DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with
SHELBY COUNTY

WATER-RESOURCES INVESTIGATIONS
REPORT 89-4019
(SHEET 1 OF 2)

INTRODUCTION

Intense rainfall on December 24-25, 1987, caused flooding in many areas of West Tennessee. The area most seriously affected was in and around the city of Millington in northern Shelby County. As a result of the intense rainfall, Big Creek and its tributaries overflowed their banks and inundated a large part of Millington, including residential, industrial, and adjacent farm areas. Flooding also occurred along the Loosahatchie River south of Millington.

The U.S. Geological Survey, in cooperation with Shelby County, conducted an investigation of the flood on Big Creek and several of its tributaries in the Millington area and on Loosahatchie River south of Millington (fig. 1). The purposes of the study were to: (1) define flood elevations, magnitudes, and frequencies; (2) delineate the areas inundated and depth of flooding in Millington; and (3) define water-surface profiles of the flood peak on the streams most affected. This report briefly describes the storm that produced the flooding and presents the results of these flood studies. The data presented in this report can provide a basis for flood-plain management decisions by other Federal, State, and local managers and planners that could help minimize damaging effects of future floods.

ACKNOWLEDGMENT

Acknowledgment is made to the National Weather Service at Memphis, Tennessee, and the United States Naval Air Station in Millington, Tennessee, for providing rainfall data and to Fischer, Phillips, Arnold Engineering, Memphis, Tennessee, for providing bench-mark elevations and some high-water-mark elevations for the flood. Navy personnel at the Naval Air Station also provided valuable assistance in defining the limits of flooding in that area, which is greatly appreciated. The support and cooperation provided by Mayor George R. Harvell, Jr., of the city of Millington is also gratefully acknowledged.

ADDITIONAL DATA

Additional information pertaining to floods on streams in the report area as well as other areas of Tennessee can be obtained from the District Office of the U.S. Geological Survey, A-413 Federal Building-U.S. Courthouse, Nashville, TN 37203.

DESCRIPTION OF THE STORM

A stalled cold front across Middle Tennessee induced intense rainfall in the southwestern corner of Tennessee and eastern Arkansas during the period December 23-27, 1987, with many areas receiving more than 10 inches of rain (fig. 2). The city of Millington received a total of 14.8 inches of rainfall during this period, with 11.8 inches occurring during the period December 24-25, and 9.2 inches occurring in a 12-hour period from 6 p.m. on December 24 to 6 a.m. on December 25 (fig. 3). This 12-hour total rainfall exceeded the 100-year, 12-hour duration storm total of about 7 inches reported in U.S. Weather Bureau (now National Weather Service) Technical Paper no. 40. The Memphis Airport received a total of 9.0 inches for December 24-27, of which 6.9 inches was recorded on December 24-25.

PEAK DISCHARGE AND FREQUENCY

The rate of discharge of a stream is the volume of water that passes a particular location in a specific period of time, generally expressed in cubic feet per second. The discharge rates at selected sites listed in table 1 are the instantaneous peak discharges which generally occur at the maximum gage height, or elevation of the flood.

The relation of peak discharges for floods to the probability of occurrence, or recurrence interval, is referred to as a flood-frequency relation. As applied to annual floods, the recurrence interval is the average interval of time between equal or greater peak discharges. For example, a flood with a 100-year recurrence interval is expected to be equaled or exceeded on the average, once in 100 years. As a probability, it has a 1 in 100 chance of occurring in any given year and may even occur in consecutive years.

Peak discharges for North Fork Creek at U.S. Highway 51, and Big Creek at Raleigh-Millington Road were computed from hydraulic characteristics and flood elevations after the flood had occurred (table 1). This procedure to indirectly compute flood-peak discharges is described by Benson and Dalrymple (1967), Bodhaine (1968), and Matthai (1967). The discharge of the 100-year flood (table 1) for these sites was estimated using the regional regression equation in the report by Randolph and Gamble (1976). The peak discharge for North Fork Creek at U.S. Highway 51 was about equal to the 100-year flood. The peak discharge for Big Creek at Raleigh-Millington Road was almost twice the discharge of the 100-year flood. From field inspection, the tributaries to Big Creek upstream of North Fork Creek had large amounts of runoff which contributed to the flooding of Big Creek in Millington.

At the U.S. Geological Survey gaging station on the Loosahatchie River at U.S. Highway 70 near Arlington (about 15 miles southeast of Millington), the peak discharge for this flood was the greatest since the gage was installed in 1969. The peak discharge on December 25, 1987, at this station (table 1) was about equal to a 75-year flood, based on the weighing procedure described on page 9 of the report by Randolph and Gamble (1976). A discharge hydrograph for the storm period is shown in figure 4.

