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FLOOD OF SEPTEMBER 20-23, 1969 IN THE GADSDEN COUNTY AREA, FLORIDA

By
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and
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FLOOD OF SEPTEMBER 20-23, 1969 IN THE GADSDEN COUNTY AREA, FLORIDA

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W. C. Bridges[1] and D. R. Davis[2]

ABSTRACT

The center of low pressure of a tropical disturbance which moved northward in the Gulf of Mexico, reached land between Panama City and Port St. Joe, Florida, on September 20, 1969. This system was nearly stationary for 48 hours producing heavy rainfall in the Quincy-Havana area, 70-80 miles northeast of the center.

Rainfall associated with the tropical disturbance exceeded 20 inches over a part of Gadsden County, Florida, during September 20 through 23, 1969, and the maximum rainfall of record occurred at Quincy with 10.87 inches during a 6-hour period on September 21. The 48-hour maximum of 17.71 inches exceeded the 1 in 100-year probability of 16 inches for a 7-day period.

The previous maximum rainfall of record at Quincy (more than 12 inches) was on September 14-15, 1924. The characteristics of this historical storm were similar in path and effect to the September 1969 tropical disturbance.

Peak runoff from a 1.4-square mile area near Midway, Florida, was 1,540 cfs (cubic feet per second) per square mile. A peak discharge of 45,600 cfs on September 22 at the gaging station on the Little River near Quincy exceeded the previous peak of 25,400 cfs which occurred on December 4, 1964. The peak discharge of 89,400 cfs at Ochlockonee River near Bloxham exceeded the April 1948 peak of 50,200 cfs, which was the previous maximum of record, by 1.8 times. Many flood-measurement sites had peak discharges in excess of that of a 50-year flood.

Nearly $200,000 was spent on emergency repairs to roads. An additional $520,000 in contractual work was required to replace four bridges that were destroyed. Agricultural losses were estimated at $1,000,000.

INTRODUCTION

A small tropical disturbance moved northward from the Gulf of Mexico on September 20, 1969, and became quasi-stationary for about 48 hours in the coastal area between Port St. Joe and Panama City, Florida. Rainfall associated with the disturbance was in excess of 20 inches over an area bounded by the towns of Attapulgus, Georgia and Quincy and Havana, Florida.

Areas affected most by the storm were the Little River basin (southern part of Decatur County, Georgia, and Gadsden County, Florida) and part of the Ochlockonee River basin in Florida (Leon, Gadsden, Liberty, and Wakulla counties). This area is generally enclosed by the 10-inch isoyhet in figure 1, the total-storm rainfall map for September 20-23.

Rainfall intensities, at the Quincy National Weather Service Office, located just outside the area of maximum rainfall, for 2-, 6-, 12-, 24-, 48-, and 72-hour periods and the storm total, exceeded the 1 in 100-year probabilities of occurrence. Most of the rain fell on September 21, with 10.87 inches recorded during the 6-hour period ending at 11:10 a.m.

Although no lives were lost, the cost and inconvenience to the public owing to widespread road closures were substantial. The Florida Department of Transportation noted 51 sites where the roads were closed due to high water or to the washout of bridges or culverts. These sites are shown in figure 2.

Traffic was virtually at a standstill in Gadsden County on September 21 and 22. U.S. Highway 90, the main artery through the county, was closed from September 21 until September 23, when one lane was opened. Most of the traffic in the county was moving, with only minor inconveniences, by early September 23.

This report documents the magnitude and extent of flooding for September 20-23, 1969. It provides information for public and private agencies that are concerned with flooding, with planning of land development, and with road design and construction. The report describes flood damage, rainfall intensities, and storm characterization. It gives peak discharges at selected sites and flood pro-

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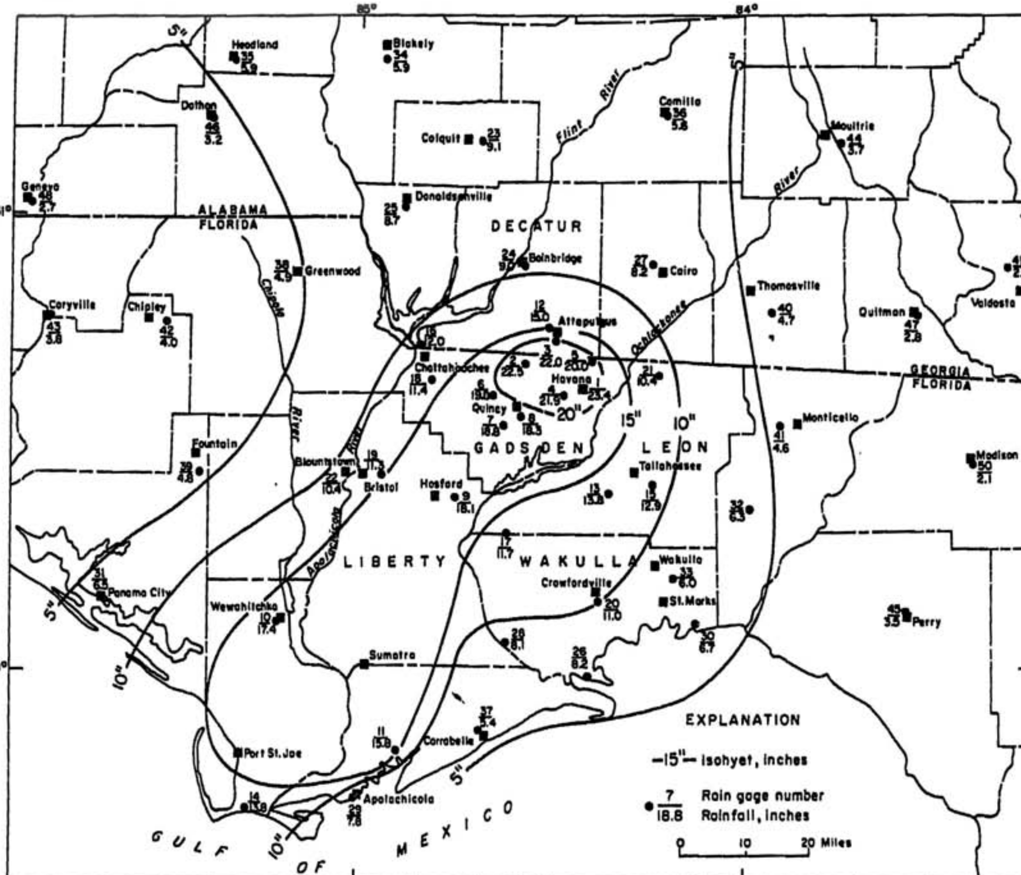

Figure 1.—Total-storm rainfall map for September 20-23, 1969.

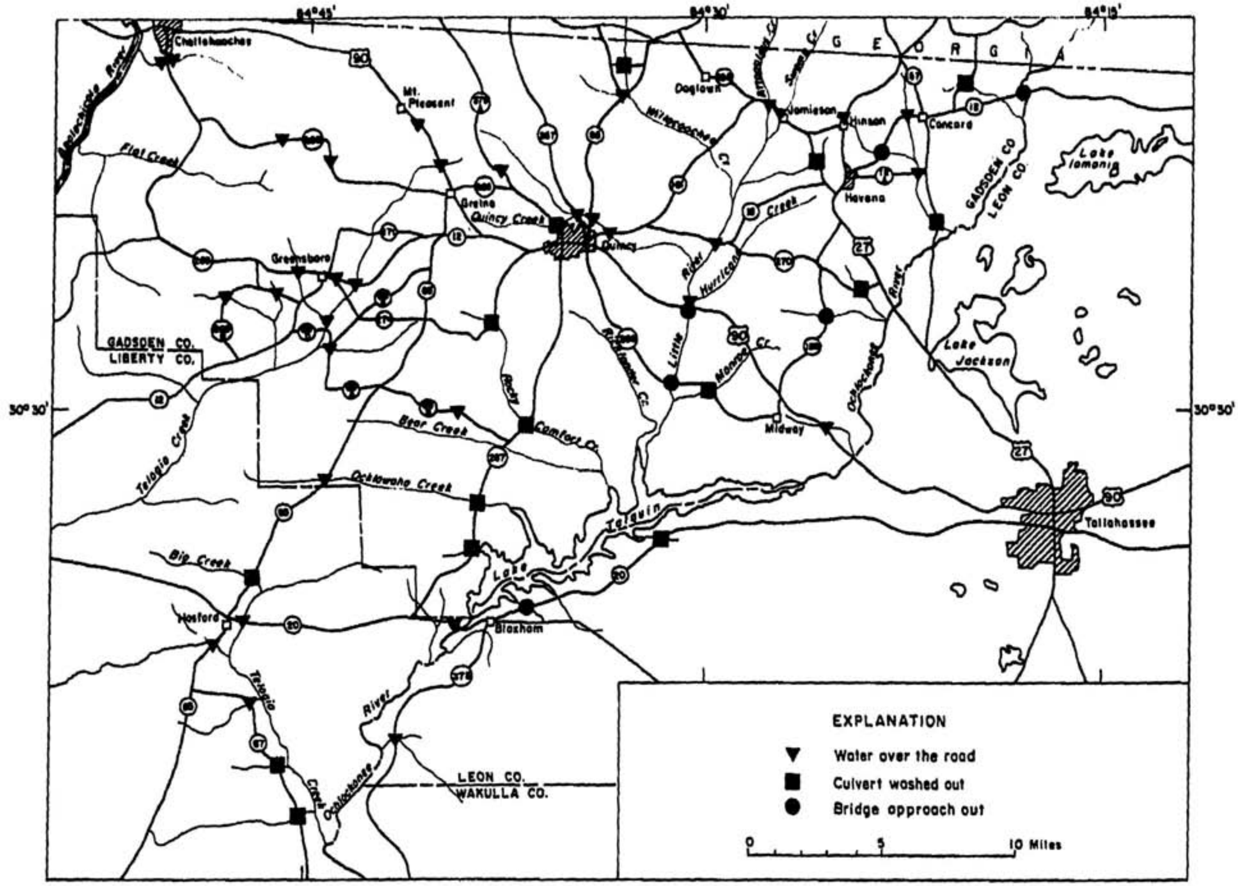

Figure 2.—Map showing locations of road closures resulting from September 1969 flood.

files of selected reaches of three streams, and makes comparisons with previous flood peaks.

The report was prepared under the general supervision of C. S. Conover, District Chief, Water Resources Division, U.S. Geological Survey, as part of the cooperative program with the Florida Department of Transportation.

ACKNOWLEDGMENTS

The hydrologic data in this report were collected by the U.S. Geological Survey in cooperation with the Florida Department of Transportation, the Florida Bureau of Geology, and the Florida Power Corporation. Rainfall and related weather and radar data were collected by the National Weather Service.

The authors gratefully acknowledge the cooperation of the Florida Department of Transportation in furnishing damage estimates to roads and bridges and highwater marks for flood profiles; the assistance of Robert L. Smith, meteorologist in charge of the National Weather Service Radar Station at Apalachicola, Florida, in the interpretation of the radar photographic records of the storm; and the assistance provided by J. F. Bailey, hydraulic specialist, U.S. Geological Survey, Washington, D. C., in the collection and computation of peak discharge data and preparation of the report.

STORM DESCRIPTION

Rainfall intensities of 5 to 6 inches in 24 hours are not uncommon throughout the gulf coastal area. Rains of 10 inches or more in 24 hours are rare, and the chance of having as much as 10 to 15 inches in 24 hours is 1 in 100 years (Hershfield, 1961, p. 105).

Excessive rainfall along the gulf coast may be associated with any one of numerous weather systems. Well-developed thunderstorms occasionally produce heavy precipitation. Cold fronts moving into the southeast frequently become quasi-stationary along the northern coast of the Gulf of Mexico and may produce rain for 2, 3, or more days; the total rainfall accumulation may be several inches. Extra-tropical lows may develop over Texas or the western Gulf in the spring and move eastward across the northern Gulf producing copious rains over the coastal areas of Louisiana, Mississippi, Alabama, and Florida.

The heaviest rains, however, are generally associated with cyclonic (low pressure) systems of tropical origin. The storms include:

(a) **hurricanes** with winds of 74 mph (miles per hour) or higher;

(b) **tropical storms** having closed isobars about a low-pressure center with a distinct counter-clockwise circulation and winds of 39 to 73 mph;

(c) **tropical depressions** having closed isobars about a low-pressure center, a counter-clockwise wind circulation with winds to 39 mph; and

(d) **tropical disturbances** with low-pressure centers that are low enough for a closed isobar and a poorly defined wind circulation.

