Determination of the 100-Year Flood Plain on Fourmile Branch at the Savannah River Site, South Carolina, 1996

By TIMOTHY H. LANIER

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
foot (ft)	0.3048	meter
foot per mile (ft/mi)	0.1894	meter per kilometer
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
square mile (mi^2)	2.590	square kilometer

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

Acronyms used in this report:

ERM	Elevation reference mark
NRCS	Natural Resources Conservation Service
SRS	Savannah River Site
USDOE	U. S. Department of Energy
USGS	U.S. Geological Survey
USC&GS	U.S. Coastal and Geodetic Survey
WSPRO	Computer model for Water Surface Profile Computations

In this report, the station number represents the distance in feet upstream from the mouth of the subject stream. For example, Station 37600 on Fourmile Branch is 37,600 feet upstream from the mouth of Fourmile Branch.

In this report, the words "right" and "left" refer to the directions that would be reported by an observer facing downstream.

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Abstract

A hydrologic analysis was made to estimate the 100-year recurrence-interval flow for Fourmile Branch. The analysis showed the South Carolina upper Coastal Plain regional rural- and urban-regression equations were applicable for the Fourmile Branch drainage basin. This was verified by analysis of the flood-frequency data collected from U.S. Geological Survey gaging station 02197342 on Fourmile Branch.

Cross sections were surveyed throughout the reach, and other pertinent data such as flow resistance and land use were collected. The surveyed cross sections and computed 100-year recurrence-interval flows were used in a step-backwater model to compute the 100-year flood profile for Fourmile Branch. The profile was used to delineate the 100-year flood plain on a topographic map. Results are also provided in tabular and graphical formats.

INTRODUCTION

In 1951, the U.S. Department of Energy (USDOE), formerly the Atomic Energy Commission, created the Savannah River Site (SRS) to produce nuclear materials for national defense. The SRS is located in parts of Aiken, Barnwell, and Allendale Counties, South Carolina. The operation of the first nuclear production reactor, in area R, began in 1953 (fig. 1). In addition, there are four other nuclear reactors at the SRS, located in areas C, K, L, and P. Reactors in areas R and P were permanently deactivated in 1964 and 1991, respectively, and except for the restart testing of K reactor in 1991, all of the remaining reactors have been placed on stand-by since the late 1980's. Other areas on the SRS include reactor materials (area M), separation (areas F and H), waste management (areas E, F, H, S, Y, and Z), heavy-water processing (area D), administration (areas A, B, and CS), the Savannah River Ecology Laboratory, and the Savannah Technology Center (Arnett and others, 1992).

In 1992, the U.S. Geological Survey (USGS), in cooperation with the USDOE, initiated an investigation to determine the areal extent of the inundation caused by the 100-year recurrence-interval flow (100-year flow) for the Savannah River along the SRS boundary and for the major streams and their tributaries on the SRS, with the exception of Lower Three Runs. This report describes the inundation caused by the 100-year flow on Fourmile Branch.

Purpose and Scope

This report documents the approximate boundaries of the 100-year flood plain on the SRS for Fourmile Branch (fig. 2). One-hundred-year flows at selected locations, graphical and tabular profiles of the 100-year flood are listed in tables. Descriptions and elevations of benchmarks for Fourmile Branch are listed in the appendix.

Less-than-detailed methods, which require less cross-sectional definition, were used to compute the 100-year flood-plain boundaries. In particular, cross sections were surveyed primarily at road crossings or other easily accessible locations.

Intermediate cross sections were interpolated using these surveyed cross sections and 7.5-minute topographic maps (U.S. Geological Survey, 1963-65b). This method was requested by the USDOE, because greater accuracy was not warranted.

Description of Study Area

The SRS occupies more than 300 mi^2 along the Georgia-South Carolina border in parts of Aiken, Barnwell, and Allendale Counties, South Carolina. The southwestern boundary of the SRS is formed by the Savannah River. The five major streams that drain into the Savannah River from the SRS are Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs (fig. 2). The SRS is located in the upper Coastal Plain of South Carolina, which encompasses about 20 percent of the State (fig. 1). The general topography of the upper Coastal Plain consists of rounded hills with gradual slopes; however, some areas of highly irregular terrain exist in the province, and some elevations exceed 700 ft above sea level. The highest elevation on the SRS is approximately 420 ft above sea level, near Tims Branch and the northwest boundary of SRS (fig. 2). The land-surface elevation at the boundary of the upper and lower Coastal Plains, located southeast of the SRS, is usually less than 200 ft above sea level. Upper Coastal Plain stream slopes range from 5 to 20 ft/mi, and many of the streams are bordered by swamps with wide flood plains relative to the size of the stream (Zalants, 1990).