FLOOD HEIGHTS AND PROFILES

The height of a flood is usually given above a selected datum plane. That datum plane can be arbitrary or it can be a nationally recognized datum such as sea level. For this report, flood heights are reported as height in feet above sea level.

Flood elevation profiles for Big Creek, Royster Creek, North Fork Creek, unnamed tributary to Big Creek and Casper Creek, are shown in figures 5 to 9. A similar flood profile for Loosahatchie River located to the south and southeast of Millington is shown in figure 10. These profiles were developed using high-water marks from field surveys completed soon after the flood. Most of the marks were located near bridge crossings; however, some were located between bridges where more definition was needed. Royster Creek, North Fork Creek, and Casper Creek are tributaries to Big Creek, which is tributary to Loosahatchie River. Loosahatchie River is tributary to the Mississippi River.

Streambed elevations shown on figures 5 to 10 were obtained from flood insurance studies published by the Federal Emergency Management Agency (FEMA) for the city of Millington (1980) and Shelby County (1985), and from field surveys at the two sites where measurements of peak discharge were made by indirect methods. The streambed profiles are intended to show general shape and approximate depth of flooding. For Royster Creek, the computed 500-year profile from the FEMA study is also shown for comparison with the December 25, 1987, flood profile (fig. 6). This comparison indicates that the FEMA study for Millington may need to be updated on the basis of data available for the December 25, 1987 flood.

EXTENT OF FLOODING

The area flooded by the December 25, 1987 flood in the city of Millington and adjacent areas is delineated on sheet 2. The flood boundaries on this map are based on high-water marks, flood-elevation profiles (figs. 5-10), field inspection of the flooded area, and information obtained from local residents and officials.

Lines of equal water-surface elevation normal to flow shown on this map are based on the flood-elevation profiles. The approximate depth of flooding within the inundated area can be estimated by subtracting the ground elevation from the water-surface elevation. The maximum depth of overbank flooding in Millington was about 10 feet and occurred near the Big Creek channel.

FLOOD DAMAGES

According to newspaper reports, about 2,000 people were forced from their homes by the floodwaters. About 230 houses, 186 mobile homes, 183 apartment units, 10 businesses, and 1 public building were damaged by the flood. Also several automobiles were flooded to dashboard depths. Flooding and flood damage scenes are shown in figures 11-14.

Preliminary estimates of flood damages to structures and their contents, and cleanup costs total about $9.2 million (Jim Reeder, Corps of Engineers, Memphis District, oral commun., 1988). Estimates have not yet been made for damage to roads, bridges, and flooded automobiles.

SUMMARY

Intense rainfall totaling 9.2 inches in a 12-hour period on December 24-25, 1987, and 14.8 inches for the period December 23-27 caused record floods in Millington, Tennessee and vicinity. The peak discharge of Big Creek at Raleigh-Millington Road was almost twice the discharge of the 100-year flood. The peak discharge of North Fork Creek was about equal to the 100-year flood discharge and that of Loosahatchie River near Arlington was about equal to the 75-year flood discharge.

Documentation of the flood has been presented in the form of water-surface profiles, peak discharges and frequencies, and delineation of the flooded area. Techniques for the determination of flood depths in the inundated area are also presented.

Estimates of flood damage to structures and their contents and cleanup costs total about $9.2 million. Estimates have not been made for damage to roads, bridges, and flooded automobiles.

Comparison of data for the December 25, 1987 flood with computed profiles in the 1980 flood insurance study indicates that an update of the flood insurance study for Millington using data from the 1987 flood may be needed.

REFERENCES CITED

Benson, M.A., and Dalrymple, T., 1967, General field and office procedures for indirect discharge measurements: U.S. Geological Survey Techniques of Water-Resources Investigation, book 3, chapter A1, 30 p.

Bodhaine, G.L., 1968, Measurement of peak discharge at culverts by indirect methods: U.S. Geological Survey Techniques of Water Resources Investigations, book 3, chapter A3, 60 p.

Federal Emergency Management Agency, 1980, Flood insurance study, City of Millington, Tennessee: Federal Emergency Management Agency, 21 p., 5 profiles.

-----1985, Flood insurance study, Shelby County, Tennessee: Federal Emergency Management Agency, v. 1 and 2: v. 1., 67 p.; v. 2, 69 profiles.

Matthai, H.F., 1967, Measurement of peak discharge at width contractions by indirect methods: U.S. Geological Survey Techniques of Water-Resources Investigations, book 3, chapter A4, 44 p.