SYNOPTIC DISCUSSION

The heavy rain of September 20-23, 1969 was associated with a tropical cyclone that was marginal between a tropical depression and a tropical disturbance. At times the central pressure was low enough for a closed isobar; at other times it was not. The circulation was counter-clockwise, but winds were light both at the surface and aloft.

The synoptic situation was similar to that associated with the previous record rainfall (1922-70) for the Quincy area which occurred September 14-15, 1924 (U.S. Weather Bureau). The tropical storm of September 1924 dumped over 12 inches of rain on Gadsden County within a 24-hour period causing flooding and extensive crop damage (U.S. Weather Bureau, September 1924, p. 39). The characteristics of the September 1924 storm were similar in path and effect to the September 1969 storm.

The first indication of the September 1969 tropical depression was on the surface-weather chart of September 19, when a ship report indicated the presence of a low-pressure area at about lat. 25.3°N. and long. 86.4°W., about 150 miles west-northwest of Key West, Florida. The surface-weather analysis at 1:00 a.m. September 20, placed a low with a closed isobar about a central pressure of 29.70 inches of mercury centered at lat. 25.0°N. and long. 88.4°W. This low-pressure system moved northward during the day and reached land between Panama City and Port St. Joe, Florida, by 4:00 a.m. September 21. Figure 3 shows the surface-weather map for 7:00 a.m. September 21 with the low center positioned on the gulf coast.

A large high-pressure area at the surface (fig. 3) and weak

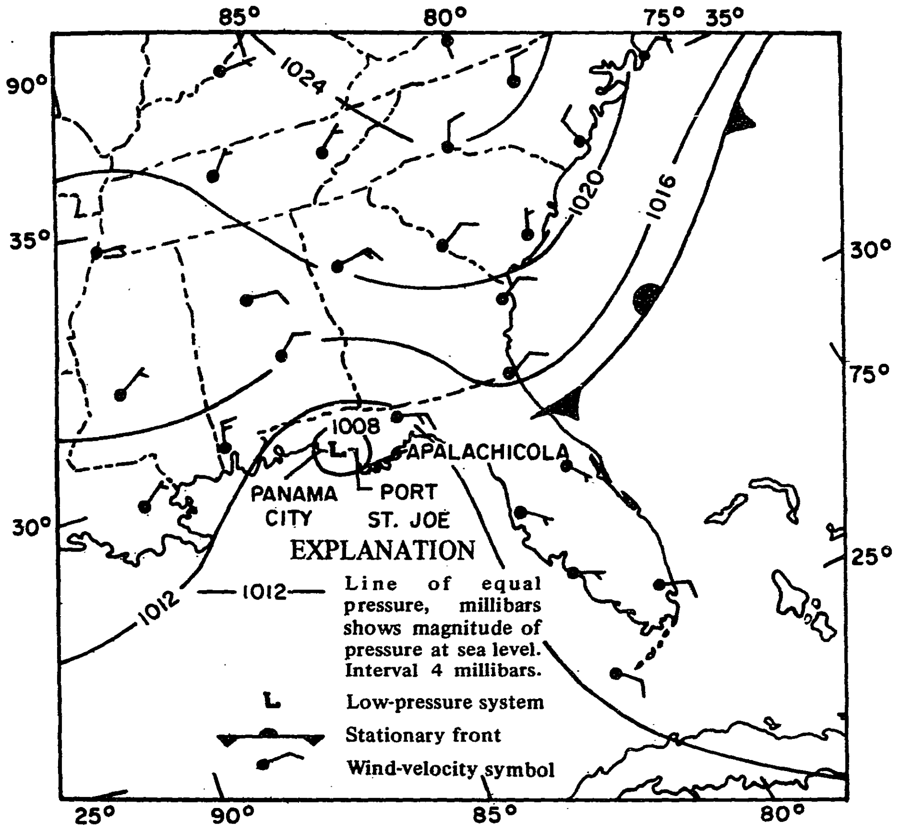

Figure 3.—Surface-weather map for 7:00 a.m. September 21, 1969, showing a tropical depression on the Florida gulf coast. (Redrawn from U.S. Dept. of Commerce, Daily Weather Maps, Weekly Series, September 15-21, 1969.)

wind circulation aloft (fig. 4) covered most of the eastern half of the nation. With the blocking action of the high at the surface and no pronounced wind pattern aloft to keep the system moving, the tropical depression stalled near the coast where it remained for about 48 hours.

The dynamics of a tropical depression blocked by a shallow dome of cooler air are favorable for heavy precipitation. The counter-clockwise circulation around the low-pressure center transported warm, moist, and unstable tropical air inland. Orographic lifting and forced upslope motion of the warm moist air over the cooler denser

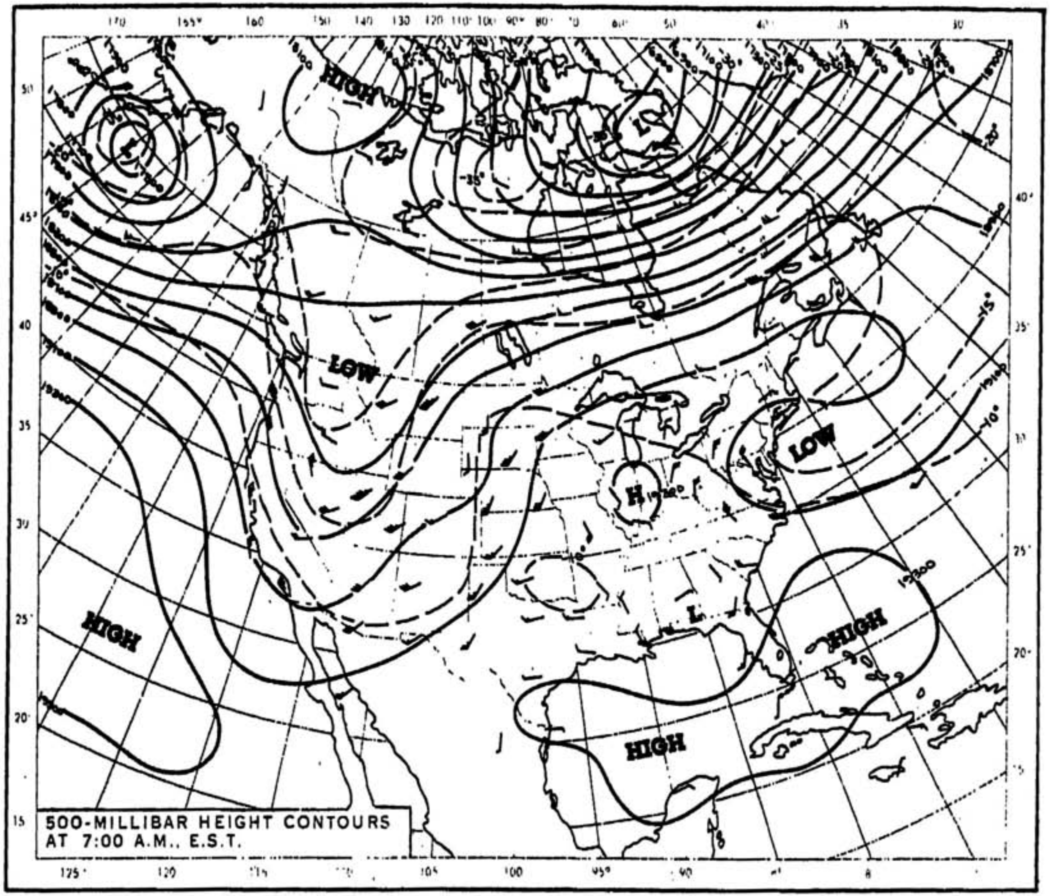

Figure 4.—Upper air 500-millibar constant pressure chart for 7:00 a.m., September 21, 1969. (Reproduced from U.S. Dept. of Commerce, Daily Weather Maps, Weekly Series. September 15-21, 1969.

air of the high-pressure dome, in addition to the instability of the tropical air, was sufficient to produce torrential rains most of the time that the low remained over the Panama City-Port St. Joe area. By September 23, the high-pressure system along the eastern seaboard weakened, and the low filled until it was discernable only as a weak inverted trough.

During the 48 hours the storm was stationary, heavy rain fell on the Ochlockonee River basin and on the lower Apalachicola River basin. Map analysis indicated periods when the storm weakened followed by periods of re-intensification. This was reflected in the variability of intensity of rainfall throughout the life of the storm.

RADAR OBSERVATIONS

The precipitation area associated with this tropical depression was under constant surveillance by the National Weather Service's radar located at Apalachicola, Florida. The radar is classed as Weather Search Radar-57. It has a range of 250 nautical miles[1]. Photographs were made every 5 minutes during the storm. Because the radar station was near the storm path excellent picture coverage was obtained.

Radar detection of a large area of precipitation in the Gulf of Mexico was made late on September 19. The precipitation reached the Florida coast at 1:00 a.m., September 20. Figure 5 is a photograph of the radar scope at 5:50 a.m., September 20. This figure shows an area of precipitation from 60 nautical miles north-northeast to 150 nautical miles south of Apalachicola that varies from 50-150 nautical miles in width with nearly 100 percent coverage to the south of Apalachicola. The heaviest precipitation was over the Gulf.

As the area of precipitation progressed northward, it tended to orient into lines or bands. Two bands were prominent at 9:25 a.m. One was 8-10 nautical miles wide, extending from 20 nautical miles northwest to 75 nautical miles southeast of Apalachicola, and the second band extended 125 nautical miles offshore. Cells (heavy rain centers) appeared to be moving north or northwest along the bands while the whole precipitation area moved slowly northward.

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[1]All references to miles in this report are to statute miles except where designated as nautical miles. One nautical mile equals approximately 6,076 feet.

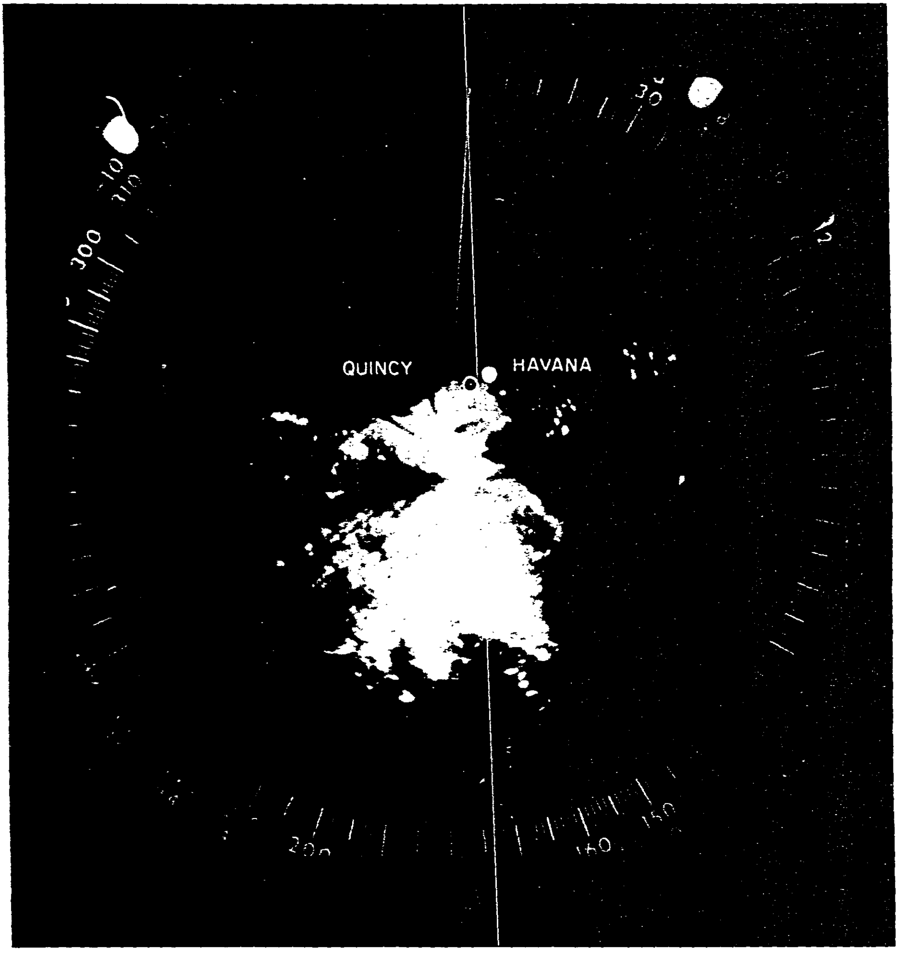

Figure 5.—Photograph of radar scope at 5:50 a.m., September 20, showing large precipitation area from 60 nautical miles north-northeast to 150 nautical miles south of Apalachicola. Range setting 250 nautical miles. Range marker 50 nautical mile intervals. No attenuation. Antenna elevation angle ½ degree.