The study area is the Fourmile Branch Basin (pl. 1). Fourmile Branch begins just upstream from Road F (fig. 1; pl. 1), and flows into the Savannah River south of Augusta, Ga., at river mile 150.7 (pl. 1). Fourmile Branch enters the Savannah River Swamp approximately 11,400 ft upstream from its confluence with the Savannah River; downstream from this point, Fourmile Branch becomes braided and mixes with flow from the Savannah River. The downstream study limit is the confluence of Fourmile Branch and the Savannah River; however, 100-year flood-plain and profile computations begin upstream from where Fourmile Branch enters the Savannah River Swamp because of the effect of backwater from the Savannah River (pl. 1). The drainage area of Fourmile Branch before it enters the Savannah River Swamp is 23.0 mi^2.

The upstream study limit is located at Road F; this point was selected because the drainage area upstream of Road F is less than 1.0 mi^2, and there is no urbanization or road crossings upstream of this point. All of the Fourmile Branch drainage basin lies within the SRS, and contains significant industrialization, which includes areas C, CS, E, F, and H (fig. 1).

Acknowledgment

The author is grateful to Lee Davis, USDOE, for his logistical and administrative support of this project.

HYDROLOGIC AND HYDRAULIC DATA COLLECTION

Hydrologic data, which includes drainage area, soil type, impervious area, and peak-flow records at USGS gaging stations, were used to estimate the 100-year flow for Fourmile Branch. The drainage area for the basin was delineated using 7.5-minute series topographic maps (U.S. Geological Survey, 1963-65b) at selected locations along the reach. These locations were selected based on major tributary confluences, changes in drainage-area shape, and changes of imperviousness within the drainage basin. Soil types were determined from the Natural Resources Conservation Service (NRCS) [formerly the Soil Conservation Service] soil reports of Aiken and Barnwell Counties and the Savannah River Plant Area (Rogers, 1977; 1985; 1990). Urbanized areas in the drainage basin were determined from aerial photographs, 7.5-minute series

