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Simulation of Flood Profiles for Catoma Creek near Montgomery, Alabama, 2008

Scientific Investigations Report 2008–5171

U.S. Department of the Interior
U.S. Geological Survey

Cover. Catoma Creek near Hayneville Road, Montgomery, Alabama.

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Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
	Hydraulic gradient	
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Within the study reach, the National Geodetic Vertical Datum of 1929 was an average of 0.03 foot lower than the North American Vertical Datum of 1988.

Abbreviations and Acronyms

FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
HEC-RAS	Hydrologic Engineering Center's River Analysis System
NGVD29	National Geodetic Vertical Datum of 1929
NLCD	National Land Cover Dataset
USGS	U.S. Geological Survey

Simulation of Flood Profiles for Catoma Creek near Montgomery, Alabama, 2008

By K.G. Lee and T.S. Hedgecock

Abstract

A one-dimensional step-backwater model was used to simulate flooding conditions for Catoma Creek near Montgomery, Alabama. A peak flow of 50,000 cubic feet per second was computed by the U.S. Geological Survey for the March 1990 flood at the Norman Bridge Road gaging station. Using this estimated peak flow, flood-plain surveys with associated roughness coefficients, and surveyed high-water marks for the March 1990 flood, a flow model was calibrated to closely match the known event. The calibrated model then was used to simulate flooding for the 10-, 50-, 100-, and 500-year recurrence-interval floods. The 100-year flood stage for the Alabama River also was computed in the vicinity of the Catoma Creek confluence using observed high-water profiles from the 1979 and 1990 floods and gaging-station data.

The results indicate that the 100-year flood profile for Catoma Creek within the 15-mile study reach is about 2.5 feet higher, on average, than the profile published by the Federal Emergency Management Agency. The maximum and minimum differences are 6.0 feet and 0.8 foot, respectively. All water-surface elevations computed for the 100-year flood are higher than those published by the Federal Emergency Management Agency. The 100-year flood stage computed for the Alabama River in the vicinity of the Catoma Creek confluence was about 4.5 feet lower than the elevation published by the Federal Emergency Management Agency. The results of this study provide the community with flood-profile information that can be used for flood-plain mitigation, future development, and safety plans for the city.

Introduction

The future flooding potential of Catoma Creek is of great interest to the City of Montgomery and local residents. Effective flood-plain management and planning depend on the accurate determination of flood profiles. In most cases, the application of both a hydrologic and a hydraulic model is necessary in the computation of flood profiles.

The Federal Emergency Management Agency's (FEMA) flood profiles are being used for flood insurance zoning and planning and design for current and future development. The Flood Insurance Study (FIS) was completed in January 1991 and released in January 1992. Select portions of the study were updated and released in 2003 (Federal Emergency Management Agency, 2003). Approximately 43.5 miles (mi) of Catoma Creek are included in the original FIS. The portion updated in the 2003 study only includes about 1.25 mi of the stream reach. Since the completion of the 1992 study, local residents have questioned the validity of the profiles being used for flood-plain zoning.

The U.S. Geological Survey (USGS), in cooperation with the City of Montgomery, revised the hydrology and flood profiles for an approximately 15-mi reach of Catoma Creek to accurately depict the current flooding potential. These flood profiles are designed to aid Montgomery's engineers and planners in making decisions concerning flood-plain mitigation, future development, current zoning, and evacuation routes.

Purpose and Scope

The purpose of this report is to document the results of an investigation to determine the flood profiles for a reach of Catoma Creek that is about 15 mi long. This reach extends from Norman Bridge Road downstream to the confluence with the Alabama River. Flood profiles were developed for the 10-, 50-, 100-, and 500-year floods by using hydrologic and hydraulic models. Prior to the development of these profiles, the hydraulic model was calibrated to match the March 17, 1990, flood in order to apply the model to other flooding scenarios. The flood-profile information in this report can be used by the community for future planning and design purposes.

Description of the Study Reach

The City of Montgomery is in south-central Alabama in Montgomery County. The county is bound on the northeast by the Tallapoosa River. The Tallapoosa River joins the Coosa River to form the Alabama River, the northwest county boundary. The stream network in the county is made up of several large streams feeding the Tallapoosa and Alabama Rivers. Approximately 70 percent of the surface area of the county drains into the Alabama River, and 18 percent drains into the Tallapoosa River. The large streams contributing flow directly to the Alabama River are Pintlalla Creek and Catoma Creek (fig. 1).

Figure 1. The Catoma Creek basin, Montgomery County, Alabama.

The drainage area of Catoma Creek at the confluence with the Alabama River is 360 square miles (mi^2). This is approximately 45 percent of Montgomery County's total surface area (fig. 1). The major tributaries to Catoma Creek are Ramer Creek (82 mi^2) and Little Catoma Creek (53 mi^2). The study reach is a 15-mi portion of Catoma Creek that extends from the USGS streamgage (USGS 02421000) at Norman Bridge Road to the confluence with the Alabama River. The study reach contains 7 roadway crossings (including railroads) consisting of 13 hydraulic structures. The mean slope of the channel in the study reach is 2 feet per mile (ft/mi). The stream flows in a northwesterly direction and has a mean bankfull width of 190 feet (ft) with minimum and maximum widths of 90 and 570 ft, respectively. Bankfull width is the width between the top left and right channel banks for a stream channel. The average flood-plain width (headwater flooding only) is 5,600 ft and ranges from about 880 to 10,300 ft.

Flood History

Two types of storms are associated with floods in Alabama—frontal systems and tropical storms. The intense precipitation associated with tropical storms and hurricanes, thunderstorms, and slow-moving frontal systems usually result in flooding. The flooding potential is increased when rivers and creeks are already swollen from spring runoff. The mean annual precipitation varies seasonally and geographically. The statewide mean rainfall is about 55 inches and varies from about 50 inches in central and west-central Alabama to about 65 inches near the Gulf of Mexico (Paulson and others, 1991).

Past flooding on Catoma Creek has affected many residents of Montgomery County. The USGS has operated a streamflow gaging station (USGS 02421000) at the Norman Bridge Road crossing of Catoma Creek since June 1952. Streamflow records indicate significant flooding along the creek in 1961, 1975, and 1990. Minor flooding also occurred in 1949, 1958, 2001, and 2005 (table 1).

A portion of the study reach is directly affected by river flooding as a result of backwater. The downstream boundary of the study reach is at the confluence of Catoma Creek with the Alabama River. To determine the effect of the Alabama River on Catoma Creek, data from the Alabama River streamgage (USGS 02420000) upstream from the confluence was examined along with measured flood profiles for the 1979 and 1990 floods. The Alabama River streamgage is approximately 5.5 mi upstream from the confluence. Inspection of streamgage data indicates that significant flooding occurred on the Alabama River in 1886, 1888, 1929, 1948, 1961, 1979, and 1990. Record-high concurrent flooding on the Alabama River and Catoma Creek occurred in 1961 and 1990. Both floods are calculated to be greater than a 50-year recurrence interval flood for the Alabama River and Catoma Creek streamgages (Hedgecock and Feaster, 2007).

Table 1. Historical flood flows at the Catoma Creek streamgage (USGS 02421000) near Montgomery, Alabama.

[ft^3/s, cubic feet per second; ft, feet; +, plus]

Water year[1]	Date	Discharge (ft^3/s)	Gage height (ft)	Approximate recurrence interval (years)
1949	Nov. 28	[2]38,300	27.50	25+
1958	Mar. 8	25,600	25.70	10+
1961	Feb. 25	48,600	[3]28.60	50+
1975	Feb. 17	43,900	28.13	25+
1990	Mar. 17	50,000	29.78	50+
2001	Mar. 4	28,600	27.20	10+
2005	Mar. 28	28,300	27.14	10+

[1] Water year is the period October 1 to September 30 and is designated by the year in which the period ends.

[2] Discharge is a historic peak. Historic peaks are annual maximum observations that occurred outside any period(s) of systematic data collection.

[3] Gage height is an estimate.

Flood of 1961

During February 17–26, 1961, Alabama, Florida, Georgia, Louisiana, and Mississippi had widespread, prolonged flooding. A succession of three large storms produced accumulated rainfall totals as high as 18 inches in central and southern Alabama (fig. 2). This series of storms produced the annual maximum peak at the Catoma Creek streamgage for the 1961 water year. The peak flow value of 48,600 cubic feet per second (ft^3/s) is slightly larger than the 50-year recurrence interval flood (Hedgecock and Feaster, 2007). Many small streams had flooding that became superimposed in the large rivers to produce record peak flows (Barnes and Somers, 1961). The 1961 flood was also an extreme event for the Alabama River near the Montgomery streamgage, where the recorded peak discharge also was calculated to be greater than a 50-year recurrence interval flood. Flood stages of this magnitude had not been experienced since 1886. The extreme variations in intensity produced prolonged inundation. The Alabama River remained above flood stage for 19 days (Barnes and Somers, 1961).