By noon, the bands were nearly spiral with the center of curvature about 95 miles southwest of Apalachicola.

Rainfall began at Havana early on September 20 and increased noticeably in intensity by 2:00 p.m. Destined to be in the area of maximum rainfall, Havana and Quincy are shown (fig. 6) on the northeastern edge of the precipitation area on the 2:30 p.m. radar

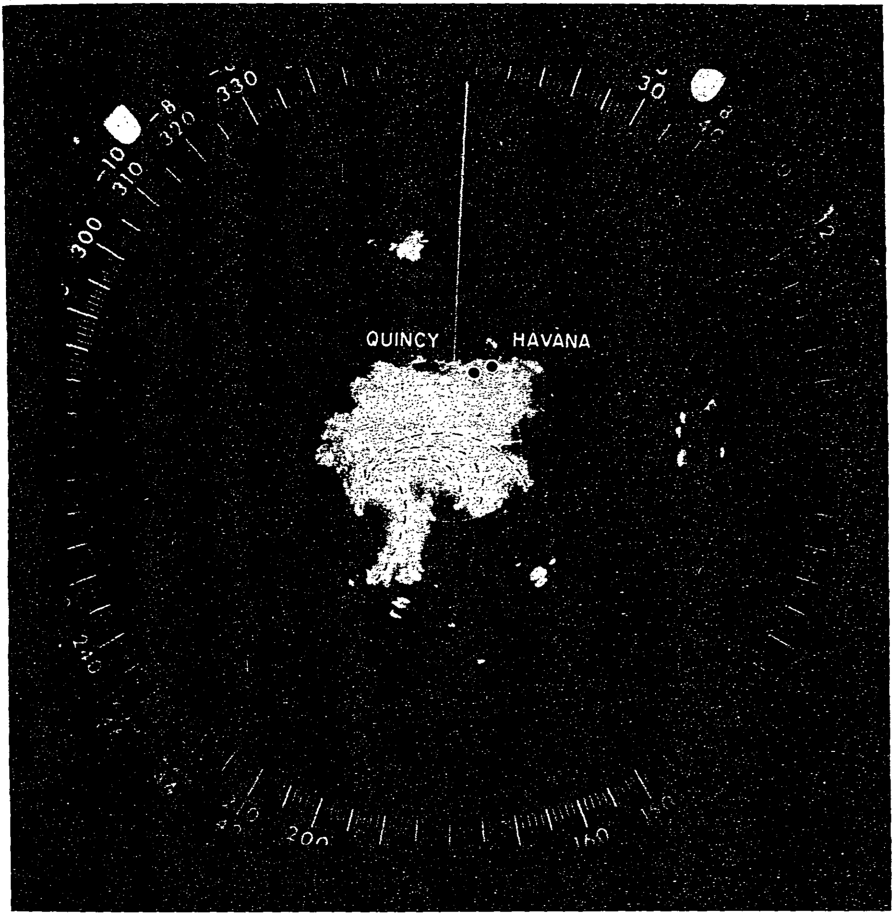

Figure 6.—Photograph of radar scope at 2:30 a.m., September 20, showing spiral lines with apparent center of curvature about 80 nautical miles southwest of center of scope. Range setting 250 nautical miles. Range markers 50 nautical mile intervals. No. attenuation. Antenna elevation angle ½ degree.

picture. The center of curvature is shown about 80 nautical miles southwest of the radar station (center of the scope). The intensity of rainfall is indicated by the brightness of the cells in the bands. Moderate to heavy rain was falling over most of the lower Apalachicola and Ochlockonee river basins at the time this photograph was taken. The rain continued during most of the remainder of the day.

After the center of the tropical depression reached the coast on

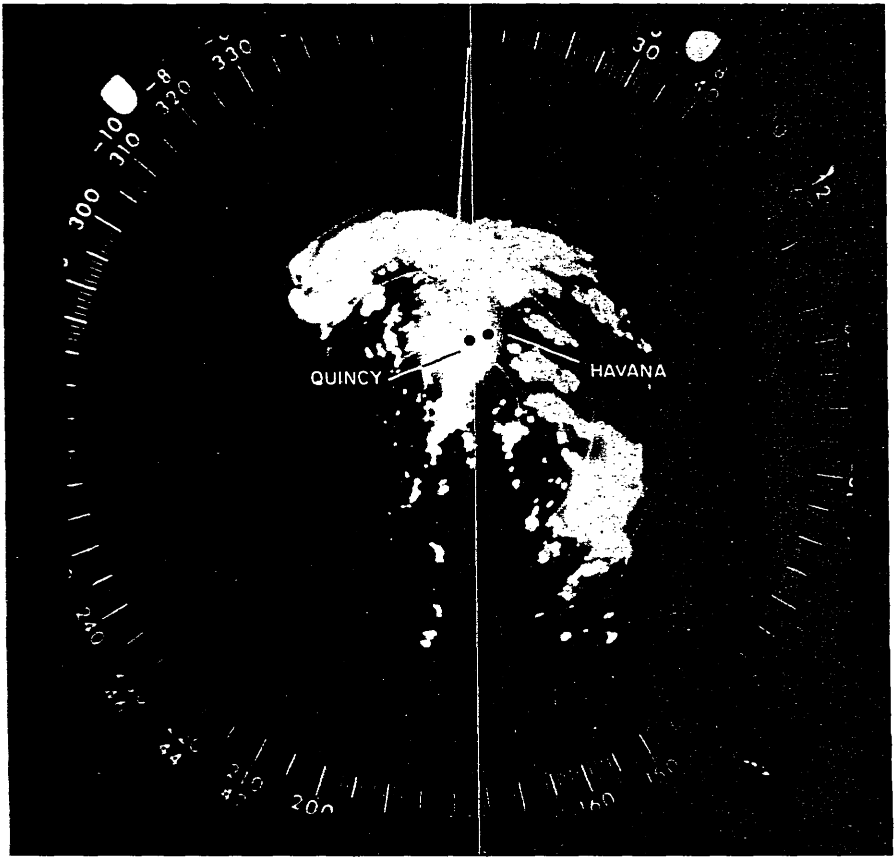

Figure 7.—Photograph of the radar scope at 6:39 a.m., September 21. The bright rain area located approximately 58 nautical miles at about 24 degrees to the right of the top of the scope was located over a recording rain gage at Quincy, Florida. Rainfall intensity at this time was in excess of 6 inches per hour. Range setting 250 nautical miles. Range markers 50 nautical mile intervals. No attenuation. Antenna elevation angle ½ degree.

the morning of September 21, radar pictures indicated a tendency for the heavier precipitation to be oriented in northwest-southeast or north-south lines with the heaviest precipitation area virtually stationary over Gadsden and neighboring counties in Florida and south Georgia. Individual cells moved along the lines converging on the Gadsden County area while the lines moved little. At times, 2 or 3 lines appeared to radiate out of a point centered over or near

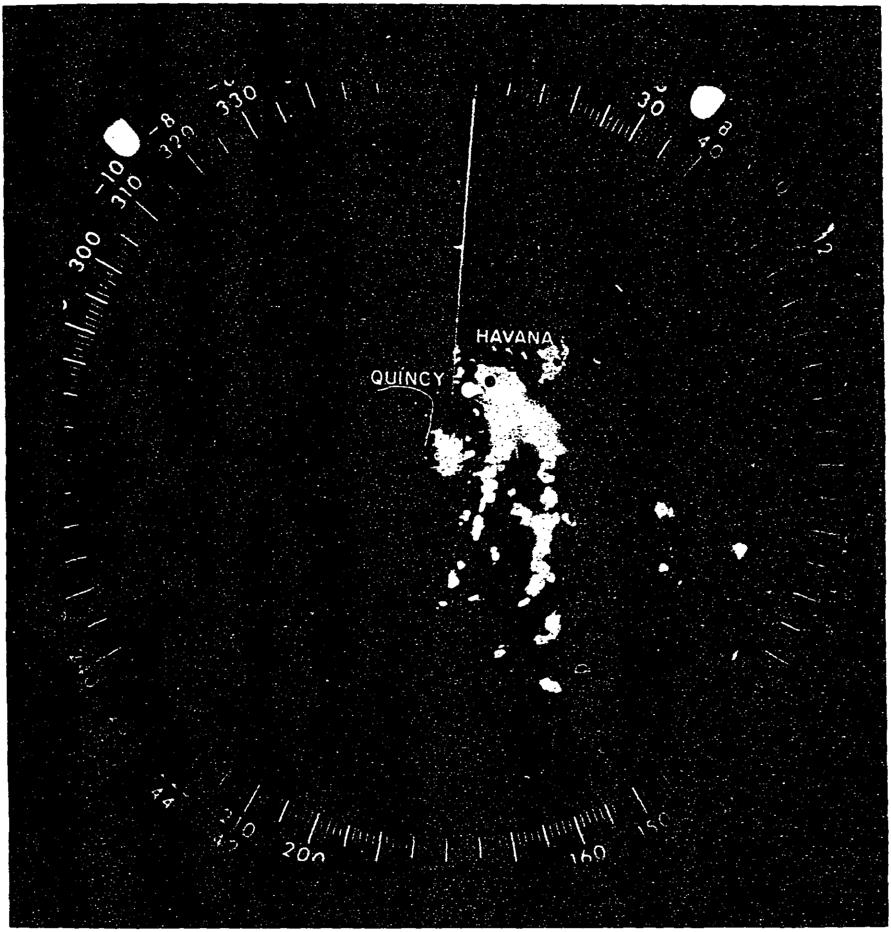

Figure 8.—Photograph of the radar scope at 9:12 p.m., September 22 showing 2 well-developed rain bands or lines coverging on an area over the Ochlockonee River basin. Range setting 250 nautical miles. Range markers 50 nautical mile intervals. No attenuation. Antenna elevation angle ½ degree.

a small area in north Gadsden County and the south part of Grady and Decatur counties in Georgia.

The two recording rain gages (7 and 8, fig. 1) nearest the center of maximum rainfall were located approximately 12 miles southwest, near Quincy. Figure 7 shows the precipitation pattern at 6:39 a.m., September 21, shortly after the start of rainfall that exceeded

6 inches per hour at Quincy. The recording gages showed very heavy rainfall continued for nearly 3 hours. At times during the day on September 21, the heights of the radar echoes exceeded the 40,000-foot level.

Precipitation bands continued to converge on the Ochlockonee River basin with individual cells in the bands moving up to the Ochlockonee River basin where they become stationary. Figure 8 is a photograph of the radar scope taken at 9:12 p.m. on September 21. Through that night and the following morning, the precipitation patterns were similar to that shown in figure 8. The precipitation lines slowly disintegrated into non-orientated cells during the afternoon of September 22 and regrouped again into well-defined lines after 5:30 p.m. By early morning on September 23 the precipitation area began to show signs of eastward movement, and by 9:00 a.m. the lines broke up into individual cells which moved rapidly out to the east and northeast.

DEPTH-AREA DURATION

This storm occurred in an area having an unusually large number of rain gages. Those which collected 2 inches or more during the storm are listed in table 1 in descending order of inches of rain caught. Most of the gages were the official National Weather Service types. Of these, 2 were recording tipping-bucket gages, 2 were recording-weighing gages, 1 a Fischer-Porter recording gage, and 32 were the standard 8-inch gages. The latter is a compound, 10 to 1, can-gage with a capacity of 25 inches. Four standard gages that were in the center of maximum rainfall received 20 inches or more. Three of these were owned by the Englehart Chemical and Mineral Company and were located at company mines.

Twelve of the rain gages listed are owned by the Florida Division of Forestry. Of these, four were of the compound type with a 7-inch capacity. The others were a plastic tube-type with a 5-inch capacity. The accuracy of the plastic gage is questionable, especially for periods of intense rain. The Division reported that some of their rainfall reports were in excess of gage capacity. Havana tower gage 4 did overflow. The U.S. Geological Survey's gage (17) is a Stevens Type QA continuous recorder, with a capacity of 25 inches.

The maximum rainfall of 23.40 inches was measured at the National Weather Service's Agricultural Weather Reporting Station located on State Highway 12 near the west edge of Havana. (See

Table 1.—Rain gages and total rainfall, in inches, for September 20-23, 1969, in the tri-state area of Florida, Georgia, and Alabama shown in figure 1.