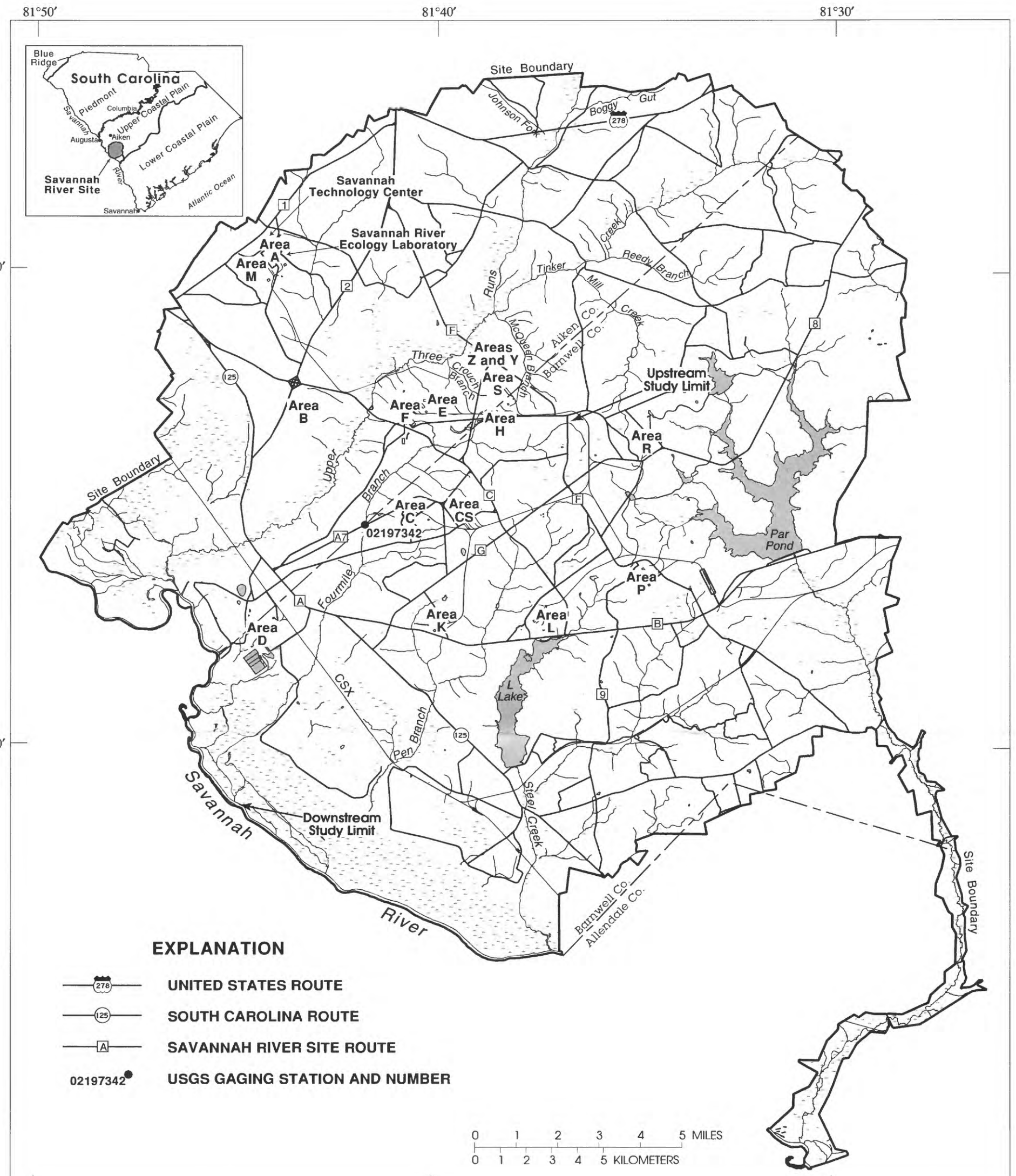

Figure 1. Savannah River Site with site areas and streams in Aiken, Allendale, and Barnwell Counties, S.C.