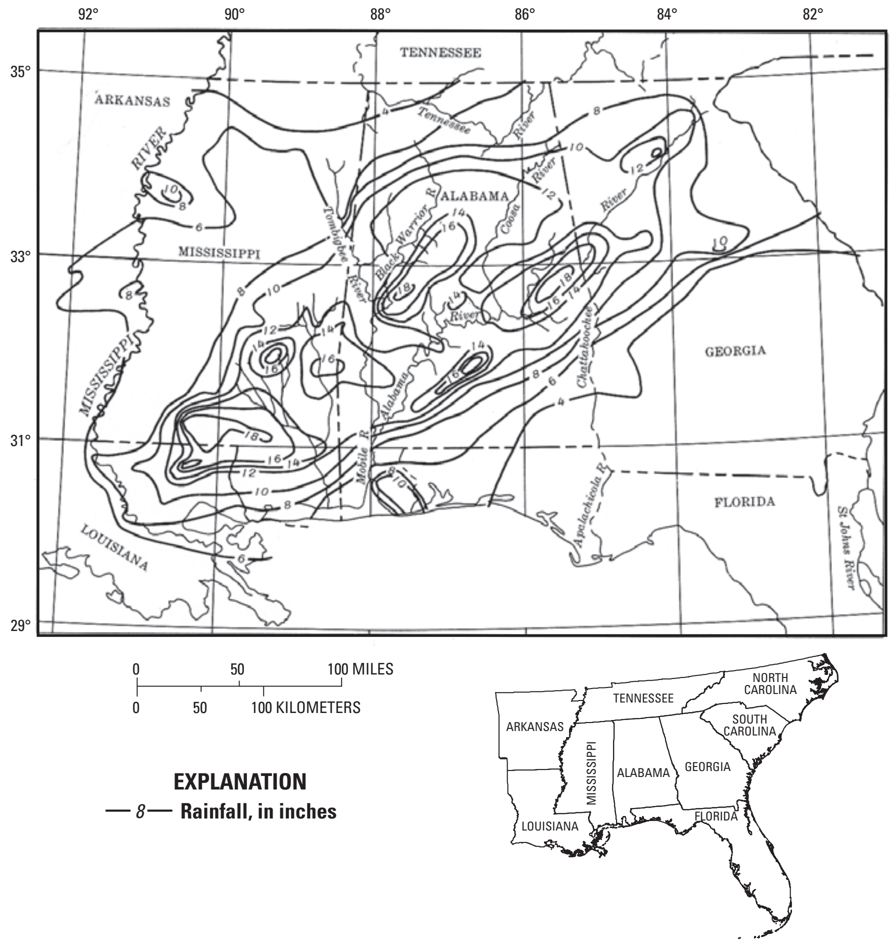


Figure 2. Isohyetal map of the Southeastern States showing storm rainfall, February 23–26, 1961 (modified from Rostvedt, 1961, p. 8).

Flood of 1990

Alabama, Georgia, and Florida sustained substantial flooding during 1990 as a result of three separate events during February, March, and December. Throughout the three-State region, 74 gaging stations exceeded previously recorded maximum streamflows, and 46 exceeded the 100-year flood flow (Pearman and others, 1991).

The calendar year began with above-average rainfall during January. The first flood occurred as a result of heavy rainfall during February 15–16 (fig. 3). The west-central and northeastern counties of Alabama incurred most of the rainfall, with totals ranging from 4 to 8 inches (Jordan and Combs, 1996). The March flood affected a greater portion of the State (fig. 3). The rainfall began on March 15 in southwestern Alabama and proceeded northeastward on March 16. Rainfall ranged from 8 to 13 inches across most of southwestern and south-central Alabama with local highs in other areas. About 35 percent of the State had 2-day rainfall totals exceeding 8 inches (Pearman and others, 1991). The lines of equal recurrence intervals shown in figure 4 are based on streamgage data for unregulated and unurbanized streams with drainage areas between 10 and 1,000 mi^2. The Catoma Creek streamgage recorded a record-breaking peak discharge of 50,000 ft^3/s on March 17. This flood was calculated to be greater than a 50-year recurrence interval. Based on historical high-water marks, approximately 5.7 mi of Catoma Creek (measured from the mouth) was affected by river flooding in 1990. Stage values recorded at the Alabama River streamgage indicate that the 1990 flood stage was 4 ft lower than the 1961 flood. The 1990 flood, however, had a higher peak discharge, which is thought to be a result of the effects of regulation and channel modifications that occurred after 1961.

Acknowledgments

Special thanks are given to Chris Conway, City Engineer, and John Trevor, Engineering Services, of the City of Montgomery for their assistance with this study.

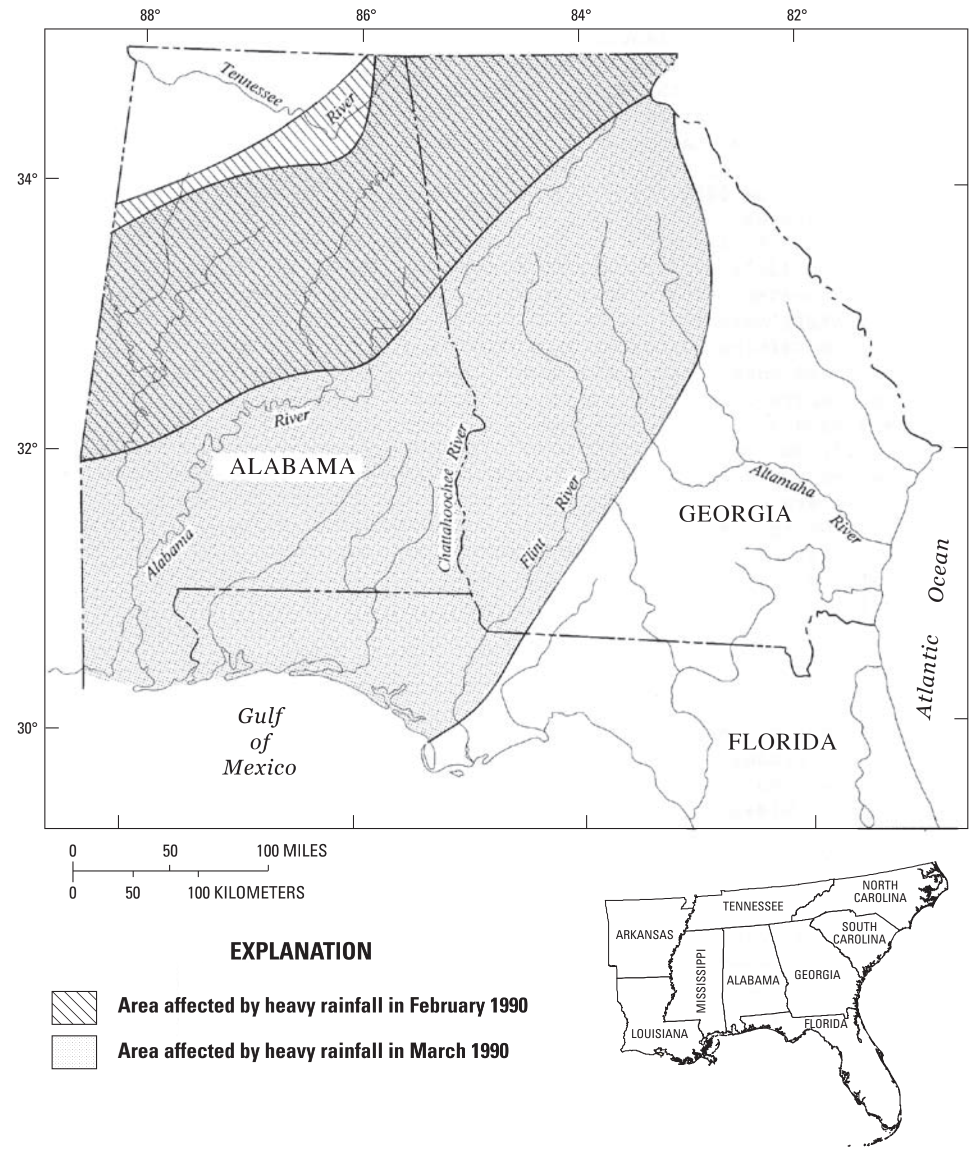


Figure 3. Areas of Alabama, Georgia, and Florida affected by heavy rainfall in February and March 1990 (modified from Pearman and others, 1991, p. 4).