Randolph, W.J., and Gamble, C.R., 1976, Technique for estimating magnitude and frequency at floods in Tennessee: Tennessee Department of Transportation, 52 p.

Robbins, C.H., 1984, Synthesized flood frequency for small urban streams in Tennessee: U.S. Geological Survey Water-Resources Investigations Report 84-4182, 24 p.

U.S. Department of Commerce, 1961, Rainfall frequency atlas of the United States: U.S. Weather Bureau, Technical Paper no. 40, 115 p.

U.S. Water Resources Council, 1981, Guidelines for determining flood flow frequency: Washington, D.C., U.S. Water Resources Council Bulletin 17B, 183 p.

CONVERSION FACTORS

For those readers who may prefer to use metric units rather than the inch-pound units, conversion factors for terms used in this report are listed below:

Multiply inch-pound units	by	To obtain metric units
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.0109	cubic meter per second per square mile [(m^3/s)/km^2]
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

Table 1.--*Summary of data for the flood of December 25, 1987, for Millington, Tennessee and vicinity*

[square miles, mi^2; cubic feet per second, ft^3/s; cubic feet per second per square mile, (ft^3/s)/mi^2]

Site no.	Stream and location	Contributing drainage area (mi^2)	Peak discharge December 25, 1987 (ft^3/s)	Peak discharge December 25, 1987 [(ft^3/s)/mi^2]	Estimated 100-year discharge (ft^3/s)
07030240	Loosahatchie River near Arlington, Tennessee.	262	27,600	105	a 28,900
07030351	North Fork Creek at U.S. Highway 51 at Millington, Tennessee.	10.8	3,960	367	3,830
070303515	Big Creek at Raleigh-Millington Road at Millington, Tennessee.	87.9	22,300	254	12,800

a Based on the weighting procedure described on page 9 of the report by Randolph and Gamble (1976).

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports Section
Federal Center, Bldg. 810
Box 25425
Denver, Colorado 80225

For additional information write to:

District Chief
U.S. Geological Survey
A-413 Federal Building
U.S. Courthouse
Nashville, Tennessee 37203

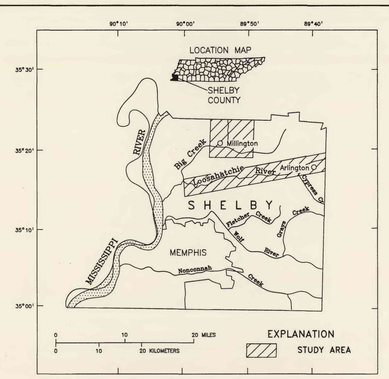

Figure 1.--Location of Big Creek and Loosahatchie River study areas, Shelby County, Tennessee.

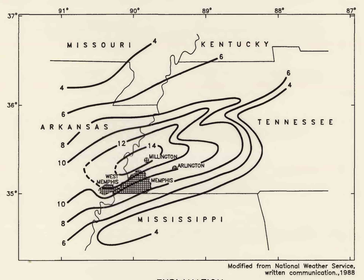

Figure 2.--Total rainfall, 7 a.m. December 23 to 7 a.m. December 27, 1987.

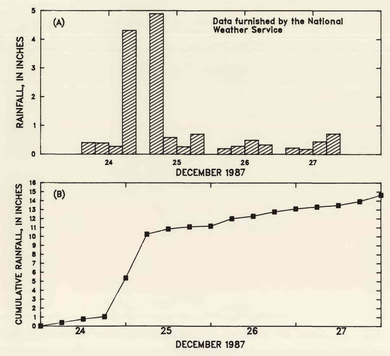

Figure 3.--Rainfall distribution at the U.S. Naval Air Station at Millington, Tennessee, showing (A) six-hour increment totals and (B) cumulative mass curve.

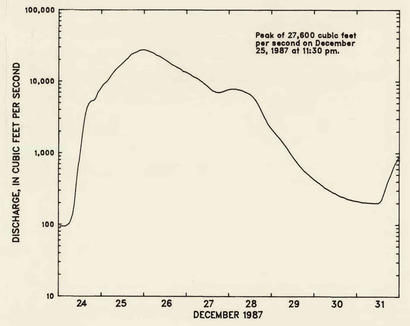

Figure 4.--Discharge for Loosahatchie River near Arlington, Tennessee.