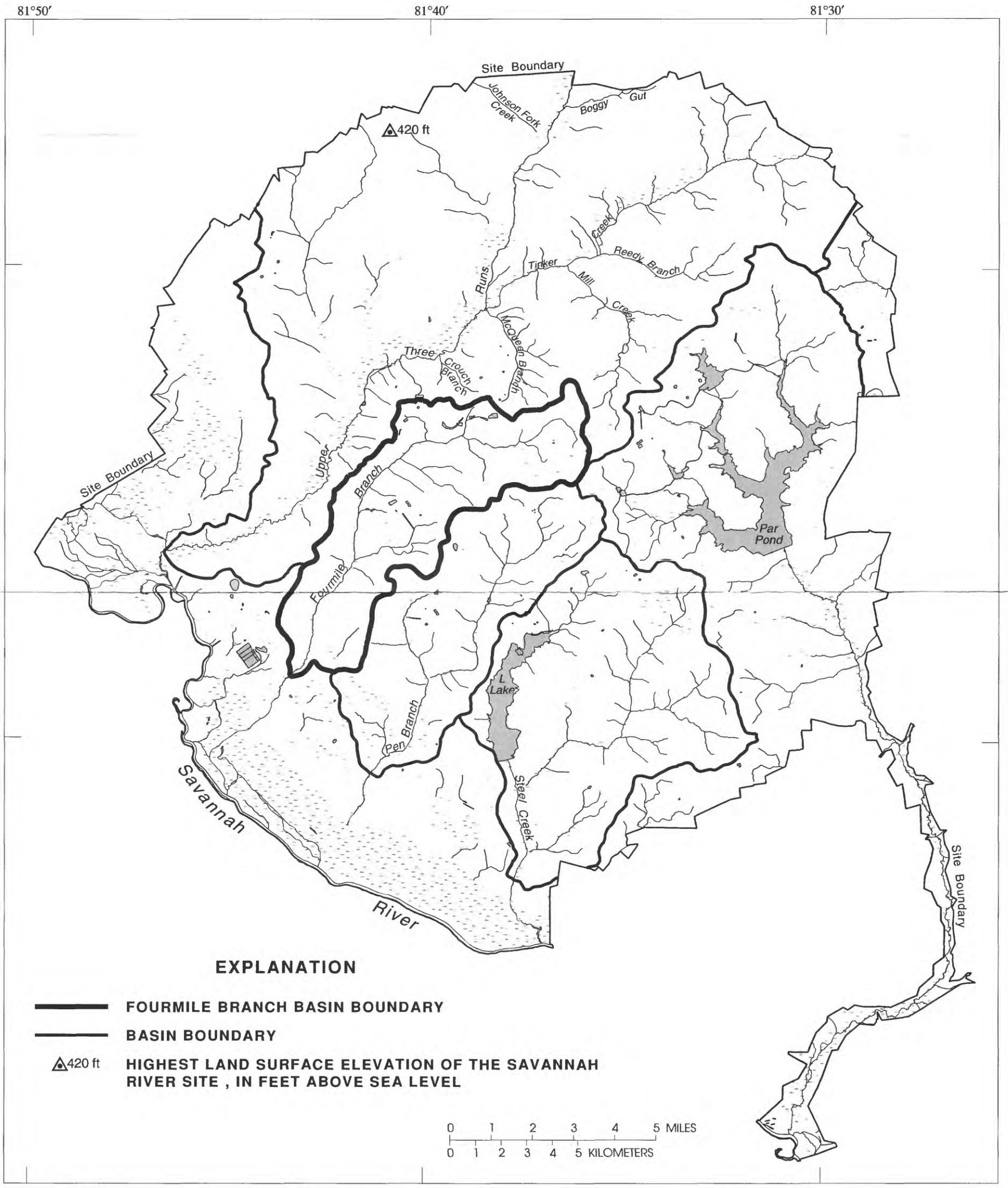

Figure 2. Boundaries, drainage basins, and stream locations at the Savannah River Site, S.C.

topographic maps (U.S. Geological Survey, 1963-65b), the SRS Atlas (Savannah River Site, 1994), and field inspections. Only urbanization in and around the industrial areas of the basin, which include areas C, CS, E, F, and H, were considered. Paved roads outside of these areas were not included. Percent-imperviousness data associated with urbanized areas were obtained from Cronshey and others (1986). Peak-flow data were obtained from USGS gaging station 02197342, Fourmile Branch at Road A-7 (fig. 1). These peak-flow data were used to verify the methods of regionalization of selected recurrence-interval flows described by Guimaraes and Bohman (1992) and Bohman (1992).

Cross sections for the step-backwater analysis of Fourmile Branch were taken upstream and (or) downstream from bridge and culvert crossings, along road grades at these crossings, and at selected locations along the streams, such as natural or man-made expansions or contractions and powerline right-of-ways. In addition, elevation data and structural geometry for all bridges and culverts were determined. Synthesized cross sections were developed using surveyed cross-sectional data and 7.5-minute series topographic maps (U.S. Geological Survey, 1963-65b).

Cross-section elevations were referenced to sea level. In areas where no elevation reference marks (ERM) were located, a global positioning system was used to establish temporary ERM's. Standard surveying levels were used to reference the temporary ERM's to more permanent structures.

Manning's roughness coefficients used in the hydraulic computations were estimated for the channels and flood plains using engineering judgement. Coefficient estimates were based on field notes, photographs, and methods documented by Arcement and Schneider (1984) and Barnes (1967).

FLOOD FREQUENCY

The regionalized rural- and urban-regression equations developed by Guimaraes and Bohman (1992) and Bohman (1992) were used to compute the 100-year flow for Fourmile Branch. The use of these equations was verified by a hydrologic analysis of peak-flow data from gaging station 02197342, Fourmile Branch at Road A-7 (fig. 1). In the hydrologic analysis, the 100-year flow was computed using the log-Pearson method and 23 years of peak-flow data; this 100-year flow was compared to the 100-year flow computed using the regional rural- and urban-regression equations. This comparison showed that the regional rural- and urban-regression equations reasonably describe the 100-year flows of Fourmile Branch.