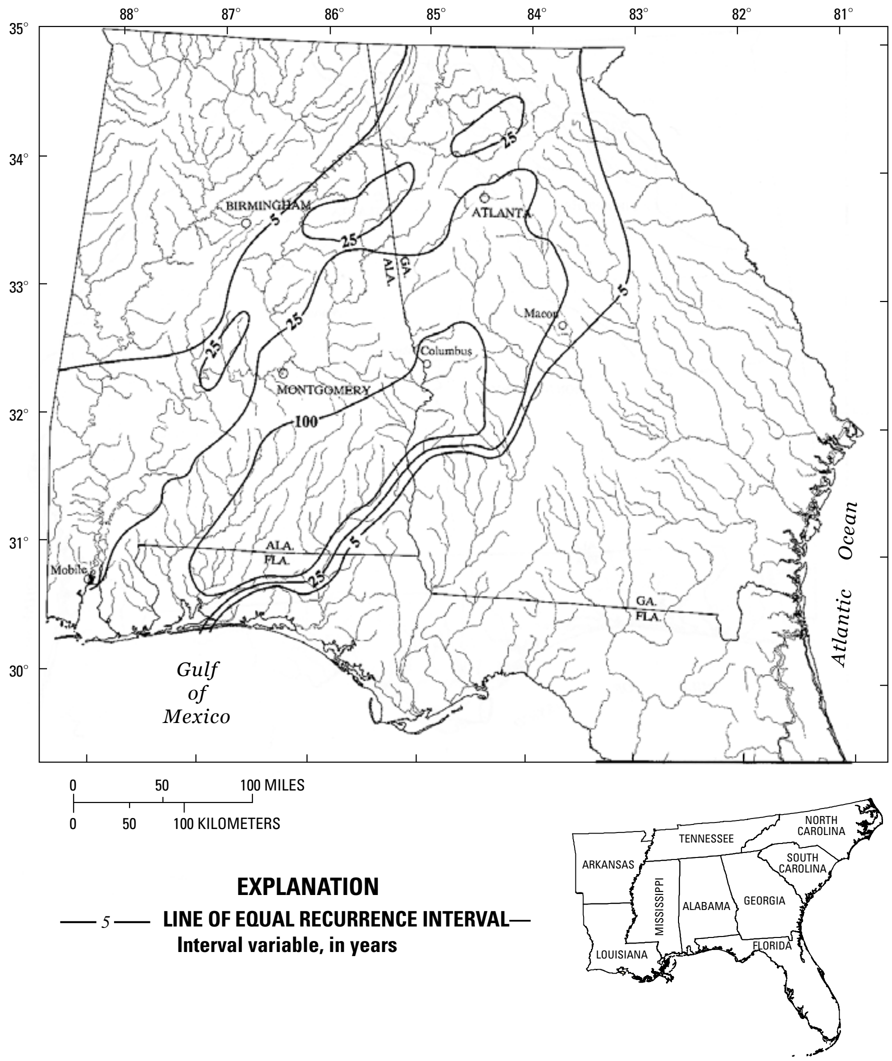


Figure 4. Locations of lines of equal recurrence intervals for March 1990 peak discharges for unregulated and unurbanized streams in Alabama, Georgia, and Florida (modified from Pearman and others, 1991, p. 10).

Approach

New flood profiles were developed through (1) field data collection, (2) hydrologic analyses, and (3) hydraulic modeling for the 10-, 50-, 100-, and 500-year floods by using hydrologic and hydraulic models. Prior to the development of these profiles, the hydraulic model was calibrated to closely match the surveyed high-water marks from the March 17, 1990, flood to increase the accuracy of the results provided by this study.

Data Collection

In order to accurately represent the stream-channel and flood-plain geometry of the reach, field surveys were conducted. Six flood-plain cross sections were surveyed by USGS personnel using an electronic total station in December 2007 (fig. 5). Cross-section data also were obtained from the Alabama Department of Transportation (fig. 6). The geometry of all drainage structures and adjacent roadways was measured. The study reach includes 4 roadway crossings and 3 railroad crossings consisting of 13 hydraulic structures (fig. 7). Four high-water marks from the March 17, 1990, flood also were surveyed by USGS personnel for model-calibration purposes. Three of these high-water marks were provided by local residents who experienced the 1990 flood. The fourth high-water mark was recorded at the USGS gaging station on Catoma Creek. The high-water marks define a 70,938-ft reach of the flood profile extending from river station 1,709 to 72,647 and were all considered to be reliable. A river station was defined for each cross section, hydraulic structure, and high-water mark. River stationing for the study reach is arbitrary and

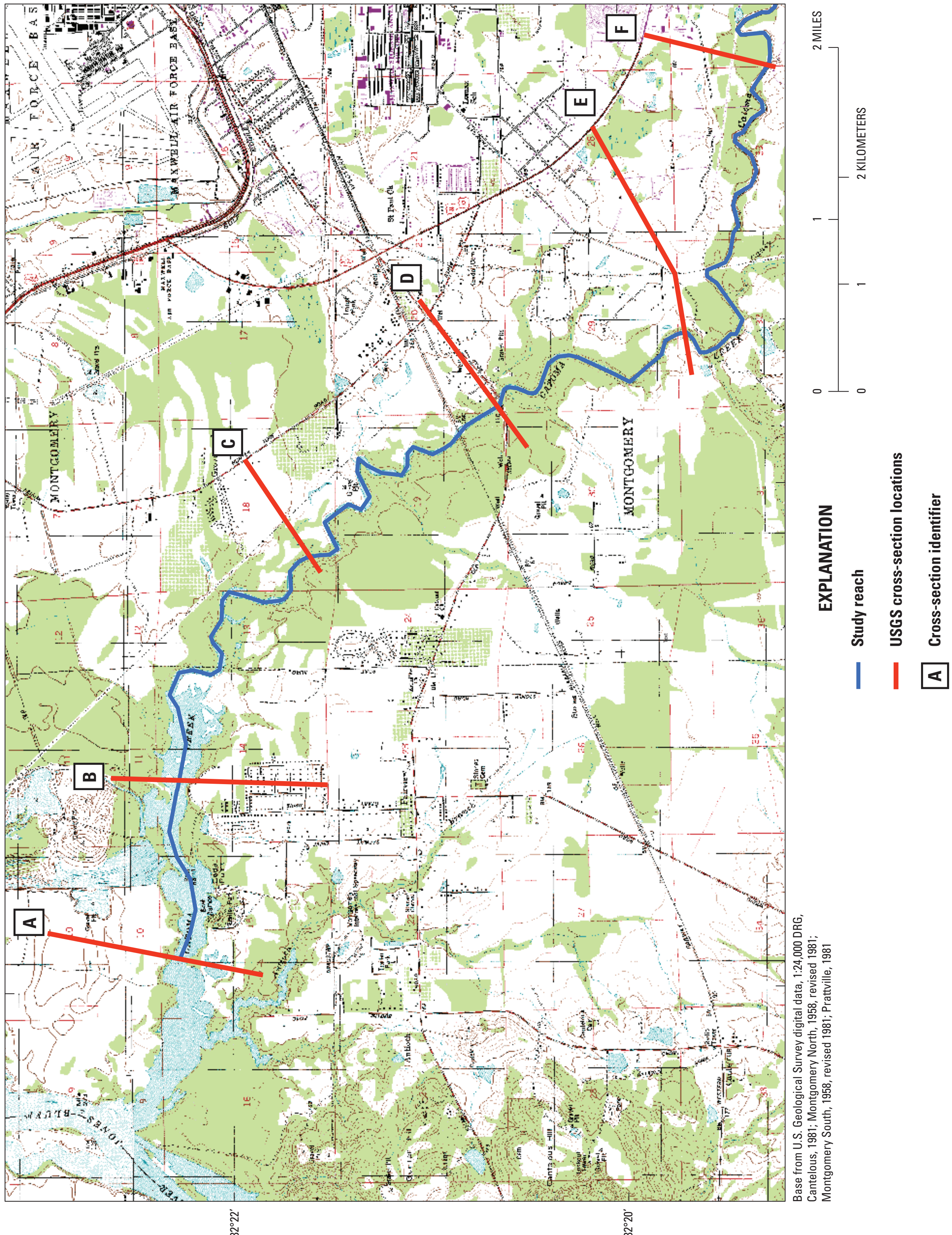


Figure 5. Approximate locations of cross sections A–F in the Catoma Creek study reach.