Gage No. (fig. 1)	Name and Location	Gage Type	Ownership[1] Gage	Rain-fall
1	Havana, Fla.	Standard 8 in.	NOAA-NWS	23.4
2	La Camelia mine, 7 miles NNE, Quincy, Fla.	do.	EC and M	22.5
3	Attapulgus mine, 1 mile S. Attapulgus, Ga.	do.	do.	22.0
4	Havana Tower, 3 miles W, Havana, Fla.	7-in. Capacity	FDF	[2]21.9
5	Lock N mine, 5 miles NNE, Havana, Fla.	Standard 8 in.	EC and M	20.0
6	Quincy Tower, 4 miles W, Quincy, Fla.	7-in. Capacity	FDF	19.8
7	Quincy, 3 miles SSW, Fla.	Tipping Bucket	NOAA-NWS	18.8
8	Tobacco Station, Quincy, Fla.	Weighing	do.	18.3
9	Hosford Tower, 3 miles E, Hosford, Fla.	5-in. Capacity	FDF	18.1
10	Wewahitchka, Fla.	Standard 8-in.	NOAA-NWS	17.4
11	East Bay Tower, 14 miles S, Sumatra, Fla.	5-in Capacity	FDF	15.8
12	Attapulgus Exp. Sta., 1 mile NW, Attapulgus, Ga.	Standard 8-in.	Univ. Ga.	15.0
13	Tallahassee WB, 5 miles SW, Tallahassee, Fla.	Weighing	NOAA-NWS	13.8
14	Cape San Blas, S, Port St. Joe, Fla.	5-in. Capacity	FDF	13.8
15	Tallahassee Tower, 3 miles SE, Tallahassee, Fla.	7-in. Capacity	do.	12.9
16	Woodruff Dam, Chattahoochee, Fla.	Fischer & Porter	NOAA-NWS	12.0
17	Otter Camp, 5 miles S, Bloxham, Fla.	Stevens	USGS	11.7
18	Rosedale Tower, 3 miles S, Chattahoochee, Fla.	5-in. Capacity	FDF	11.4
19	Bristol Tower, 3 miles E, Bristol, Fla.	7-in. Capacity	do.	11.3
20	Crawfordville, Fla.	5-in. Capacity	do.	11.0
21	Tall Timbers, N side Lake Iamonia, Fla.	Standard 8-in.	NOAA-NWS	[3]10.4
22	Blountstown, Fla.	do.	do.	10.4
23	Colquitt, 2 miles E, Ga.	do.	do.	9.1
24	Bainbridge, Ga.	do.	do.	9.0
25	Donalsonville, Ga.	do.	do.	8.7
26	St. James Tower, 3 miles S, Panacea, Fla.	5-in. Capacity	FDF	8.2
27	Cairo, 2 miles NW, Ga.	Standard 8 in.	NOAA-NWS	8.2
28	Sanborn Tower, Sanborn, Fla.	do.	do.	8.1
29	Apalachicola, Fla.	Tipping Bucket	do.	7.8
30	St. Marks, Fla.	Standard 8 in.	do.	6.7
31	Panama City, Fla.	do	do.	6.5
32	Wacissa, Fla.	5-in. Capacity	FDF	6.3
33	Newport Tower, Wakulla, Fla.	do.	do.	6.0
34	Blakely, Ga.	Standard 8 in.	NOAA-NWS	5.9
35	Headland, Ala.	do.	do.	5.9
36	Camilla, Ga.	do.	do.	5.6
37	Carrabelle, Fla.	do.	do.	5.4
38	Greenwood, Fla.	do.	do.	4.9
39	Fountain, 3 miles SSE, Fla.	do.	do.	4.8
40	Thomasville, 4 miles SE, Ga.	do.	do.	4.7
41	Monticello, 3 miles W, Fla.	do.	do.	4.6
42	Chipley, 3 miles E, Fla.	do.	do.	4.0
43	Caryville, Fla.	do.	do.	3.8
44	Moultrie, 2 miles ESE, Ga.	do.	do.	3.7
45	Perry, Fla.	do.	do.	3.5
46	Dothan, Ala.	do.	do.	3.2
47	Quitman, Ga.	do	do.	2.8
48	Geneva, Ala.	do.	do.	2.7
49	Valdosta, 4 miles NW, Ga.	do.	do.	2.4
50	Madison, Fla.	do.	do.	2.1

[1]NOAA, National Weather Service (NOAA-NWS), Englehart Chemical and Mineral (EC and M), Florida Division of Forestry (FDF), U.S. Geological Survey (USGS).

[2]Gage overflowed—total does not include overflow.

[3]Average of four gages.

fig. 1, gage 1.) The 20-inch isohyet enclosed an area of about 160 square miles in which the average precipitation was about 22 inches. The 15-inch isohyet enclosed an area of about 2,000 square miles and the average of all the rain gages within this area was 19.8 inches. Rainfall amounts and area depths are probably biased to the low side due to the intensity of rainfall and the limited capacity of some of the gages.

Figure 9 shows accumulated rainfall-curves for Havana, Quin-

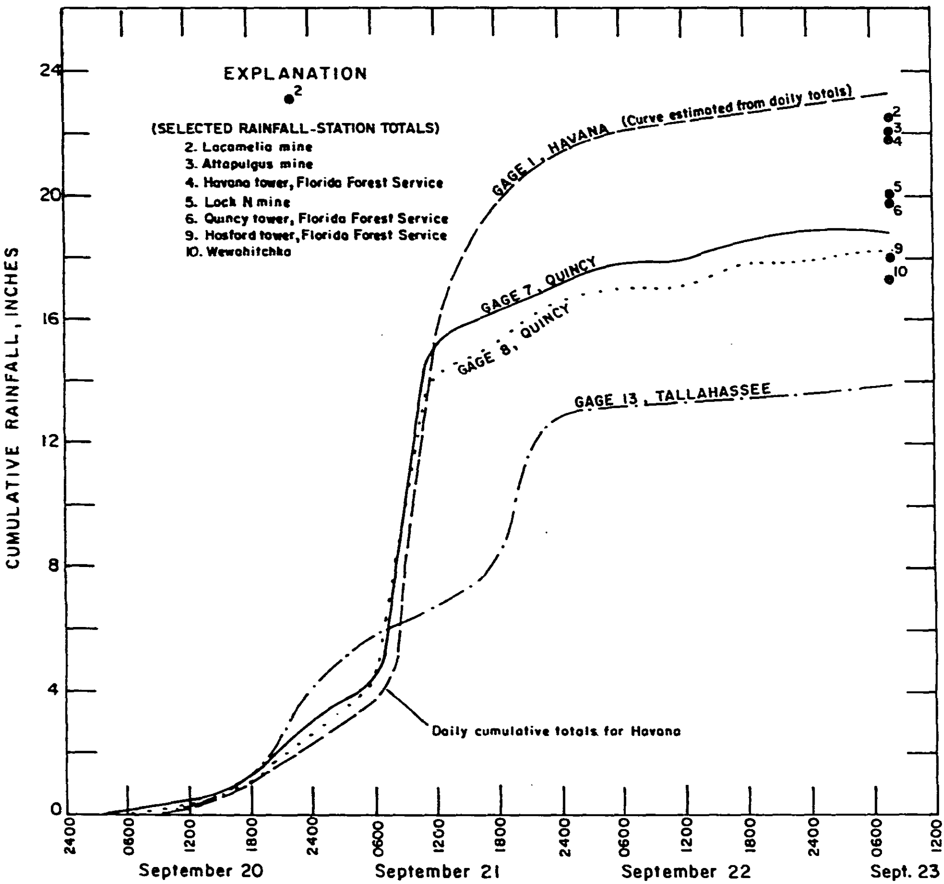

Figure 9.—Cumulative rainfall and selected rainfall-station totals for September 20-23, 1969.

Table 2.—Maximum rainfall intensities at gage 7, Quincy, September 20-23, 1969.

Rainfall Duration	Rainfall (inches)
5 minutes	0.62
10 minutes	1.17
15 minutes	1.61
20 minutes	1.98
30 minutes	2.50
45 minutes	3.24
60 minutes	3.76
2 hours	6.23
3 hours	7.90
6 hours	10.87
12 hours	12.07
24 hours	15.06
48 hours	17.71
72 hours	18.84

Storm Total 18.85 inches
Storm Duration 72 hours and 16 minutes

Rain Began 4:10 a.m., Sept. 20
Rain Ended 4:26 a.m., Sept. 23

cy, and Tallahassee; and total rainfall for other selected stations. The Havana curve was estimated from the daily rainfall reports and from the Quincy curve.

There were no recording gages in the maximum rainfall center, that area receiving 20 inches of rainfall or more (fig. 1). Rainfall intensities for the area between Quincy and Havana, however, were probably similar to those recorded by tipping-bucket gage 7 at the National Weather Service Office located 3 miles southwest of Quincy. Although that gage overflowed for a few minutes, a quantity adjustment was made using the record from the adjacent gage 8.

Rainfall intensities for the Quincy area are shown in table 2 which presents the maximum amounts of rainfall recorded for designated time intervals. The intensities for 2-, 6-, 12-, 24-, 48-, and 72-hour periods, and for the storm total, exceeded the 1 in 100-year probability of receiving such rainfall amounts (Hershfield, 1961 and Miller, 1964). The 2-day maximum of 17.71 inches exceeded by 1.71 inches the 1 in 100-year probability of a rainfall of 16 inches for a 7-day period for Quincy (Miller, 1964).

The maximum 6-hour rainfall at Quincy (gage 7) was recorded between 2 and 8 hours after the storm center reached land on the morning of September 21. The center of maximum precipitation was 60-65 miles to the east of where the center of low pressure made landfall and some 50 miles inland.

DESCRIPTION OF THE FLOOD

FLOOD STAGES AND DISCHARGES

The damaging floods that occurred in September 1969 were mainly confined to the Little River basin and the lower Ochlockonee River basin (south of U.S. Highway 27, fig. 2). Areas affected were the southern part of Decatur and Grady counties, Georgia, and all or parts of Gadsden, Leon, Liberty, Wakulla, Franklin, Bay, and Gulf counties, Florida (fig. 10).

Current-meter measurements of peak discharge were not obtained at the sites shown in figure 10 because the flood peak was of short duration, because it occurred during the night, or because the gaging station was inaccessible due to flooded roads and washouts. In cases where water-stage recorders malfunctioned or were damaged by the flood, high-water marks and direct readings on nonrecording gages were used to determine flood peaks.

Indirect measurements of peak discharge were made at 15 sites—3 regular gaging stations and 12 miscellaneous sites. Indirect measurement techniques used included: slope-area method; contracted-opening method; flow-through culvert method; and over road-embankment method. Indirect measurements based on field surveys of high-water profiles, channel geometry, and geometry of the bridge or culvert were computed in accordance with established methods of the Geological Survey.

Maximum stages and discharges at 19 continuous-recording and crest-stage partial-record stations, the maximum contents for Lake Talquin, and peak discharges for 13 ungaged sites are summarized in table 3. These sites are located on the map in figure 10.

Flood peaks at selected stations on several streams in the Ochlockonee River basin during September 20-30 were generally of short duration (fig. 11). Most of the streams peaked on the 22d and receded to base flow in 48 to 72 hours. Small streams such as Rocky Comfort Creek (sta. 23) peaked on the 21st and receded to base flow in 12 to 18 hours.

Figure 11 shows that the peak for Ochlockonee River near Havana (sta. 8, fig. 10) was relatively low compared to peaks of nearby streams. The total rainfall decreased rapidly in the upstream part of this 1,140 square-mile basin and the peak discharge was only 17,000 cfs or 14.9 cfs per square mile. Most of the flooding on the lower Ochlockonee River was downstream from station 8 and was the result of runoff from Little River and from small tributaries around Lake Talquin.