By using the peak-flow data of gaging station 02197342, a 100-year flow of 1,080 ft^3/s was computed using the log-Pearson method. However, the 100-year flow computed with the regional rural-regression equation was 661 ft^3/s. This large difference in computed flows is probably the result of the 5.0-percent imperviousness of the basin. However, the lower limit of imperviousness used to develop the regional urban-regression equations presented by Bohman (1992) is 10 percent. Therefore, a relation of impervious area to flow was established for the drainage area of station 02197342, using the rural flows which assume no significant imperviousness and the urban-regional flows using 10- to 50-percent imperviousness (fig. 3). The relation and an impervious area of 5.0 percent were used to obtain a 100-year flow of 1,170 ft^3/s. This flow was adjusted using methods described in Guimaraes and Bohman (1992) for determining flood frequency at or near a gaged site on the same stream. A 100-year flow of 1,110 ft^3/s was obtained, compared to 1,080 ft^3/s computed by log-Pearson methods. The flows are well within the 95-percent confidence limits of both methods. Therefore, the regionalized rural and urban-regression equations were used to compute the 100-year flows on Fourmile Branch.

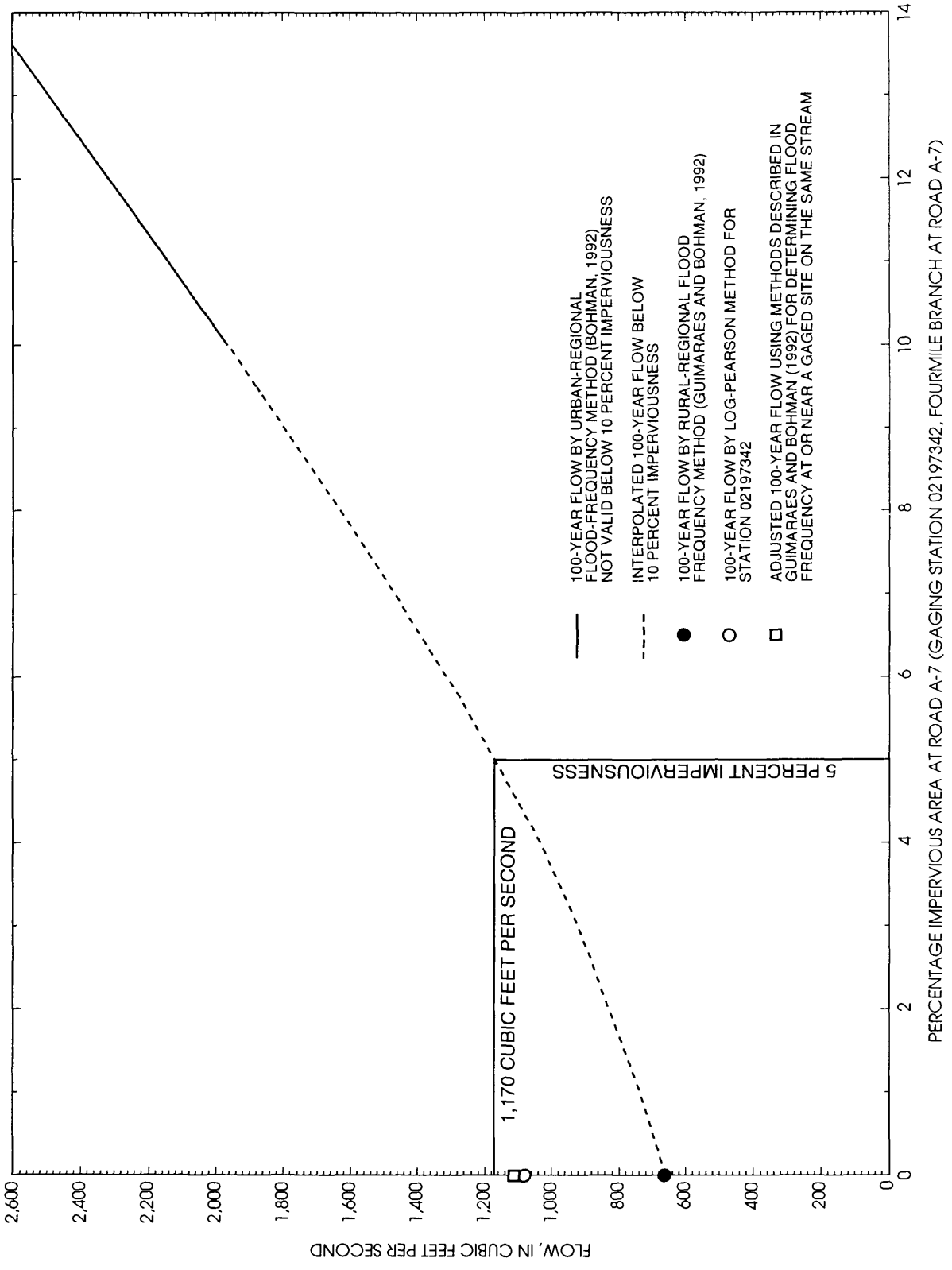

Figure 3. Relation of percent impervious area and 100-year recurrence interval flow for Fourmile Branch at Road A-7, Savannah River Site, S.C.

The equations are:

for rural Upper Coastal Plain watersheds (Guimaraes and Bohman, 1992),

$$RQ_{100} = 116(A)^{0.69}, \quad (1)$$

and for urban watersheds (Bohman, 1992),

$$UQ_{100} = 10.4(A)^{0.506}(TIA)^{0.932}(RQ_{100})^{0.280}, \quad (2)$$

where

RQ_{100} is the 100-year recurrence-interval flow for rural drainage basins, in cubic feet per second;

A is the drainage area, in square miles;

UQ_{100} is the 100-year recurrence-interval flow for urban drainage basins, in cubic feet per second; and

TIA is the total impervious area, in percent of total drainage area.

Equation 1 requires that the drainage areas be greater than 4.4 mi^2 and less than 1,720 mi^2. However, the relation was extended downward to 1.04 mi^2, because no other regional-regression equations specific to South Carolina were available. This extrapolation seems to be viable, because the logarithmic regional relation is linear. In addition, the relations for other physiographic provinces are generally linear throughout the range of data, and therefore, it is expected that the relation for the upper Coastal Plain could be extrapolated below a drainage area of 4.4 mi^2.