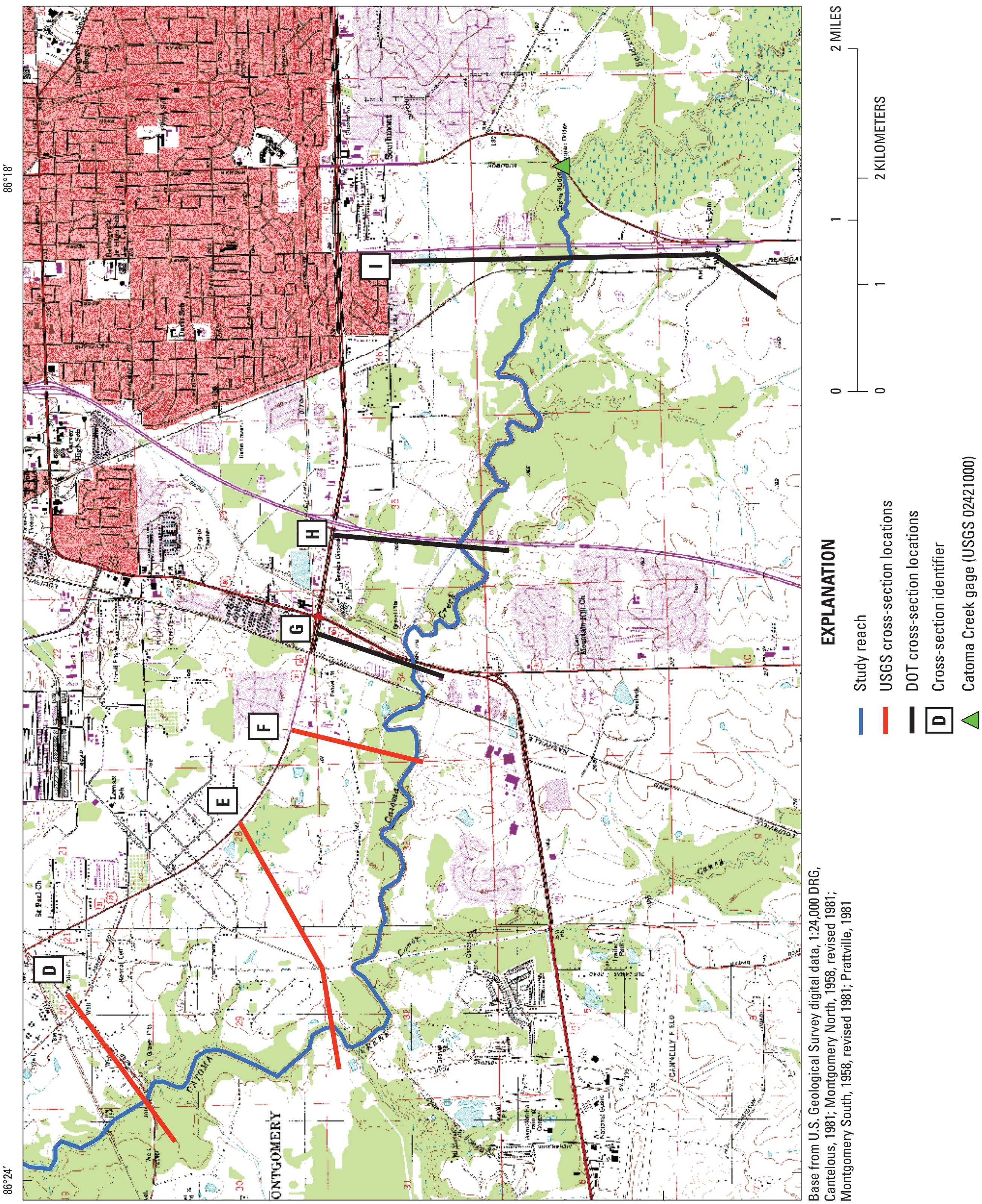


Figure 6. Approximate locations of cross sections D–I in the Catoma Creek study reach.

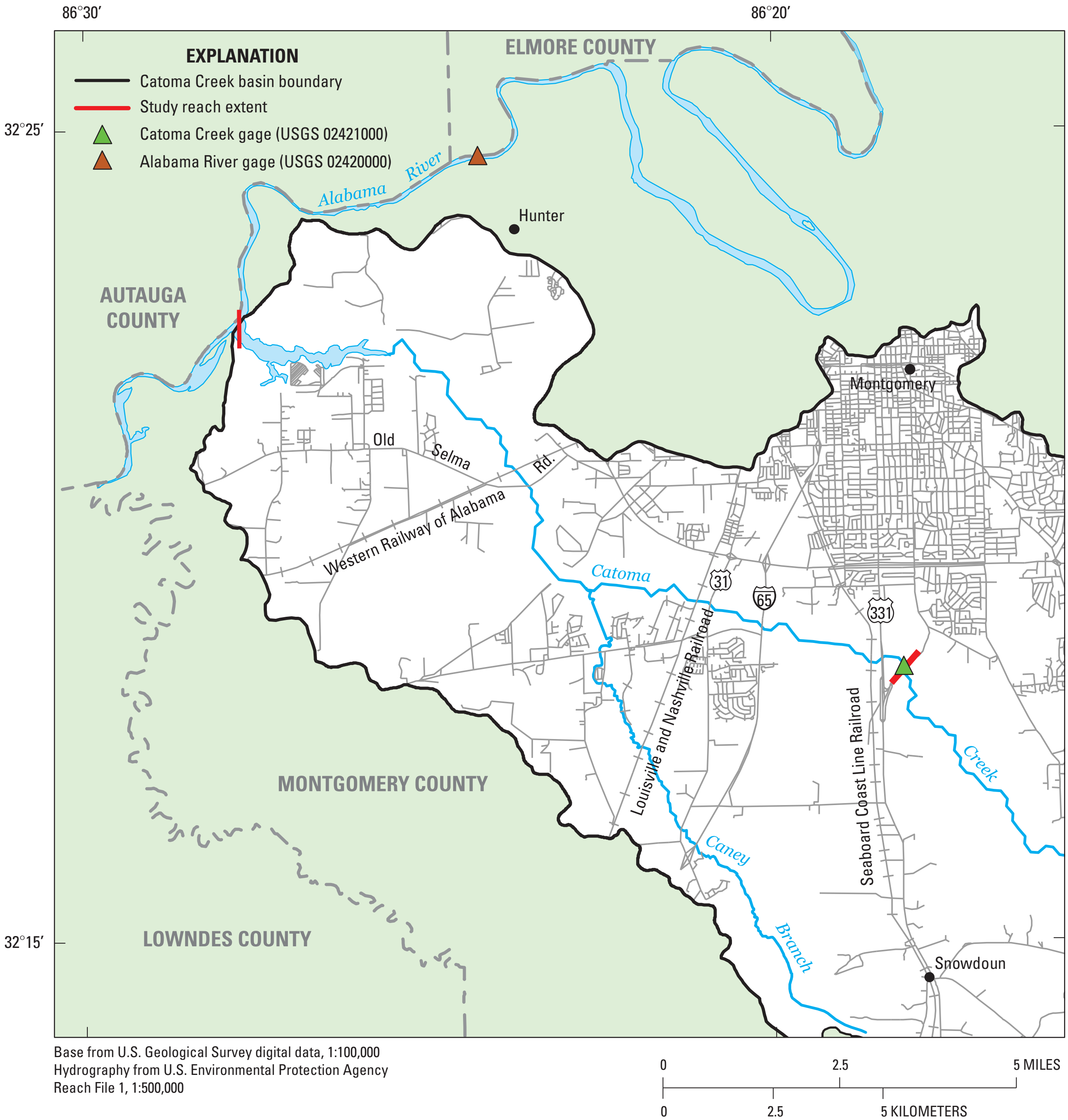


Figure 7. Catoma Creek study reach, Montgomery County, Alabama.

is referenced from the downstream-most cross section (section A), which is river station zero. Cross section A is approximately 5,800 ft above the mouth of Catoma Creek.

Inspection of the 2001 National Land Cover Dataset (NLCD; Multi-Resolution Land Characteristics Consortium, 2006), showed that the land cover of the drainage basin is characterized by grassy fields (30 percent) and wooded areas (57 percent) with moderate vegetative undergrowth. Approximately 12 percent of the drainage basin is covered by residential development, which typically has minimal or maintained vegetative growth and areas of ineffective flow. The remaining 1 percent of the basin is described as open water (fig. 8).