Gaging station 13, Little River near Quincy, was located near

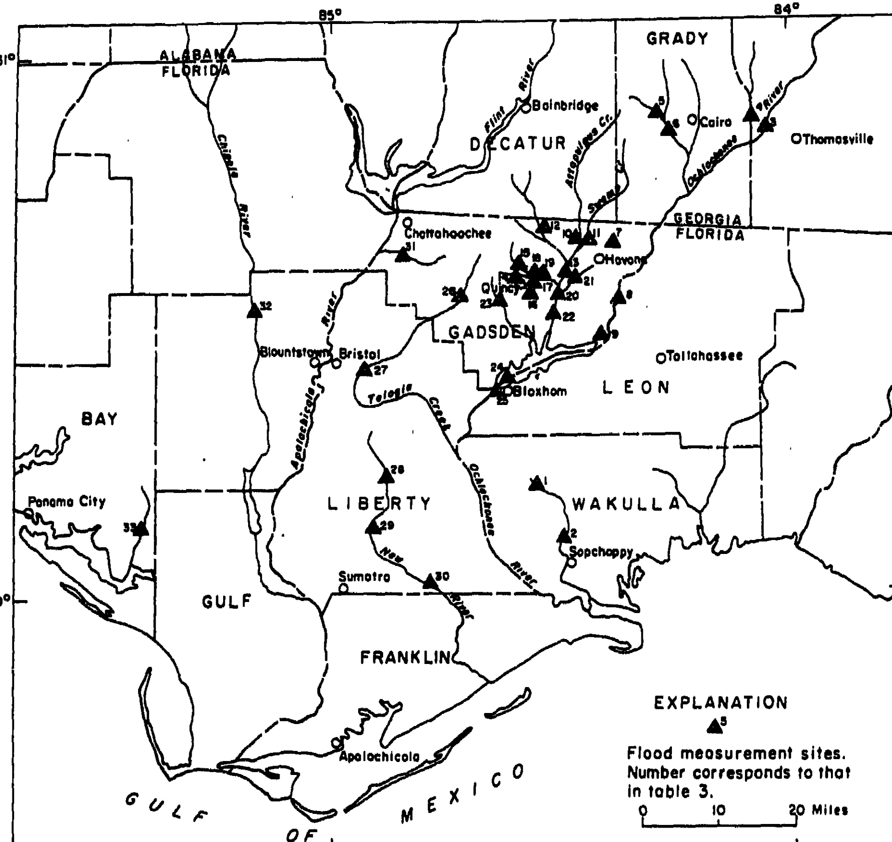

Figure 10.—Map showing location of flood-measurement sites.

Table 3.—Summary of flood stages and discharges

Sta. No. (fig. 10)	Permanent Sta. No.	Stream and place of determination	Drainage area (sq mi)	Maximum flood previously known: Period of Record	Maximum flood previously known: Date	Maximum flood previously known: Gage height (ft)	Maximum flood previously known: Discharge (cfs)	Maximum during September 1969 flood: Day	Maximum during September 1969 flood: Gage height (ft)	Maximum during September 1969 flood: Discharge: Cfs	Maximum during September 1969 flood: Discharge: Cfs per sq mi	Maximum during September 1969 flood: Discharge: Recurrence interval (yr)
		Ochlockonee River basin and coastal area										
1	3270.5	Sopchoppy River near Arran, Fla.	48.2	1964-69	Dec. 4, 1964	58.38	4,740	22	56.33	2,350	48.8	4
2	3271.	Sopchoppy River near Sopchoppy, Fla.	97.9	1961-69	Dec. 5, 1964	38.78	4,880	23	30.60	3,440	35.1	4
3	3275.	Ochlockonee River near Thomasville, Ga.	550	1937-69	Apr. 2, 1948	[a]29.1	72,000	23	8.67	872	1.6	≦1.1
4	3277.	Barnetts Creek near Thomasville, Ga.	104	1951-69	Dec. 5, 1964	[a]20.4	17,700	22	10.36	680	6.5	1.2
5	3279.	Wolf Creek near Whigham, Ga.	[b] 19	1948, 1951-69	Dec. 4, 1964	10.02	.	21	7.56	1,300	68.4	3
6	3280.	Tired Creek near Cairo, Ga.	[b] 60	1943-69	Apr. 1, 1948	[a]16.3	28,100	21	8.30	2,940	49.0	4
7	3288.59	Ochlockonee River tributary near Havana, Fla.	1.34	.	...	...	.	21	....	1,700	1,270	(c)
8	3290.	Ochlockonee River near Havana, Fla.	[b]1,140	1926-69	Apr. 4, 1948	35.08	55,900	21	30.00	17,000	14.9	7
9	3292.6	Midway Branch near Midway, Fla.	1.38	....	...	....	....	21	....	2,130	1,540	(c)
10	3293.52	Attapulgus Creek at Jamieson, Fla.	95.6	....	. .	....	.	21	....	22,200	232	[d] 2.28
11	3294.04	Swamp Creek at Jamieson, Fla.	53.0	...	.	....	....	21	...	18,800	355	[d] 2.56
12	3294.81	Willacoochee Creek tributary near Quincy, Fla.	1.26		...	....	.	21	...	642	510	[d](c)
13	3295.	Little River near Quincy, Fla.	287	1950-69	Dec. 4, 1964	20.81	25,400	22	[a]24.65	45,600	192	[d] 2.99
14	3295.16	Quincy Creek near Quincy, Fla.	6.16	...	. .	....	. .	21	....	4,840	786	(c)
15	3295.38	Hollman Branch near Quincy, Fla.	3.09	....	....	....	. .	21	....	1,050	340	(c)
16	3295.46	South Prong Tanyard Branch near Quincy, Fla.	2.29	...	....	....	. .	21	....	1,480	646	(c)
17	3295.48	Tanyard Branch near Quincy, Fla.	4.91	....	. .	....	.	21	....	2,430	495	(c)
18	3295.53	Hubbert Branch near Quincy, Fla.	4.68	....	....	....	.	21	....	2,360	504	(c)
19	3295.56	Winkley Branch near Quincy, Fla.	1.64	...	....	....	.	21	....	1,000	610	(c)
20	3295.65	Little River near Littman, Fla.	[e] 292	....	....	....	...	22	....	[e] 47,400	167	[d] 2.89
21	3295.82	Hurricane Creek near Havana, Fla.	8.31	....	. .	....	.	21	....	7,450	896	(c)
22	3296.	Little River near Midway, Fla.	305	1965-69	Dec. 5, 1964	83.27	27,800	22	[a]86.25	49,200	161	[d] 2.85
23	3297.	Rocky Comfort Creek near Quincy, Fla.	9.46	1964-69	Dec. 4, 1964	41.00	2,140	21	[a]42.5	7,610	804	(c)
24	3299.	Lake Talquin near Bloxham, Fla.	1,720	1930-69	Sept. 24, 1932	70.90	[f]96,320	22	71.60	[f]105,300		....
25	3300.	Ochlockonee River near Bloxham, Fla.	1,720	1926-69	Apr. 5, 1948	28.50	[g]50,200	23	[a]29.2	89,400	52.0	[d] 2.19
26	3300.5	Telogia Creek near Greensboro, Fla.	28.1	1965-69	Apr. 27, 1965	96.86	4,410	21	[a]99.9	12,000	427	[d] 2.26
27	3301.	Telogia Creek near Bristol, Fla.	126	1950-69	Dec. 5, 1964	11.11	8,280	22	[a]16.65	20,600	163	[d] 1.49
28	3302.	New River at Vilas, Fla.	28.2	1961-69	Oct. 16, 1964	5.86	675	22	8.73	2,570	111	8
29	3303.	New River near Wilma, Fla.	81.7	1964-69	Sept. 20, 1966	46.32	2,720	22	50.67	8,790	108	46
30	3304.	New River near Sumatra, Fla.	157	1965-69	Dec. 7, 1964	24.68	3,620	23	27.38	6,670	42.5	8
		Apalachicola River basin										
31	3586.	Flat Creek near Chattahoochee, Fla.	24.9	1961-69	Apr. 26, 1965	11.43	3,990	21	[a]13.6	8,450	339	[d] 1.70
32	3590.	Chipola River near Altha, Fla.	781	1921-27, 1929-31, 1943-69	Sept. 20, 1926	33.55	25,000	21	14.83	3,100	4.0	1.3
		Coastal area between Apalachicola River and Choctawhatchee River										
33	3593.	Sandy Creek near Panama City, Fla.	[b] 25	1961-69	Oct. 15, 1964	17.06	2,260	21	13.24	1,180	47.2	[d] 1.13

[a] From floodmark
[b] Approximately
[c] Not defined
[d] Ratio of peak discharge to 50-year storm
[e] Includes Hurricane Creek
[f] Contents, are feet
[g] Exceeded by undetermined peak discharge on Sept. 30, 1957, which was caused by failure of earth embankment of Jackson Bluff dam.

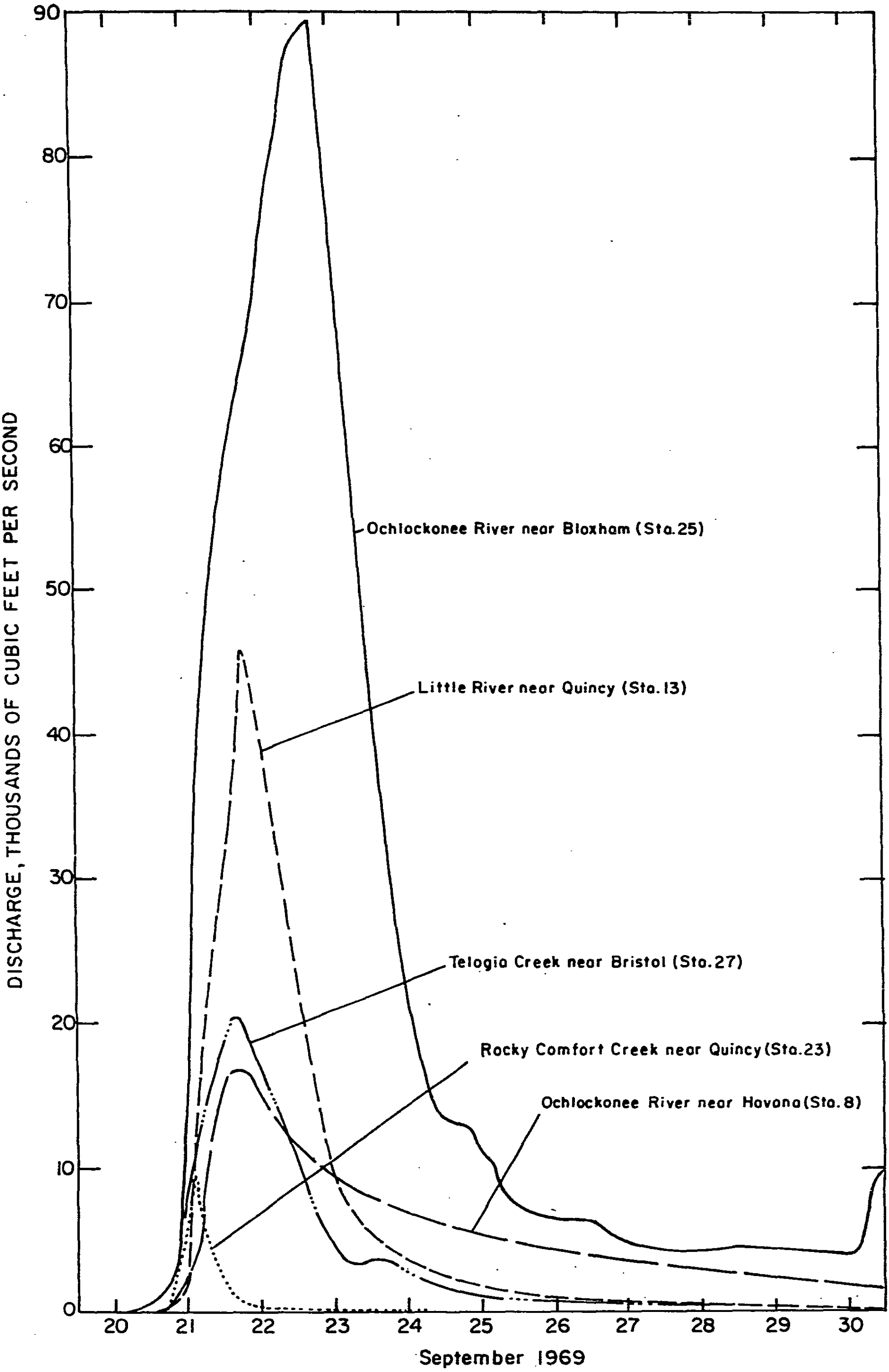

Figure 11.—Discharge hydrograph for selected gaging stations in the Ochlockonee River basin, September 20-30, 1969.

the center of greatest rainfall. At this station the stage rose 21 feet between 6 a.m. September 21 and 6 a.m. September 22, and rainfall during the same period was 13 inches at the recording gage 3 miles south-southwest of Quincy. The peak discharge of 45,600 cfs occurred about 7 a.m. September 22. This discharge was 2.99 times greater than that of a 50-year flood and 1.8 times greater than the 19-year record peak discharge of 25,400 cfs which occurred in December 1964 (table 3).

