dateland-Hyder area, Maricopa and Yuma Counties, Arizona, by W. G. Weist, Jr.: 46 p., 8 figs., 1965.
- *24. Annual report on ground water in Arizona, spring 1964 to spring 1965, by N. D. White and others: 62 p., 22 figs., 1965.
25. An appraisal of the ground-water resources of Avra and Altar Valleys, Pima County, Arizona, by N. D. White, W. G. Matlock, and H. C. Schwalen: 66 p., 12 figs., 1966.
26. Basic hydrologic data of the Hualapai, Sacramento, and Big Sandy Valleys, Mohave County, Arizona, by J. B. Gillespie, C. B. Bentley, and William Kam: 39 p., 6 figs., 1966.
27. Basic ground-water data for western Salt River Valley, Maricopa County, Arizona, by William Kam, H. H. Schumann, L. R. Kister, and F. E. Arteaga: 72 p., 11 figs., 1966.
28. Anticipated changes in the flow regimen caused by the addition of water to the East Verde River, Arizona, by H. W. Hjalmarson and E. S. Davidson: 10 p., 3 figs., 1966.
29. Infiltration and recharge from the flow of April 1965 in the Salt River near Phoenix, Arizona, by P. C. Briggs and L. L. Werho: 12 p., 7 figs., 1966.

No.

30. Hydrologic conditions in the Douglas basin, Cochise County, Arizona, by N. D. White and Dallas Childers: 26 p., 9 figs., 1967.
31. Compilation of flood data for Maricopa County, Arizona, through September 1965, by L. L. Werho: 36 p., 1 fig., 1967.
- *32. Annual report on ground water in Arizona, spring 1965 to spring 1966, by E. B. Hodges and others: 61 p., 22 figs., 1967.
33. Basic ground-water data for southern Coconino County, Arizona, by E. H. McGavock: 49 p., 4 figs., 1968.
34. Spring flow into the Colorado River—Lees Ferry to Lake Mead, Arizona, by P. W. Johnson and R. B. Sanderson: 26 p., 5 figs., 1968.
35. Ground water in Paradise Valley, Maricopa County, Arizona, by F. E. Arteaga, N. D. White, M. E. Cooley, and A. F. Sutheimer: 76 p., 15 figs., 1968.
36. Annual report on ground water in Arizona, spring 1966 to spring 1967, by C. J. Cox and others: 43 p., 30 figs., 1968.
37. Ground-water conditions in the Waterman Wash area, Maricopa and Pinal Counties, Arizona, by E. E. Denis: 23 p., 9 figs., 1968.
38. Annual report on ground water in Arizona, spring 1967 to spring 1968, prepared under the direction of H. M. Babcock, District Chief, Arizona District, Water Resources Division, U.S. Geological Survey: 54 p., 32 figs., 1969.
39. Hydrologic conditions in the Gila Bend basin, Maricopa County, Arizona, by R. S. Stulik and Otto Moosburner: 63 p., 10 figs., 1969.
40. Ground-water conditions in McMullen Valley, Maricopa, Yuma, and Yavapai Counties, Arizona, by P. C. Briggs: 31 p., 9 figs., 1969.
41. Ground-water conditions in the Ranegrass Plain, Yuma County, Arizona, by P. C. Briggs: 28 p., 7 figs., 1969.
- *42. Annual report on ground water in Arizona, spring 1968 to spring 1969, prepared under the direction of H. M. Babcock, District Chief, Arizona District, Water Resources Division, U.S. Geological Survey: 46 p., 33 figs., 1969.

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No.

43. Annual report on ground water in Arizona, spring 1969 to spring 1970, prepared under the direction of H. M. Babcock, District Chief, Arizona District, Water Resources Division, U.S. Geological Survey: 44 p., 30 figs., 1970.

No.

44. Floods of September 1970 in Arizona, Utah, and Colorado, by R. H. Roeske: 20 p., 5 figs., 1971.