Roughness characteristics for the reach were assessed from field investigations and aerial photography (2002). Manning's roughness coefficients were selected to reflect current conditions and the conditions during the 1990 flood. Manning's roughness coefficients and geometric conditions were calibrated to provide the best match to the surveyed 1990 flood profile. The hydraulic parameters were then adjusted slightly to reflect current conditions. Manning's roughness coefficients ranged from 0.04 to 0.06 for the channel and from 0.04 to 0.16 for the overbank areas. Photographs of the cross sections and the surrounding area are included as appendix figures A1–A24.

Hydrologic Analyses

The Catoma Creek drainage basin at the confluence with the Alabama River drains 360 mi^2. The upstream extent of the study reach, Norman Bridge Road, has a drainage area of 290 mi^2. To accurately represent the change in contributing area, two subreaches were defined. The first subreach extends from Norman Bridge Road to the confluence with Caney Branch (fig. 7). The second subreach extends from Caney Branch to the confluence of Catoma Creek and the Alabama River (figs. 5 and 6). Peak flows were computed for the 1990 flood, and for the 10-, 50-, 100-, and 500-year floods for Catoma Creek at the Norman Bridge Road (gaged site) crossing and at Caney Branch (ungaged site, tables 2, 3).

Hydrologic analyses were conducted using streamflow gaging-station data and the USGS rural regression equations and procedures outlined in Hedgecock and Feaster (2007). The rural regression equations are based on peak-flow data collected through September 2003 at 216 rural gaging stations having 10 or more years of record. The logarithms of the annual peaks were fitted to a Pearson Type III distribution to determine the frequency of peak discharge. Multiple regression equations were developed for estimating peak discharges having recurrence intervals of 1.5-, 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-years. The explanatory variable affecting peak discharge is drainage area. Average standard errors of prediction for the relations in this hydrologic area range from $\pm$23 to $\pm$30 percent for the 10- to 500-year recurrence interval flows.

The USGS has operated a streamflow gaging station on Catoma Creek (USGS 02421000) at Norman Bridge Road since June 1952. The peak flow for the March 17, 1990, flood was determined to be 50,000 ft^3/s (table 2). Recurrence intervals for flood estimates at this site were determined by weighting the regional and station flood estimates for the specified recurrence interval using the number of years of station record and the accuracy of the regional flood-frequency relations expressed as equivalent years of record. The 1990 flood peak and computed recurrence-interval peaks for the Catoma Creek gage were transferred downstream to the confluence with Caney Branch by using the transfer equation outlined in Hedgecock and Feaster (2007). The transfer equation is based on the drainage area ratio with a regional slope exponent.

Alabama River

The 100-year flood stage for the Alabama River was computed in the vicinity of the Catoma Creek confluence using observed high-water profiles from the 1979 and 1990 floods, gaging station data from the Alabama River gage near Montgomery (USGS 02420000), and the published 100-year flow (308,000 ft^3/s) for the gage (Hedgecock and Feaster, 2007).

Table 2. Computed peak flows for the March 17, 1990, flood for Catoma Creek near Montgomery, Alabama.

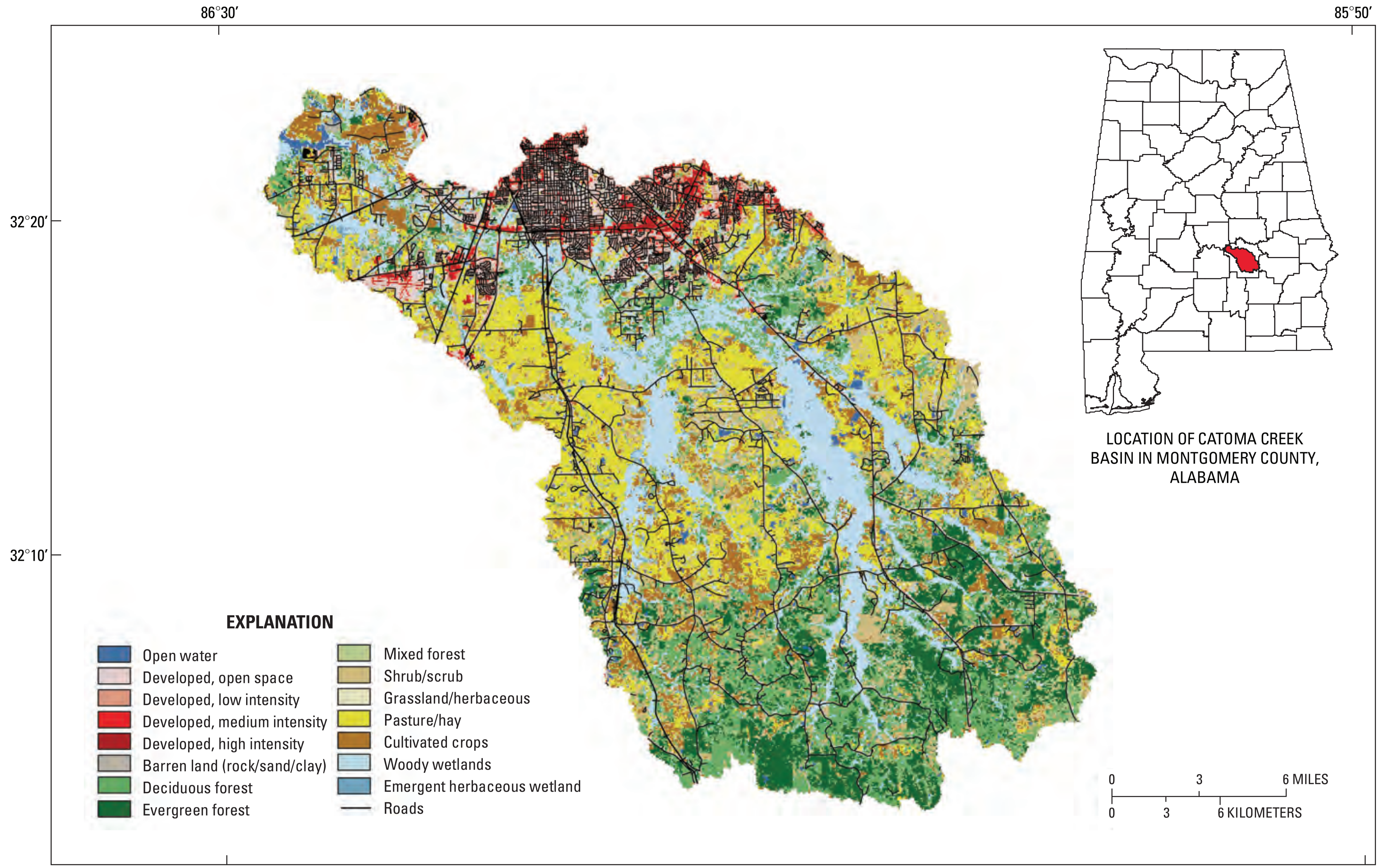
[ft, feet; mi^2, square miles; ft^3/s, cubic feet per second]

River station (ft)	Location	Drainage area (mi^2)	Peak flow (ft^3/s)
38,633	Mouth of Caney Branch	330	53,900
72,513	Norman Bridge Road (USGS 02421000)	290	50,000

Table 3. Computed peak flows for current (2008) conditions for Catoma Creek near Montgomery, Alabama.

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

River station (ft)	Location	Drainage area (mi^2)	10-year peak flow (ft^3/s)	50-year peak flow (ft^3/s)	100-year peak flow (ft^3/s)	500-year peak flow (ft^3/s)
38,633	Mouth of Caney Branch	330	27,200	49,600	61,800	98,400
72,513	Norman Bridge Road (USGS 02421000)	290	25,200	46,000	57,300	91,100



Base from U.S. Geological Survey National Land Cover Data, from Landsat-7 Thematic Mapper images 30-meter resolution, 2001

Figure 8. Land-cover data for the Catoma Creek basin.