Runoff for the flood was 9.7 inches or approximately 61 percent of the total rainfall on the basin.

At the Little River gage (sta. 13), on State Highway 12, the left bank (looking downstream) is steep and the highway enters a deep cut approximately 300 feet east of the bridge. The rain saturated the pipe clay banks causing both banks to slide and piled clay, trees, and telephone poles across the highway, blocking it for about a week. The sparse development along the relatively narrow Little River valley limited damage mostly to bridges and highway embankments.

At Rocky Comfort Creek near Quincy (sta. 23) the peak discharge was 7,610 cfs. Runoff from the 9.46 square-mile drainage area was 14.0 inches which was 74 percent of the 18.8 inches of rainfall.

The drainage structure at Rocky Comfort Creek station consists of four 8-foot x 10-foot box culverts. Near the time of the flood peak the culverts were undermined and the center section (fig. 12) settled approximately 3 feet. The road was breached around both wingwalls leaving 10-foot openings on each side.

About 8 miles downstream, at the next road crossing at State Highway 267, two sets of arch culverts were washed out and collapsed due to the head on the road fill and culverts.

Lake Talquin is the reservoir formed by Jackson Bluff Dam on the Ochlockonee River and is used primarily for hydropower. Its area is 6,890 acres (10.7 square miles) at elevation 60.0 feet.

As rain spread over the Ochlockonee River basin, Lake Talquin began to rise. By midnight September 20, after 3.17 inches of rain had accumulated at the Quincy weather station (gage 7), the lake elevation had increased 0.3 foot. Between midnight September 20 and 7 p.m. September 22, the lake level rose from 68.30 feet to 71.60 feet or 0.70 foot above the previous maximum recorded on September 24, 1932.

The contributing drainage area to the lake is 1,720 square

Figure 12.—Culverts at Rocky Comfort Creek (sta. 23).

miles. The inflow was gaged at station 8 (fig. 10), Ochlockonee River near Havana, 1,140 square miles; station 13, Little River near Quincy, 237 square miles; and station 23, Rocky Comfort Creek near Quincy, 9.46 square miles. The inflow from the ungaged 334 square-mile area was estimated on the basis of runoff from Rocky Comfort Creek and Little River and verified by a comparison of total runoff values. Storm runoff from Rocky Comfort Creek and Little River drainage basins were 74 and 61 percent, respectively, compared to 64 percent runoff from the ungaged area.

Figure 13 is a graph of Lake Talquin inflow and outflow, in cfs, and storage, in acre-feet, for September 20-30, 1969. The inflow graph (solid line) represents the combined flow past station 23 (Rocky Comfort Creek), station 13 (Little River), station 8 (Ochlockonee River), and the estimated flow of the ungaged area. It was not adjusted for time lag. The storage graph (dotted line) represents storage in Lake Talquin as measured at station 24 and the outflow graph (dashed line) represents the flow below Lake Talquin at station 25 (Ochlockonee River).

The initial inflow increase, as shown in figure 13, resulted from runoff from Rocky Comfort Creek and other small tributaries that

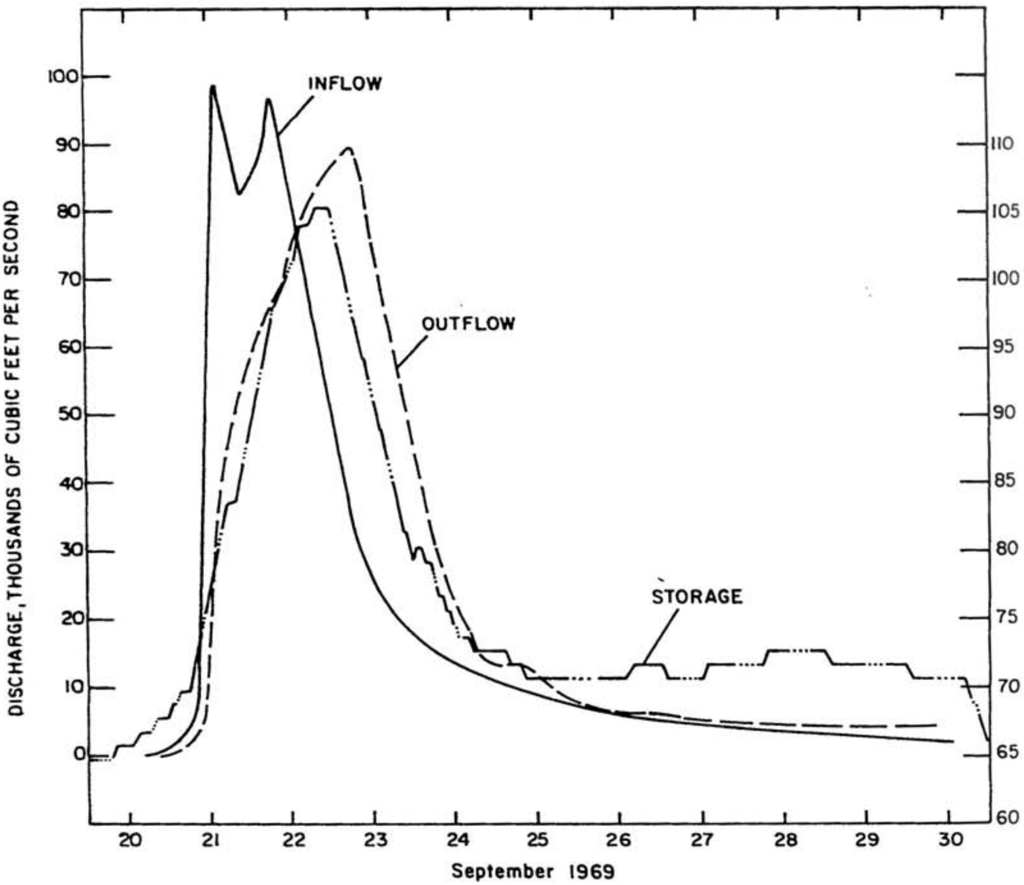

Figure 13.—Lake Talquin inflow, outflow, and storage.

surround Lake Talquin. This concentration of inflow is reflected by an increase in storage and outflow. The inflow graph shows a second peak which was the result of the flood runoff from the Little and Ochlockonee Rivers. Usable contents in the lake increased from 67,800 acre-feet, at midnight September 20, to a maximum of 105,300 acre-feet, at 7 p.m. September 22.

Gaging station 25 on the Ochlockonee River at State Highway 20 (3,000 feet below Jackson Bluff Dam) gages the outflow from Lake Talquin. The peak discharge of 89,400 cfs at this station, which occurred at 5 a.m. September 23, was 2.19 times greater than that of a 50-year flood.

The Ochlockonee River overflowed State Highway 20 just west of the main channel bridge and kept the road closed to traffic for approximately 48 hours September 22-23, 1969. At peak flow the road-overflow section was approximately 4,800 feet wide and carried approximately 20 percent of the discharge.

On September 30, 1957, a portion of the earth embankment of Jackson Bluff Dam failed thereby releasing much of the water stored in Lake Talquin. Although the peak discharge was not determined, the flood crest at the gaging station at State Highway 20 was 3.44 feet higher than that of the more recent September 23, 1969, flood.

At gaging station 27, on Telogia Creek, the peak discharge on September 22, 1969, was 20,600 cfs or 1.49 times greater than that of a 50-year flood and 2.5 times greater than the previous maximum of 8,280 cfs in December 1964. Runoff resulting from the September 1969 flood was 10.4 inches, which was about 65 percent of the total rainfall on the basin.

The highest peak discharge per unit of drainage area during the September 1969 flood occurred on Midway Branch where the peak runoff was 1,540 cfs per square mile from a 1.38 square-mile area. See station 9 (fig. 10 and table 3).

FLOOD FREQUENCIES

The recurrence interval, applied to flood events, is the number of years, on the average, during which a given flood peak will be exceeded once (Dalrymple, 1960, p. 5). It is inversely related to the chance of a specific flood peak being exceeded in any one year. For instance, a flood having 1 chance in 50 of being exceeded in any one

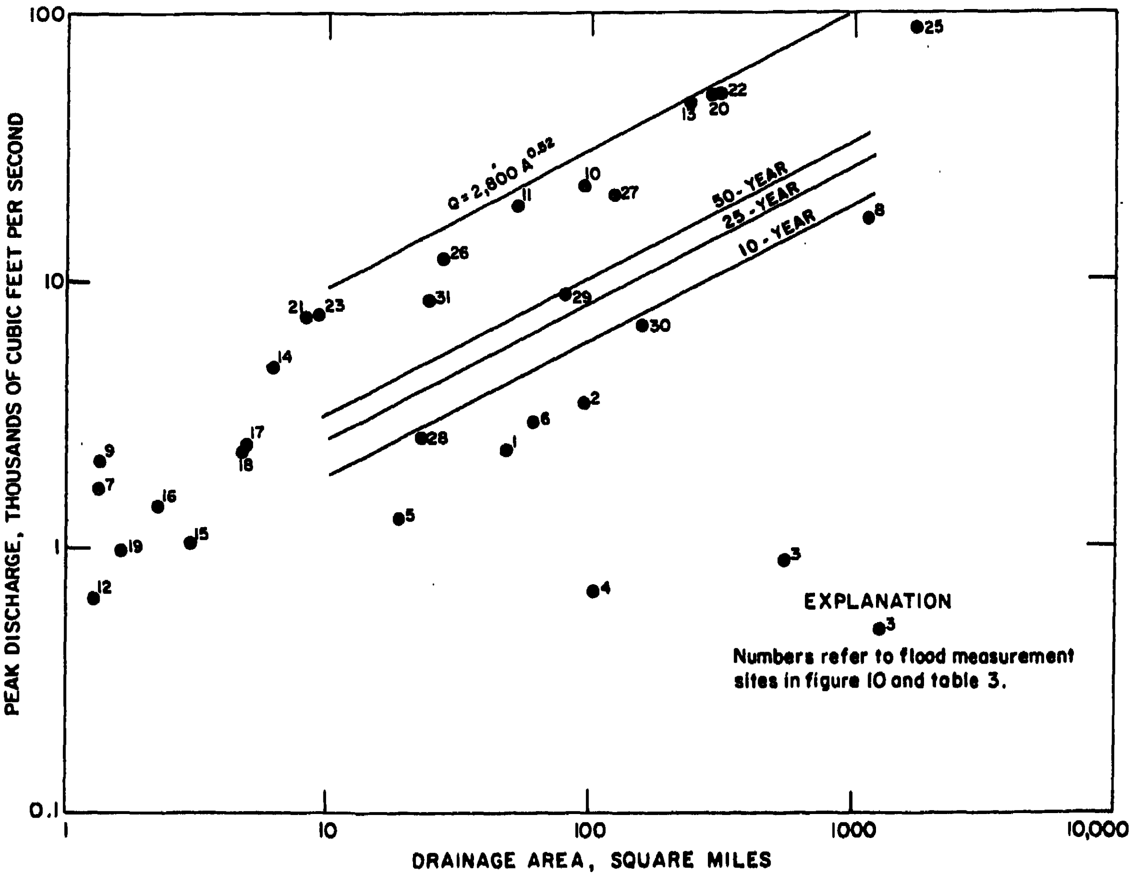

Figure 14.—Relation of peak discharges to regionalized flood-frequency curves—storm of September 20-23, 1969. Flood-frequency curves adapted from Barnes and Golden (1966).

year is said to have a recurrence interval of 50 years and is commonly referred to as the 50-year flood.

Barnes and Golden (1966, p. 7-13) present a method for determining the magnitude of floods of selected frequencies. Their regionalized method is applicable to drainage areas of greater than 10 square miles.

In figure 14 peak discharges of September 1969 are compared to the 10-, 25-, and 50-year flood-frequency curves. Many of the peak discharges were in excess of the 50-year flood and are considered to be rare occurrences. The enveloping curve shown in figure 14 may be derived from the equation:

$$Q = 2{,}800\ A^{0.52}$$

where Q is the peak discharge in cfs and A is the drainage area in square miles.