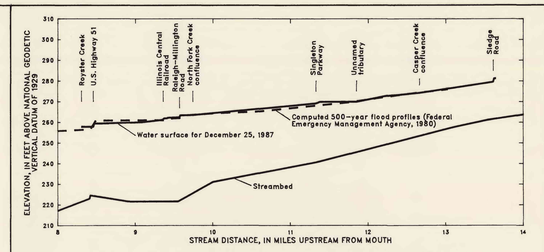

Figure 5.--Water-surface profile for the December 25, 1987, flood on Big Creek at Millington, Tennessee.

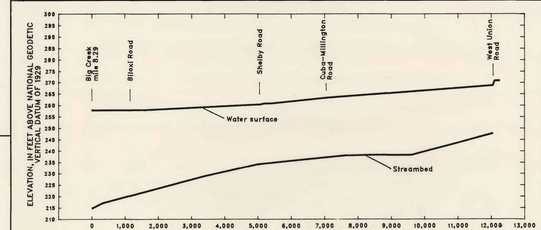

Figure 6.--Water-surface profile for the December 25, 1987, flood on Royster Creek at Millington, Tennessee.

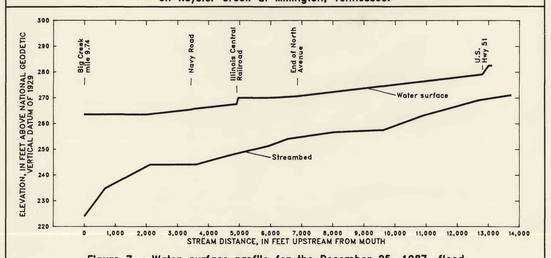

Figure 7.--Water-surface profile for the December 25, 1987, flood on North Fork Creek at Millington, Tennessee.

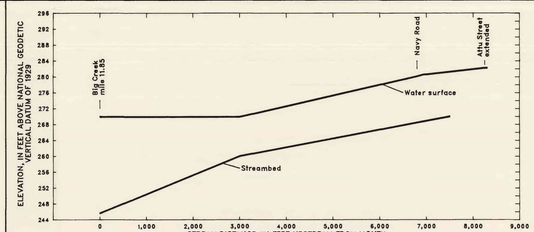

Figure 8.--Water-surface profile for the December 25, 1987, flood on the unnamed tributary to Big Creek at Millington, Tennessee.

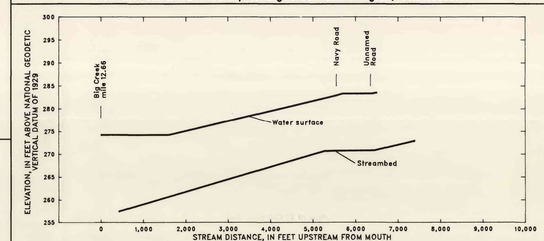

Figure 9.--Water-surface profile for the December 25, 1987, flood on Casper Creek in Millington, Tennessee.

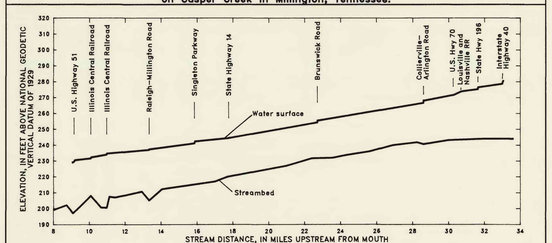

Figure 10.--Water-surface profile for the December 25, 1987, flood on Loosahatchie River, Shelby County, Tennessee.

(Photograph by Delores H. Wages, Millington, Tenn.)

Figure 11.--Flooded funeral home in Millington, Tennessee, December 1987.

(Photograph by W.H. Doyle, U.S. Geological Survey)

Figure 12.--Flood aftermath in Millington, Tennessee, December 1987.

(Photograph by W.H. Doyle, U.S. Geological Survey)

Figure 13.--Flooded house on Raleigh-Millington Road south of Millington, Tennessee, December 1987; flood waters are from the Loosahatchie River.

(Photograph by W.H. Doyle, U.S. Geological Survey)

Figure 14.--Loosahatchie River flood waters over Raleigh-Millington Road at Fite Road, south of Millington, Tennessee, December 1987.