The 1979 and 1990 floods had almost identical water-surface slopes for approximately 41 river miles below the gage. Both floods represent events occurring in modern time (post 1961) in which the dam locations and channel configuration represent current conditions. The rating (stage-discharge relation) for the gage was transferred downstream about 3 river miles using the average slope (fall relation) of the 1979 and 1990 floods to yield a 100-year flood stage of 155.0 ft. At this location the Catoma Creek and Alabama River share a common flood plain. The 100-year flood stage computed for the Alabama River in the vicinity of the Catoma Creek confluence was about 4.5 ft lower than the elevation published by FEMA. The differences in computed water-surface elevations are likely because of the use of a stepback-water model by FEMA (Federal Emergency Management Agency, 2003) as opposed to application of a fall relation used by USGS. This fall relation is based on detailed high-water profiles (1979 and 1990 floods) and stage-discharge information from the Alabama River gage near Montgomery (USGS 02420000).

Hydraulic Modeling

The Hydrologic Engineering Center's River Analysis System (HEC-RAS; U.S. Army Corps of Engineers, 2002) was selected as the model to simulate flood flow in the Catoma Creek basin. The HEC-RAS model was used to calculate the water-surface profiles for both gradually and rapidly varied steady flow. The gradually varied flow results of the model are based on the solution of the one-dimensional energy equation. The energy losses considered are those of friction and contraction and expansion. The frictional losses are computed by using Manning's equation. The contraction and expansion losses are computed as a function of the velocity head. In the areas of rapidly varied flow, the momentum equation is used in the model.

Model Calibration

Input data were entered and checked, and the computational component of the HEC-RAS model was used to simulate the March 17, 1990, flood profile. The initial output showed that the simulated water-surface elevation was higher in some areas (primarily between sections D and F) than the flood profile interpolated between measured high-water marks. Roughness values were adjusted slightly to improve agreement with the 1990 flood profile. The roughness values used were taken from topographic maps and aerial photography reflective of the land cover of that time period. The computed water-surface profile (table 4) was calibrated within 0.1 ft of the observed high-water marks from the 1990 flood. A plot showing the comparison of the computed flood profile to measured high-water marks is shown in figure 9. Two of the seven roadway crossings were overtopped by the 1990 flood—Old Selma Road, and the Seaboard Coast Line Railroad (fig. 7).

Table 4. Difference between observed and computed water-surface profiles for the March 1990 flooding of Catoma Creek near Montgomery, Alabama.

[ft, feet; HEC-RAS, Hydrologic Engineering Center's River Analysis System; —, no data; see figures 5 and 6 for cross-section locations]

River station (ft)	Cross-section identifier	Observed water-surface elevation (ft)	HEC-RAS computed water-surface elevation (ft)	Difference between observed and computed water-surface elevations (ft)
25,236	—	152.0	151.9	0.1
26,288	—	153.0	153.1	0.1
52,518	Section G	171.6	171.6	0.0
72,647	—	180.8	180.8	0.0

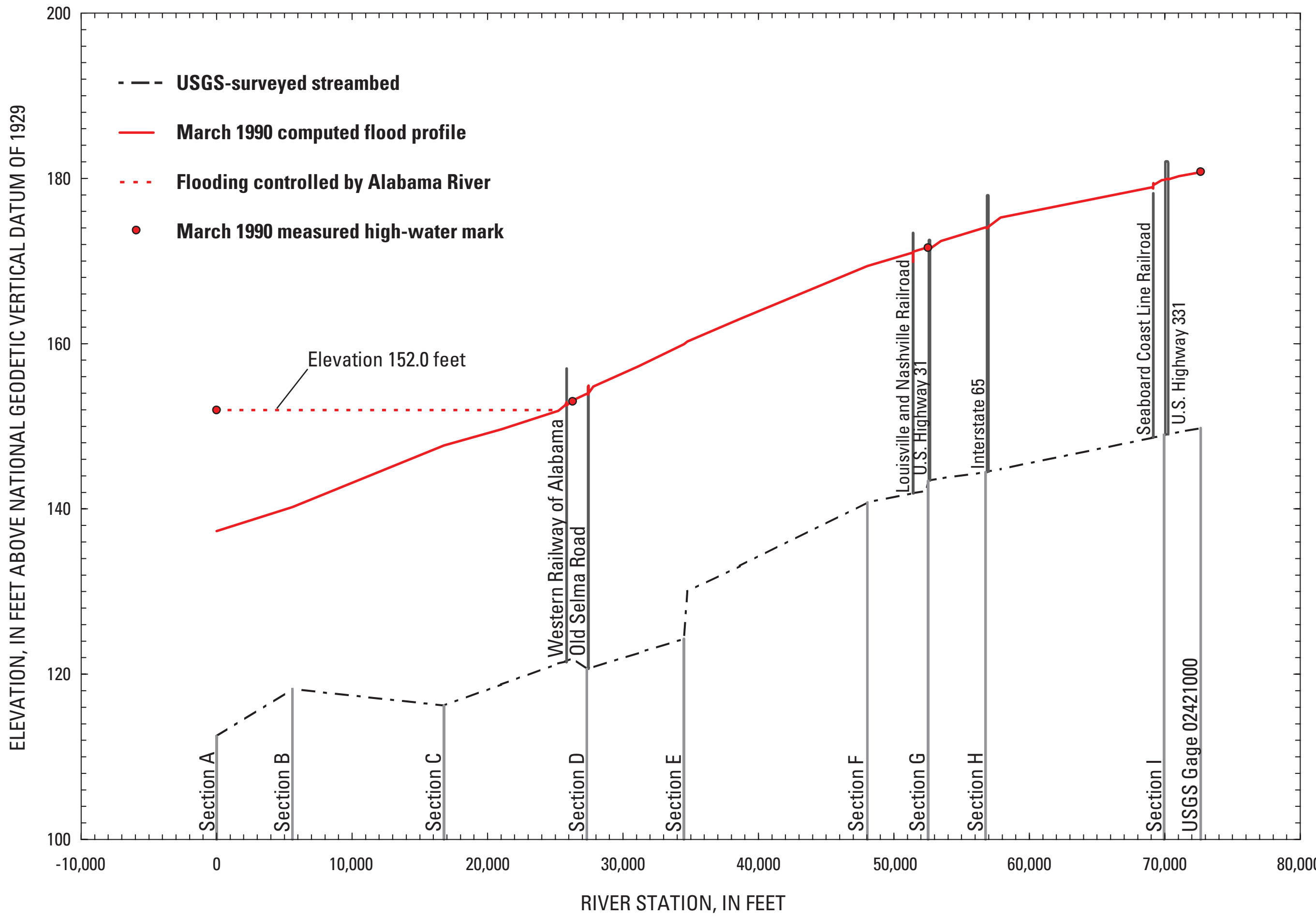


Figure 9. Computed and observed flood profiles for the March 1990 flood for Catoma Creek near Montgomery, Alabama. (See figures 5 and 6 for locations of cross sections.)

Simulation of Flood Flows

After the model was successfully calibrated to the 1990 flood, the 10-, 50-, 100-, and 500-year flood flows were simulated. Manning's roughness coefficient was slightly altered from the 1990 values to reflect current conditions. The resulting water-surface profiles represent the flooding potential for current flood-plain conditions (fig. 10). Water-surface elevations corresponding to these profiles are listed in table 5. Some water-surface elevations at the downstream face of a bridge can be lower than those at the next section downstream. This is because of the simulated drawdown effect.

The results of the simulation indicate that for the 100-year recurrence interval, the flood profile for Catoma Creek was about 2.5 ft higher, on average, than the profile published in the FEMA study (table 6). The maximum and minimum differences were 6.0 ft and 0.8 ft, respectively. All water-surface elevations (headwater flooding only) computed for the 100-year flood were higher than those published by FEMA (table 6; fig. 11). The differences in computed water-surface elevations may be attributed to: hydraulic structure changes, different hydraulic models, different modeling techniques, differences in the quality of flood-plain surveys used in the model, and differences in land cover (Manning's roughness coefficient). Flood discharges, however, were similar for both studies.

The mean flood-plain depth for the 100-year flood (headwater flooding only) was computed for each cross section by dividing the effective flow area by the total top width of flow. These depths ranged from about 3 ft just downstream from section D (fig. 5) to about 14 ft about 600 ft downstream from the Western Railway (fig. 7). It should be noted that these are mean values based on the flood-plain conditions on either side of the channel (overbank region). The actual depth varies throughout the flood plain based on the local ground-surface elevation. The elevations of the 100-year flood were compared to the elevations of local roadways and railroads in Montgomery to determine the depth of overtopping (table 7).

The mean top width of flow (headwater flooding only) for the study reach for the 100-year flood was about 5,600 ft. This value varied from section to section based on the geometry of the flood plain. For instance, the flow at section B had a top width of about 880 ft. The maximum top width of flow of 10,305 ft occurred about 800 ft upstream from U.S. Highway 331. This information is provided to show that the mean value of top width of flow is for the entire reach and is not indicative of every cross section.