All of the flood-measurement sites (stations 1-31, fig. 14 and table 3) are in the same flood-frequency region and hydrologic area, as defined by Barnes and Golden (1966, plate 1), except for Flat Creek near Chattahoochee (sta. 31). However, a comparison of the unit runoff of available peaks for Flat Creek near Chattahoochee (sta. 31) and Telogia Creek near Greensboro (sta. 26) indicates that Flat Creek does belong in the same flood-frequency region and hydrologic area as stations 1-30. Chipola River near Altha (sta. 32) and Sandy Creek near Panama City (sta. 33) are in a different region and area and therefore are not plotted in figure 14.

FLOOD PROFILES

Profiles of the flood crest of September 1969, along selected reaches of Little River, Quincy Creek, and Telogia Creek are presented in figures 15-17. The approximate channel profiles, which were constructed from the contour crossings taken from topographic maps, are also shown.

The upstream end of the Little River profile shown in figure 15 begins at the State Highway 159 crossing of Attapulgus Creek (the main headwater tributary of the Little River) and ends at Lake Talquin. Although the head loss at State Highway 159 was 1.5 feet, only minor damage occurred to the grassed shoulders of the highway embankment. The right (west) bridge end showed considerable scour as did the main channel below the bridge. At State Highway 12, only minor damage occurred to the shoulders

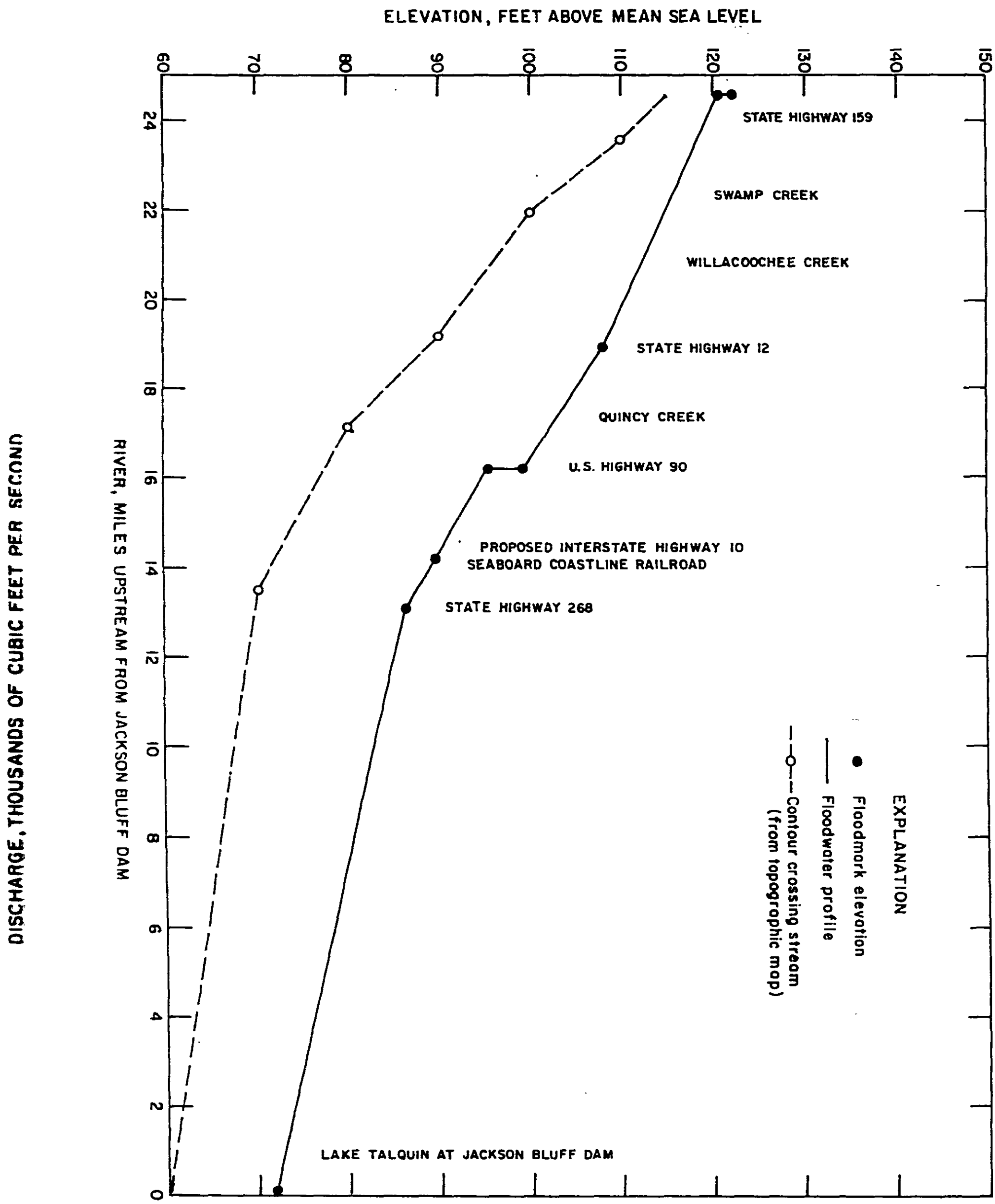

Figure 15.—Flood profile of Little River.

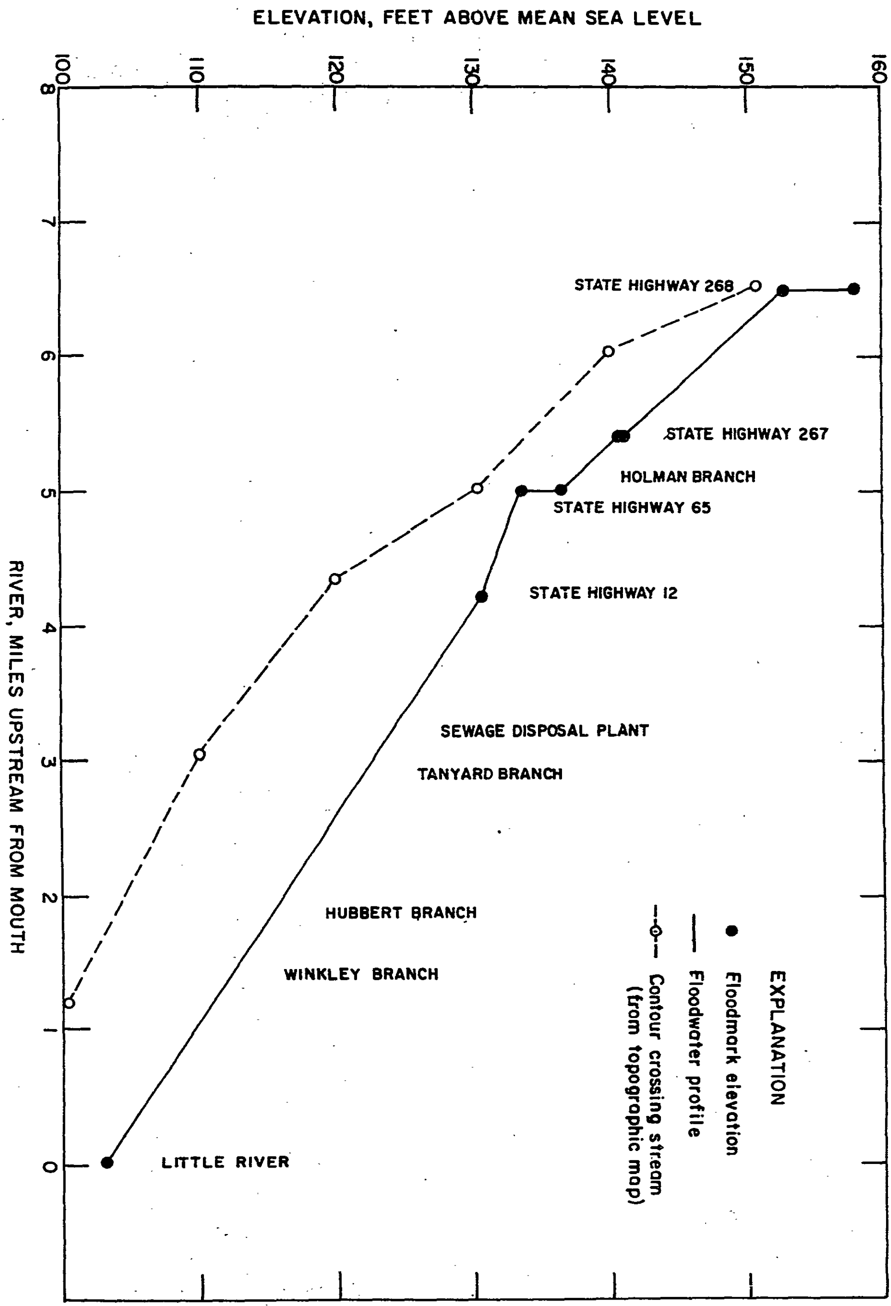

Figure 16.—Flood profile of Quincy Creek.

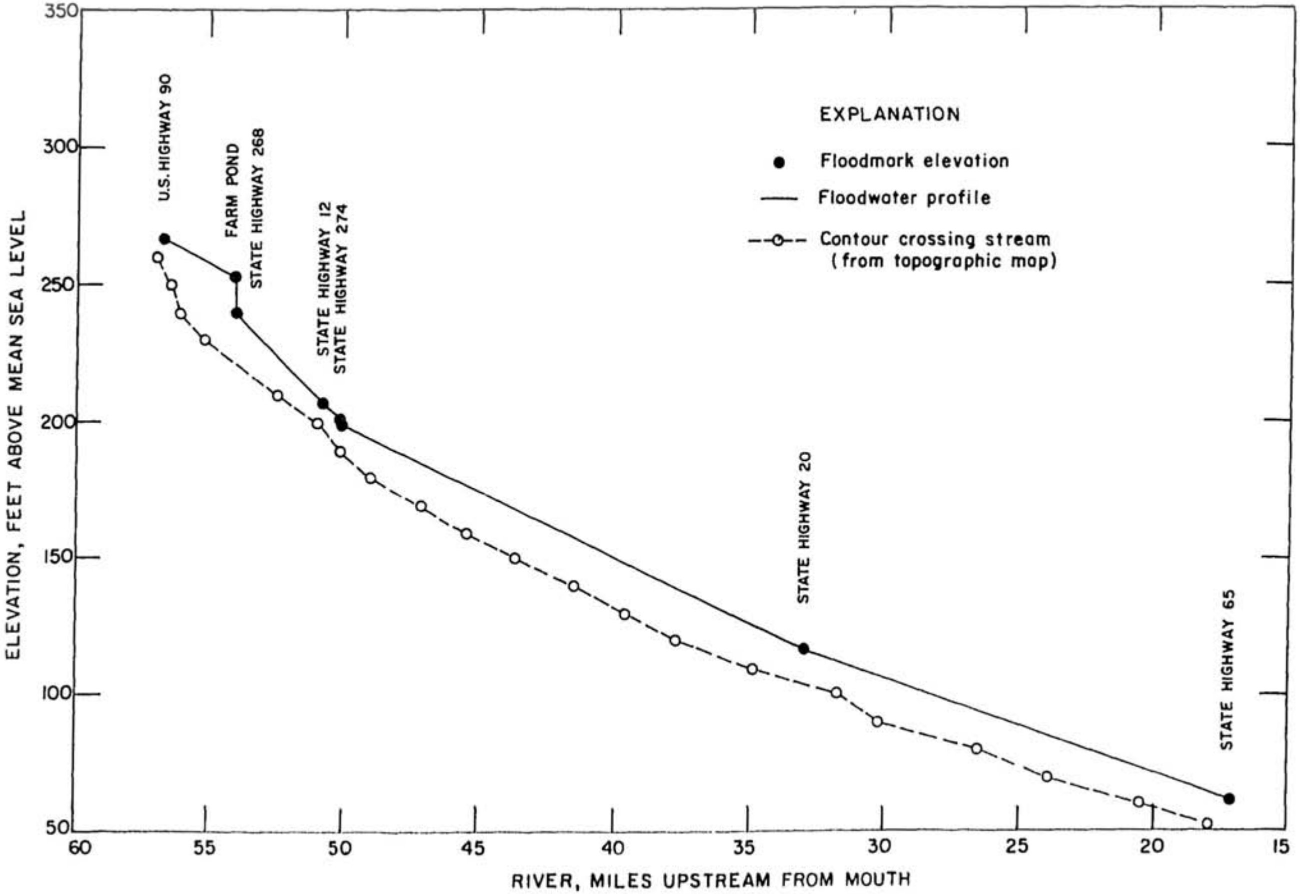

Figure 17.—Flood profile of Telogia Creek.