Equation 2 requires that the impervious area be greater than 10 percent, and the drainage area be greater than 0.18 mi^2 and less than 41.0 mi^2. The subbasins of Fourmile Branch meet the drainage area requirement for urbanized basins; however, the impervious area of the subbasins is typically less than 10 percent. Therefore, the previously described method to adjust flows for urbanization at Station 02197342 was used to compute flows for the subbasins which had an imperviousness of less than 10 percent.

The 100-year flow was computed at 15 locations on Fourmile Branch. The drainage area of nine of these sites was within 50 percent of the drainage area of the Station 02197342, therefore the flows were adjusted using the methods described in Guimaraes and Bohman (1992). The results of the hydrologic analysis on Fourmile Branch are presented in table 1.

MODEL SELECTION AND DEVELOPMENT

Water-surface elevations for the 100-year flows were computed for Fourmile Branch by using either the USGS/Federal Highways Administration step-backwater water-surface profile computer model (WSPRO) (Shearman and others, 1986; Shearman, 1990), or where flow is affected by backwater from the Savannah River, data from Lanier (1996) were used. The WSPRO model can compute backwater caused by bridges without subdividing the reach; however, the reach must be subdivided at culverts and a separate culvert-flow computation must be made to determine the backwater caused by the culvert. The culvert backwater was calculated using the USGS A-526 culvert-flow model (Bodhaine, 1968). The computed water-surface elevation at the approach to the culvert was used as the initial water-surface elevation for the WSPRO analysis of the next upstream reach.

The downstream limit of the Fourmile Branch study area was located at the confluence of the Savannah River. Because the drainage area of the Savannah River is much larger than the drainage area of Fourmile Branch, it is assumed that at the time of the 100-year flood, the flow in Fourmile Branch would have peaked and receded before peak flow occurred on the Savannah River.

Table 1.--Summary of 100-year recurrence-interval flows for Fourmile Branch, Aiken and Barnwell Counties, S.C.