Table 5. Computed flood profiles for current (2008) conditions for Catoma Creek near Montgomery, Alabama.

[ft, feet; —, no data; see figures 5 and 6 for cross-section locations]

River station (ft)	Cross-section identifier/ roadway crossing	10-year water-surface elevation (ft)	50-year water-surface elevation (ft)	100-year water-surface elevation (ft)	500-year water-surface elevation (ft)
0	Section A	130.7	136.5	138.7	143.6
5,590	Section B	134.0	139.4	141.6	146.4
16,787	Section C	141.7	146.8	149.2	154.4
21,012	—	143.8	148.8	151.3	156.3
25,236	—	146.5	151.1	153.8	158.2
25,738	—	147.0	151.8	154.4	158.5
25,838	Section D	147.3	152.1	154.6	158.2
25,839	Western Railway of Alabama	—	—	—	—
25,858	—	147.0	151.8	154.2	158.3
26,288	—	147.4	152.3	154.9	160.4
27,325	—	148.0	153.1	155.6	160.8
27,425	—	148.1	153.0	155.4	160.8
27,426	Old Selma Road	—	—	—	—
27,455	—	148.2	153.2	155.5	160.9
27,805	—	148.6	154.0	156.5	161.2
31,151	—	151.3	156.5	158.6	162.5
34,496	Section E	154.7	159.4	160.8	163.8
34,746	—	155.2	159.8	161.0	164.0
38,633	—	158.2	162.6	163.6	166.0
48,042	Section F	165.8	169.0	170.1	172.3
51,308	—	167.5	170.5	171.7	174.3
51,408	—	167.5	170.5	171.7	174.2
51,409	Louisville and Nashville Railroad	—	—	—	—
51,428	—	167.6	170.7	171.9	174.6
52,388	—	167.9	171.1	172.4	175.3
52,518	Section G	167.9	171.1	172.4	175.2
52,583	—	167.9	171.0	172.3	175.1
52,584	U.S. Highway 31	—	—	—	—
52,668	—	167.9	171.0	172.3	175.8
53,478	—	168.4	171.9	173.3	176.7
56,773	Section H	170.2	173.5	175.0	178.3
56,873	—	170.2	173.4	174.8	178.0
56,874	Interstate 65	—	—	—	—
56,983	—	170.4	173.7	175.0	179.4
57,883	—	171.2	174.7	176.2	180.7
69,043	—	176.0	179.2	180.5	183.9
69,143	—	176.0	179.1	180.4	184.0
69,144	Seaboard Coast Line Railroad	—	—	—	—
69,163	—	176.0	179.4	180.7	184.0
69,773	—	176.3	179.9	181.1	184.2
69,943	Section I	176.3	179.9	181.1	184.2
70,043	—	176.4	179.9	181.1	184.2
70,044	U.S. Highway 331	—	—	—	—
70,247	—	176.4	180.0	181.2	184.6
71,047	—	176.7	180.3	181.6	184.9
72,547	—	177.1	180.7	182.0	185.2
72,647	—	177.2	180.7	182.0	185.2

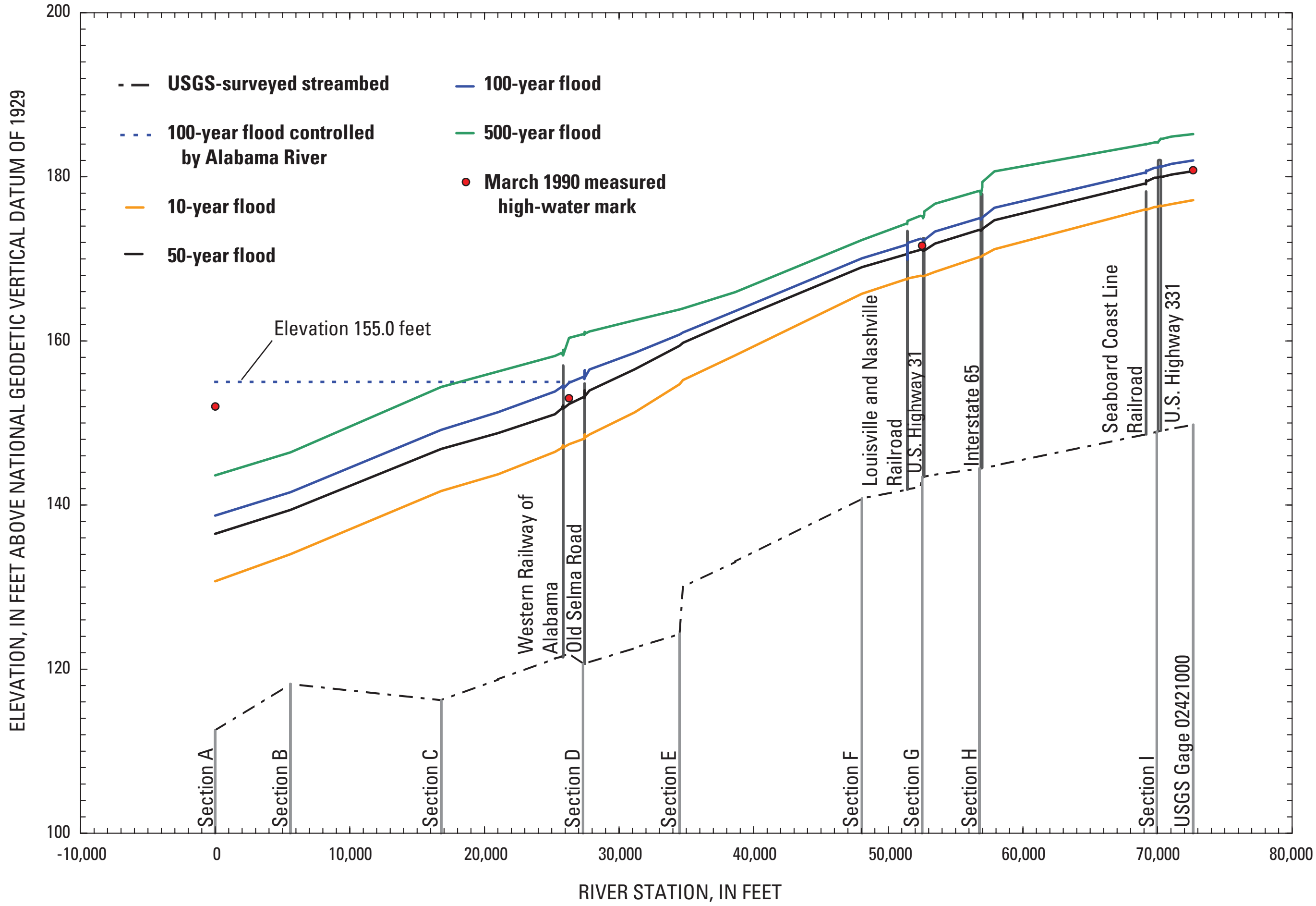


Figure 10. Computed flood profiles for current conditions for Catoma Creek near Montgomery, Alabama. (See figures 5 and 6 for locations of cross sections.)

Table 6. U.S. Geological Survey and Federal Emergency Management Agency computed 100-year flood elevations for Catoma Creek near Montgomery, Alabama.

[ft, feet; see figure 7 for roadway crossing locations; USGS, U.S. Geological Survey; FEMA, Federal Emergency Management Agency]

River station (ft)	Roadway crossing	USGS 100-year water-surface elevation (ft)	FEMA 100-year water-surface elevation (ft)[1]	Difference (ft)
25,839	Western Railway of Alabama	154.6	148.6	6.0
27,426	Old Selma Road	155.6	150.6	5.0
51,409	Louisville and Nashville Railroad	171.7	170.0	1.7
52,584	U.S. Highway 31	172.4	171.6	0.8
56,874	Interstate 65	175.0	174.2	0.8
69,144	Seaboard Coast Line Railroad	180.5	177.9	2.6
70,044	U.S. Highway 331	181.1	179.3	1.8
72,647	Norman Bridge Road	182.0	180.4	1.6

[1] Federal Emergency Management Agency, 2003.