FLOOD OF DECEMBER 25, 1987 IN MILLINGTON, TENNESSEE AND VICINITY

by
James G. Lewis and Charles R. Gamble

1989

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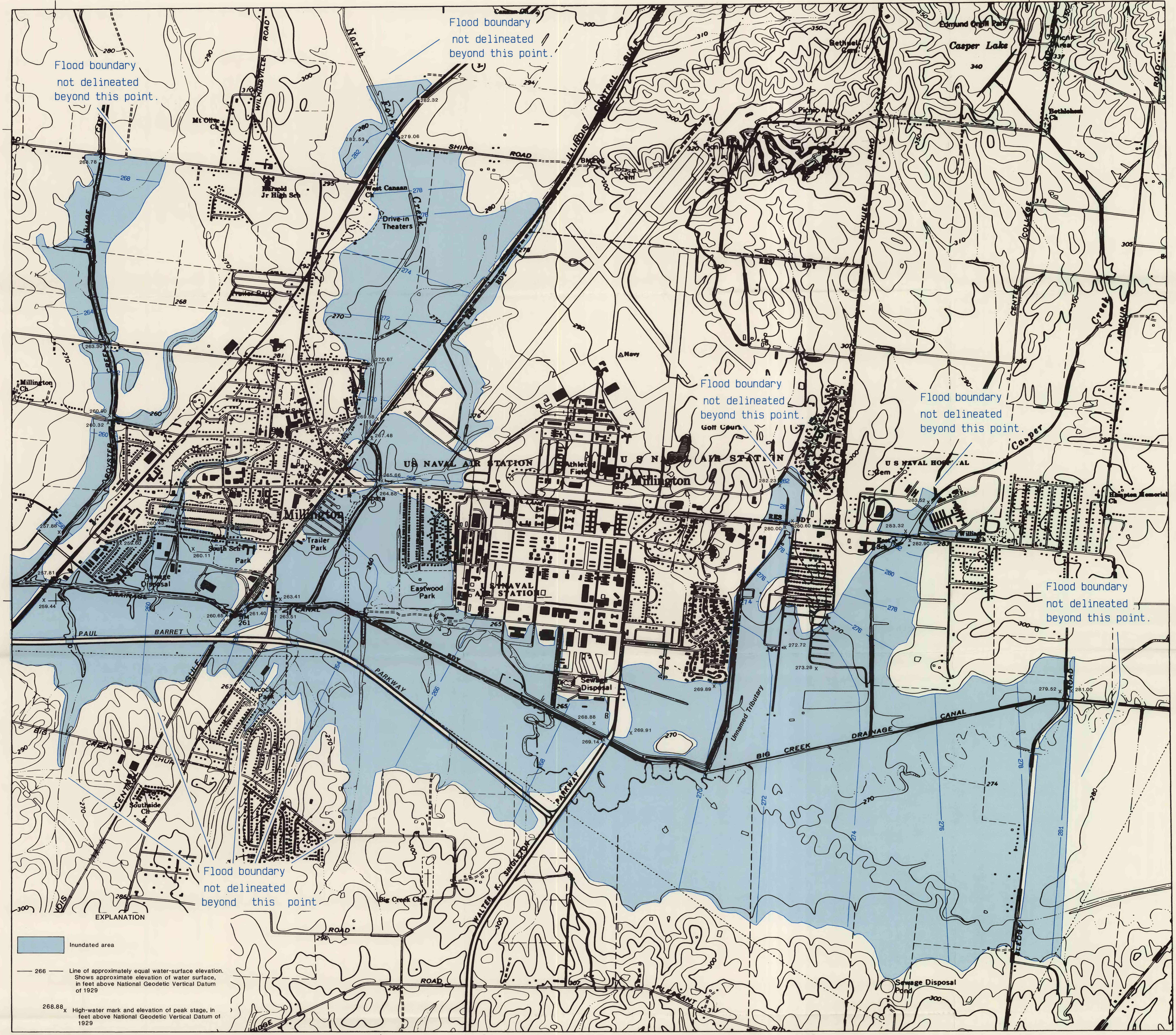
89°55′
89°50′
35°22′
35°20′
Flood boundary not delineated beyond this point.
Flood boundary not delineated beyond this point.
Flood boundary not delineated beyond this point.
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Flood boundary not delineated beyond this point
U S NAVAL AIR STATION
Millington
Casper Lake
North Fork Creek
Big Creek Drainage Canal
Unnamed tributary
Paul Barret Parkway
Walter K. Singleton Parkway
EXPLANATION
Inundated area
266 Line of approximately equal water-surface elevation. Shows approximate elevation of water surface, in feet above National Geodetic Vertical Datum of 1929
268.88 x High-water mark and elevation of peak stage, in feet above National Geodetic Vertical Datum of 1929

BASE FROM U.S. GEOLOGICAL SURVEY
MILLINGTON 1:24,000, 1971, PHOTO REVISED 1983,
AND BRUNSWICK 1:24,000, 1971, PHOTO REVISED
1983. PAUL BARRET PARKWAY AND WALTER K.
SINGLETON PARKWAY MANUALLY ADDED 1989

1 .5 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL IS 10 FEET. DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929

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