[mi^2, square miles; ft^3/s, cubic feet per second; ft, feet; --, cross section not surveyed; *, impervious area less than 1 percent.]

Location (plate 1)	Drainage area (mi^2)	Percentage of impervious area	One-hundred-year flow (ft^3/s)	Cross-section name
Station 21707; Road A-12.2	21.9	3	[1]1,380	BR30
Station 32057; at Road A	18.7	4	[1]1,400	BR70
Station 38000; 5,943 ft upstream from Road A and 3,650 ft downstream from Road 3	17.1	4	[1]1,320	--
Station 39950; upstream from the confluence with an unnamed tributary; 1,700 ft below Road 3	13.3	5	[1]1,170	S97.5
Station 44888; Road A-7	12.5	5	[1]1,110	EMB
Station 49750; 4,862 ft upstream from Road A-7 and 5,372 ft downstream from Road C-4	11.4	5.5	[1]1,060	--
Station 52500; 2,622 ft downstream from Road C-4	10.7	5.5	[1]1,030	--
Station 55350; 228 ft upstream from Road C-4	8.15	5	[1]823	--
Station 59623; 315 ft upstream from Road C	6.96	2	[1]590	--
Station 63813; 340 ft downstream from Road 4	6.08	3	570	--
Station 65238; 1,085 ft upstream from Road 4	4.50	*	327	--
Station 71750; 3,918 ft upstream from Road E-1	3.66	*	284	--
Station 73400; 5,568 ft upstream from Road E-1 and 5,320 ft downstream from Road F	1.91	*	181	--
Station 76750; 1,970 ft downstream from Road F	1.29	*	138	--
Station 78720; at Road F	1.04	*	119	SE240

[1]Flow adjusted using data from gaging station 02197342.

The elevation of the 100-year flood on the Savannah River at the mouth of Fourmile Branch is 106.0 ft, which intersects Fourmile Branch at Station 22625. Therefore, due to the backwater of the Savannah River, the initial Fourmile Branch water-surface elevation was computed by slope conveyance at cross section SEC10, which is located 18,287 ft upstream of the confluence of Fourmile Branch and the Savannah River (pl. 1). The 100-year flood elevation on the Savannah River of 106.0 ft intersects the 100-year flood elevation on Fourmile Branch at Station 19846.

ONE-HUNDRED-YEAR FLOOD PLAIN AND PROFILE

Fourmile Branch was analyzed from its confluence with the Savannah River to Road F (pl. 1). Station 0 is located at the confluence of Fourmile Branch and Savannah River. The 78,800-ft long study segment consists of 49-surveyed and 132-synthetic cross sections. Within the study area, there are 4 highway bridges, 1 railway bridge, 5 culvert crossings, and 10 breached dams or old road beds that cross Fourmile Branch. The highway bridges are located on Roads A-12.2, A, C, and 4 at Stations 21707, 32057, 59308, and 64153, respectively (pl. 1). The CSX railway bridge crosses Fourmile Branch at Station 25806 (pl. 1). The culverts are located at Roads 3, A-7, C-4, E-1, and F at Stations 41650, 44888, 55122, 67832, and 78720, respectively (pl. 1). The breached dams/road beds are located at Stations 18457, 21885, 24807, 27132, 35870, 36307, 39930, 49654, 59391, and 64218 (pl.1). Roads 6-1, 6-2, 6-3, and A-6 are located at Stations 32650, 33250, 34020, and 46475, respectively, but do not cross Fourmile Branch. In the area of Fourmile Branch affected by backwater from the Savannah River, the 100-year flood-plain widths range from 1,150 ft at Station 15850 to 350 ft at Station 20500 (pl. 1). Outside of this area, the 100-year flood-plain widths range from 900 ft at Station 58025 to 120 ft at Station 68250 (pl. 1). Backwater caused by the road and railway bridges ranges from less than 0.1 ft at Road C to 2.0 ft at the CSX Railway Bridge. The old road embankment just upstream of Road 4 causes 1.9 ft of backwater. In addition, Roads A-7, C-4, and E-1 are overtopped by a depth of 2.7 ft, 1.2 ft, and 1.0 ft, respectively. Graphical and tabular profiles of Fourmile Branch are shown in figures 4 through 7 and listed in table 2, respectively. The areal extent of the inundation caused by the 100-year flood on Fourmile Branch is shown in plate 1.