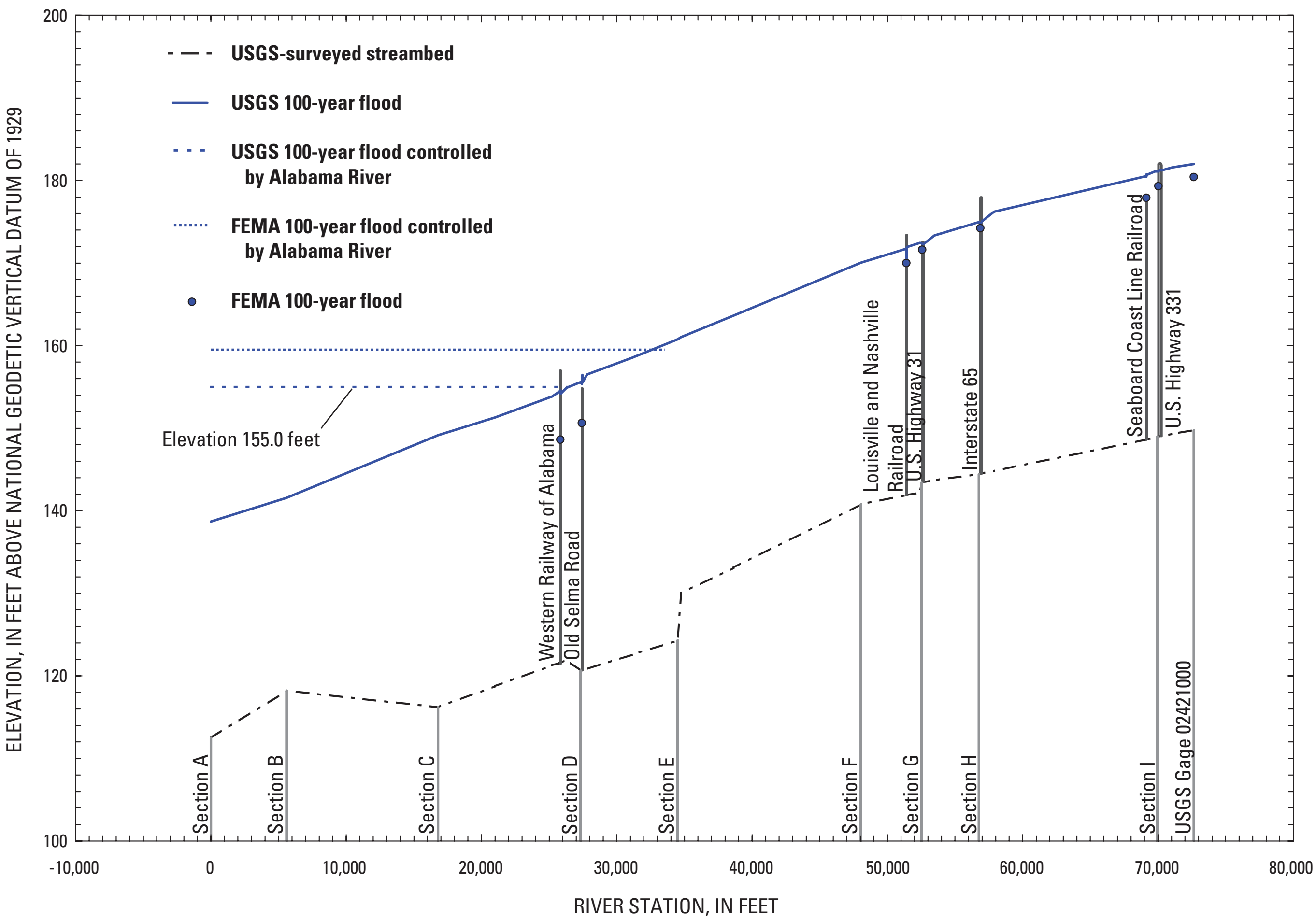


Figure 11. U.S. Geological Survey and Federal Emergency Management Agency computed 100-year flood profiles for Catoma Creek near Montgomery, Alabama. (See figures 5 and 6 for locations of cross sections.)

Table 7. 100-year water-surface elevations with local roadway crossings for Catoma Creek near Montgomery, Alabama.

[ft, feet]

River station (ft)	Roadway crossing	100-year upstream water-surface elevation (ft)	Minimum roadway elevation in vicinity of the bridge	Maximum depth of overtopping (ft)
25,839	Western Railway of Alabama	154.4	157.0	0
27,426	Old Selma Road	155.6	154.0	1.6
51,409	Louisville and Nashville Railroad	171.9	173.4	0
52,584	U.S. Highway 31	172.4	172.5	0
56,874	Interstate 65	175.0	177.9	0
69,144	Seaboard Coast Line Railroad	180.7	178.2	2.5
70,044	U.S. Highway 331	181.2	182.0	0

Summary

A one-dimensional step-backwater model was used to simulate flooding conditions for Catoma Creek near Montgomery, Alabama. The results of this study provide the community with flood-profile information that can be used for flood-plain mitigation, future development, and safety plans for the city.

Using data collected by the USGS from the March 17, 1990, flood, a flow model was calibrated to match (within 0.1 ft) the measured high-water marks. The calibrated model then was used to simulate flooding for the 10-, 50-, 100-, and 500-year recurrence-interval floods. The results indicate that the 100-year recurrence-interval flood profile for Catoma Creek was about 2.5 ft higher, on average, than the profile published by FEMA in 2003. The absolute maximum and minimum differences were 6.0 ft and 0.8 ft, respectively. All water-surface elevations (headwater flooding only) computed for the 100-year flood were higher than those published by FEMA.

The mean flood-plain depth was computed for each cross section for the 100-year flood and ranged from about 3 ft to about 14 ft. The results indicate that for the 100-year recurrence interval, overtopping would occur at Old Selma Road and at the Seaboard Coast Line Railroad. The top-width of flow (for headwater flooding only) at a given section in the study reach for the 100-year flood ranged from about 880 ft to about 10,300 ft (mean of 5,600 ft).

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Appendix. Photographs showing locations of cross sections for Catoma Creek near Montgomery, Alabama, 2008

Figure A1. Channel and right overbank at cross section A, Montgomery, Alabama. (See figure 5 for location.)

Figure A2. Left overbank at cross section A, Montgomery, Alabama. (See figure 5 for location.)

Figure A3. Looking north at cross section B, Montgomery, Alabama. (See figure 5 for location.)

Figure A4. Right overbank at cross section C, Montgomery, Alabama. (See figure 5 for location.)

Figure A5. Western Railway of Alabama crossing of Catoma Creek, Montgomery, Alabama. (See figure 7 for location.)

Figure A6. Downstream face of Old Selma Road relief bridge #1, in the vicinity of cross section D, Montgomery, Alabama. (See figures 5 and 7 for location.)

Figure A7. Downstream face of Old Selma Road relief bridge #2, in the vicinity of cross section D, Montgomery, Alabama. (See figures 5 and 7 for location.)

Figure A8. Downstream face of Old Selma Road main-channel bridge, in the vicinity of cross section D, Montgomery, Alabama. (See figures 5 and 7 for location.)

Figure A9. Cross section D, Montgomery, Alabama. (See figure 5 for location.)

Figure A10. Right overbank of cross section E, Montgomery, Alabama. (See figure 5 for location.)

Figure A11. Downstream view of cross section E, Montgomery, Alabama. (See figure 5 for location.)

Figure A12. Catoma Creek streambed drop at cross section E, Montgomery, Alabama. (See figure 5 for location.)

Figure A13. Right overbank of cross section F, Montgomery, Alabama. (See figure 5 for location.)

Figure A14. Downstream face of Louisville and Nashville Railroad Bridge, Montgomery, Alabama. (See figure 6 for location.)

Figure A15. Downstream face of U.S. Highway 31 Bridge, Montgomery, Alabama. (See figure 7 for location.)

Figure A16. Downstream face of Interstate 65 bridge, Montgomery, Alabama. (See figure 7 for location.)

Figure A17. Downstream view of cross section H, Montgomery, Alabama. (See figure 6 for location.)

Figure A18. Downstream face of Seaboard Coast Line Railroad bridge, Montgomery, Alabama. (See figure 7 for location.)

Figure A19. Seaboard Coast Line Railroad bridge, Montgomery, Alabama. (See figure 7 for location.)

Figure A20. Downstream of Seaboard Coast Line Railroad bridge, Montgomery, Alabama. (See figure 7 for location.)

Figure A21. Upstream face of U.S. Highway 331 bridge, Montgomery, Alabama. (See figure 7 for location.)

Figure A22. Downstream view of cross section I, Montgomery, Alabama. (See figure 6 for location.)

Figure A23. Upstream face of Norman Bridge Road crossing, Montgomery, Alabama. (See figure 7 for location.)

Figure A24. Norman Bridge Road crossing, Montgomery, Alabama. (See figure 7 for location.)

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