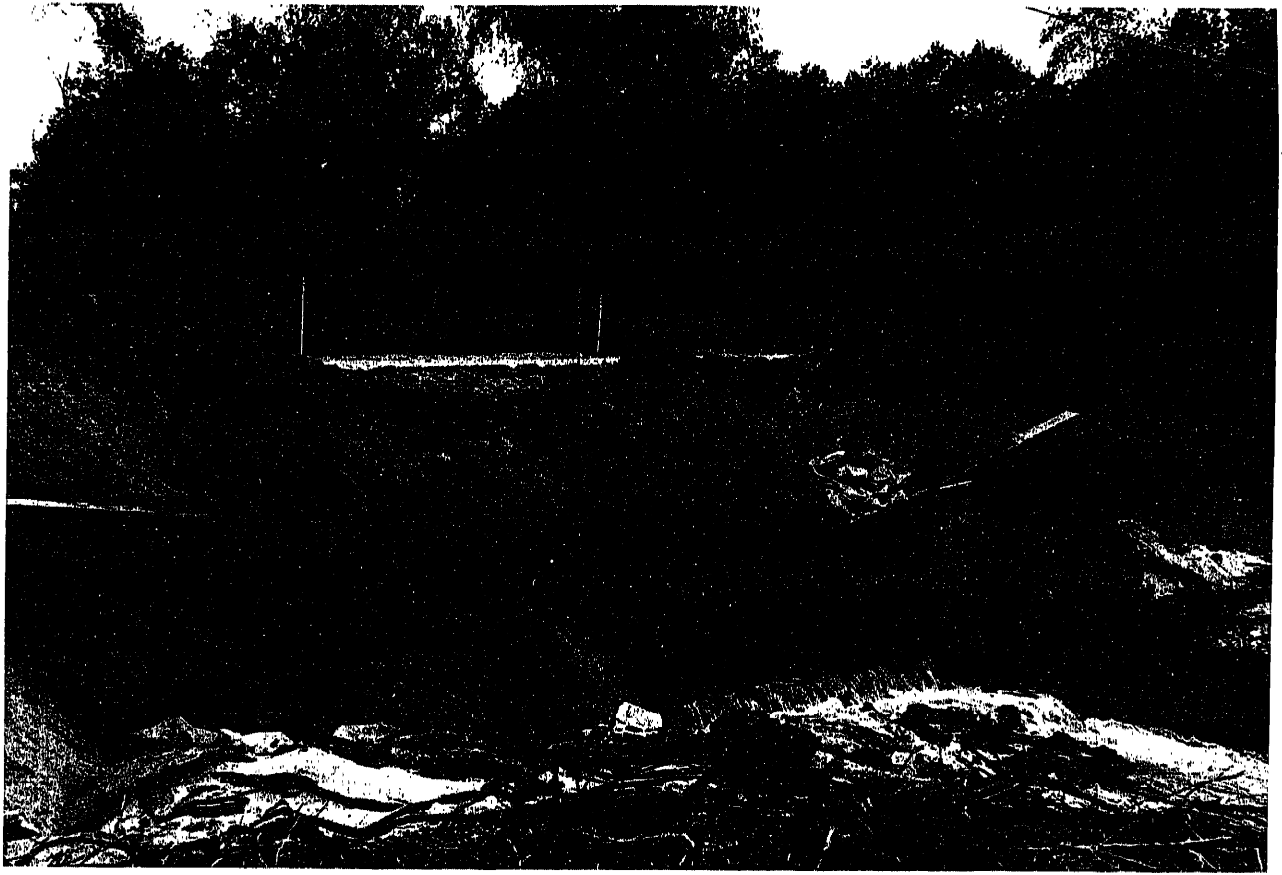

Figure 18.—Culvert on State Highway 268 at Quincy Creek.

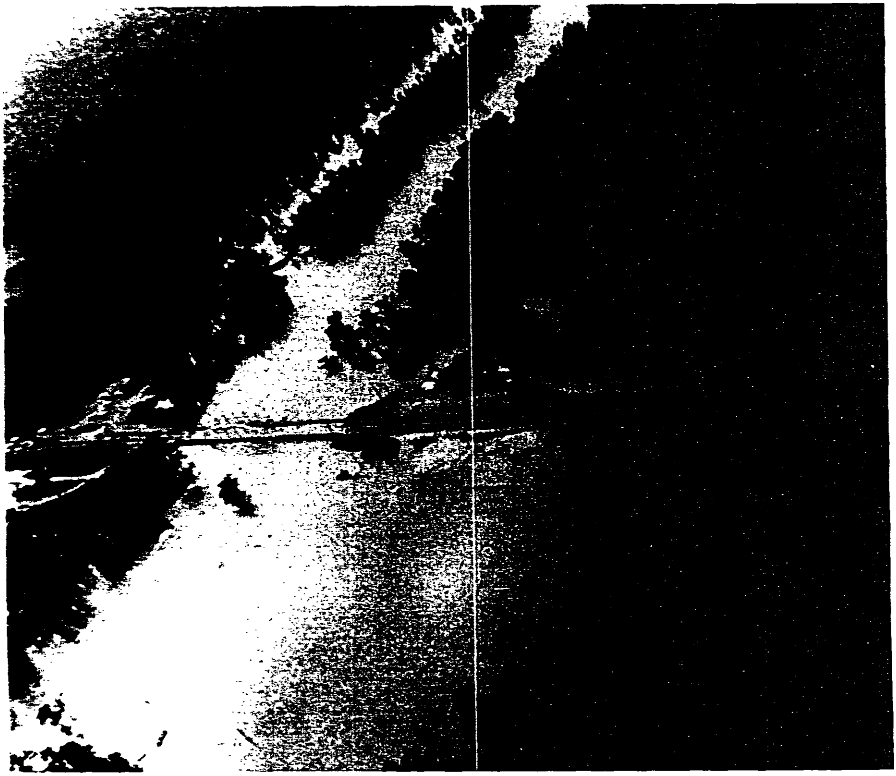

Figure 19.—Ochlockonee River at State Highway 20; 3,000 feet downstream from Jackson Bluff Dam—Photo by Tallahassee Democrat.

although the road was under approximately 0.5 foot of water. No damage to the bridge ends and no major scour took place in the main channel other than a few blow-holes downstream from the bridge.

Figure 15 shows a 3.9-foot head drop in the Little River at U.S. Highway 90. This was a result of the west-bound lane of the highway being about 4 feet higher than the older east-bound lane. The west-bound lane was submerged to a depth of 6 inches. Considerable damage occurred to the bridge ends and the embankment in the area of the relief culvert.

The water was approximately 2 feet deep on the Seaboard Coastline Railroad but damage was insignificant. At State Highway 268 the bridge and highway were submerged. Twelve hundred feet

Figure 20.—Mobile homes at Bell's Trailer Park, U.S. Highway 20 west of Tallahassee—Photo by Tallahassee Democrat.

east of the bridge and just east of the relief culvert the road fill was breached leaving an opening 60 feet wide.

Quincy Creek flows around the north side of Quincy in an easterly direction to the Little River. The reach of the Quincy Creek flood profile shown in figure 16 extends from State Highway 268, northwest of Quincy, to the Little River. At State Highway 268 there was a 5.3-foot drop in the water surface, the road was breached at the culvert, and the entire triple box culvert was undermined and settled approximately 3 feet (fig. 18).

State Highway 267 was overtopped by about 2 feet of water but was not damaged. The head drop in Quincy Creek at State Highway 65 was about 3 feet. The flood plain widens below the bridge which accounts for the flatter slope downstream.

The Telogia Creek flood profile shown in figure 17 extends from

Figure 21.—Road washout at North Lake Drive between Old Bainbridge Road and Lake Jackson—Photo by Tallahassee Democrat.

U.S. Highway 90 to State Highway 65. The break in profile upstream from State Highway 268 was due to a farm pond just upstream. Although its earthen dam was not topped there was considerable scour of the spillway around the right (west) end. At State Highway 12 a grist mill was flooded and its concrete dam was washed out. State Highway 274 was flooded to depth of about 0.7 foot and 850 feet in width.

The lower chords of the bridges at State Highway 20 and 65 were submerged, but the bridge decks and approaches remained above water.

FLOOD DAMAGE

Although no loss of life resulted from the flood, several houses, weekend cottages, and mobile homes were severely damaged—espe-

Figure 22.—Salem Branch at State Highway 159 near Havana.

cially those along the Ochlockonee River valley below the Jackson Bluff Dam. As shown in figure 19, only the roofs of several mobile homes are visible in the lower left of the picture. Bell's Trailer Park on U.S. Highway 90 between Tallahassee and Quincy was flooded when a low area filled and the outlet was inadequate to remove the excess water. Many mobile homes were removed but those pictured in figure 20 were flooded to depths of 6 inches over floor level.

Roads, highways, and bridges received the greatest damage. According to Charles Scruggs, maintenance engineer, the Florida Department of Transportation spent $198,000 for emergency repair work in Gadsden, Leon, and Liberty counties. Approximately 80 percent of the amount was used in Gadsden County. Emergency work included repairing bridge ends and culverts, and backfilling washed-out road fills. Contractual work to replace four bridges that were destroyed amounted to $522,832. Three of the bridges were in

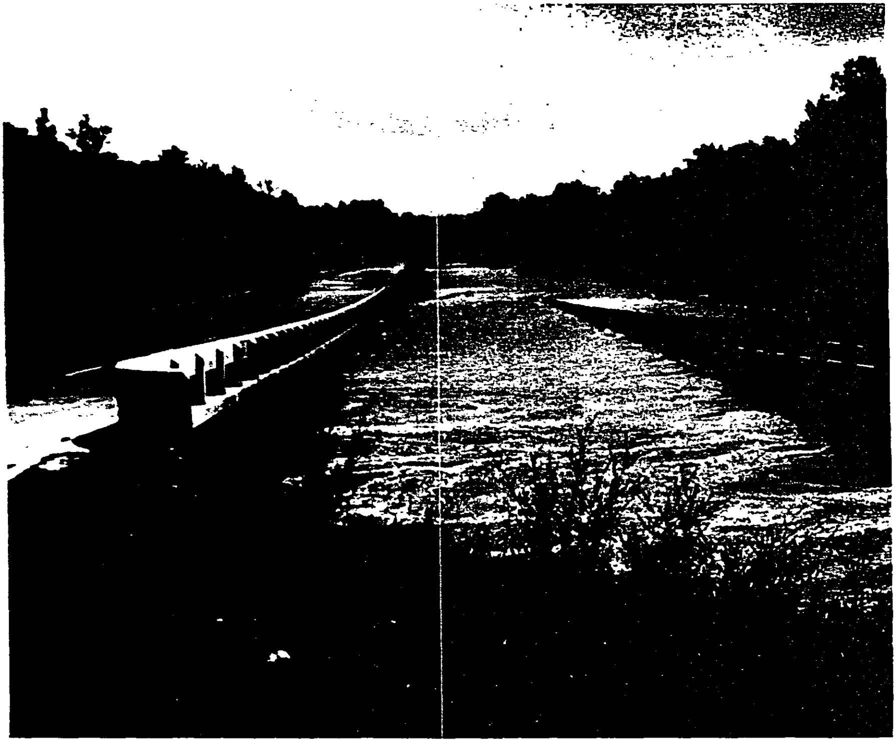

Figure 23.—Little River at U.S. Highway 90—Photo by H. P. Goodling, Portland Cement Association.

Gadsden County and the other in Liberty County. Estimated damage to streets in Quincy totaled $30,000.

Figures 21-23 show typical scenes of roads that were washed out, culverts destroyed, and highways and bridges inundated.

Railroad damage was mostly confined to temporarily-submerged tracks, land slides, and washed-out culverts along the Seaboard Coastline Railroad. Mr. J. G. Jarriel, roadmaster for the railroad, reported rail traffic at a standstill for approximately 36 hours due to submerged tracks. A work-train required about 60 days to restore damaged and washed-out fills. No dollar estimate of damage was obtained.

The Apalachicola and Northern Railroad had six washouts in its 90 miles of track between Chattahoochee and Port St. Joe. The major washout was at Big Creek near Hosford, in Liberty County (fig. 2). A papermill in Port St. Joe, dependent on pulpwood hauled by the railroad, was shut down for about 10 days resulting in the layoff of about 1,200 employees.

The Quincy Telephone Company reported approximately 2,000 telephones affected by the storm.

Agricultural losses in Gadsden County were estimated at $1,000,000. Of this amount, $659,000 were crop losses—mostly soybeans. Other losses included washed-out spillways or retaining dams for farm ponds, irrigation reservoirs, and grist mill reservoirs which were valued at approximately $350,000.

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