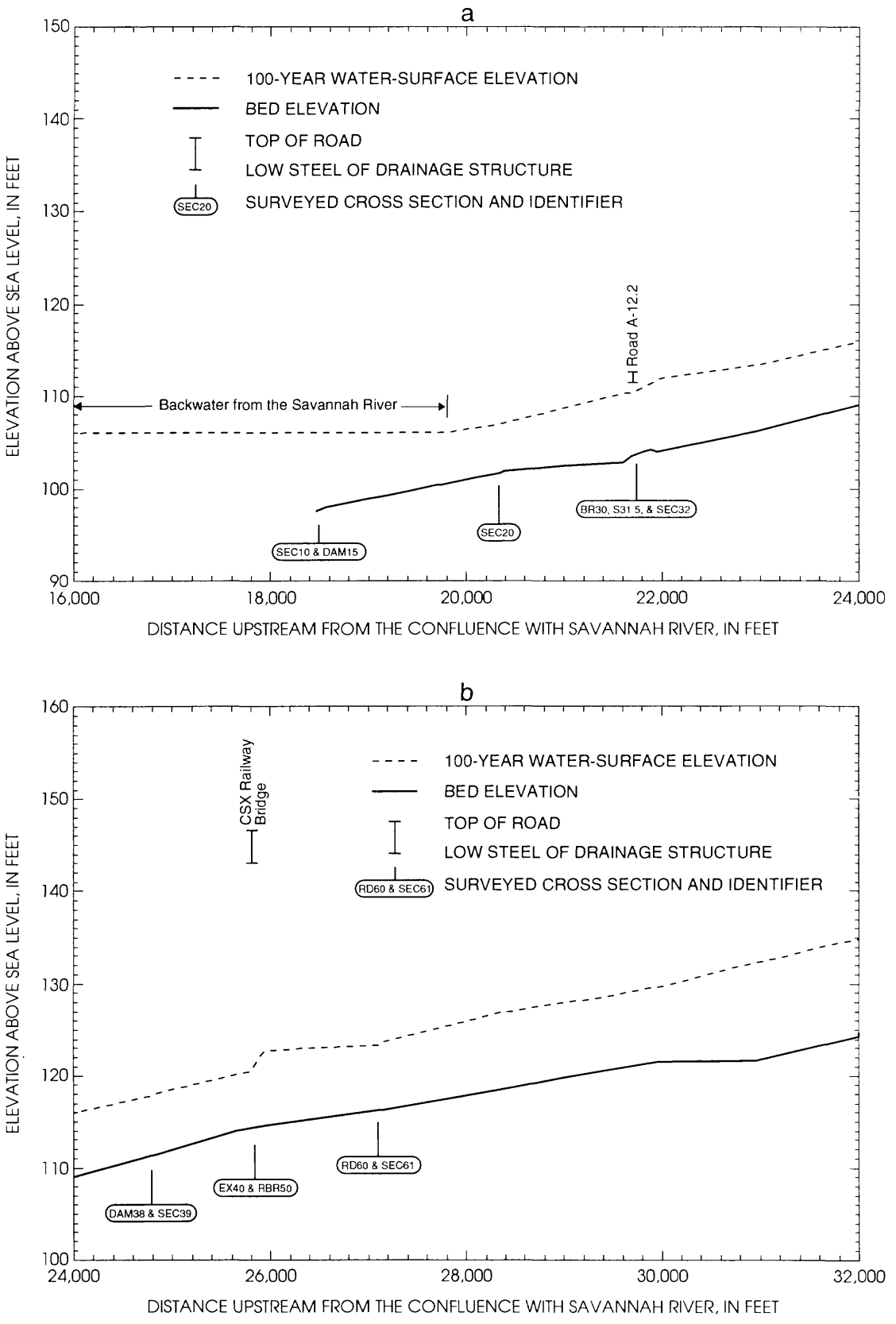

Figure 4. Flood profile of Fourmile Branch, Savannah River Site, S.C., from (a) Station 16000 to Station 24000 and (b) Station 24000 to Station 32000.

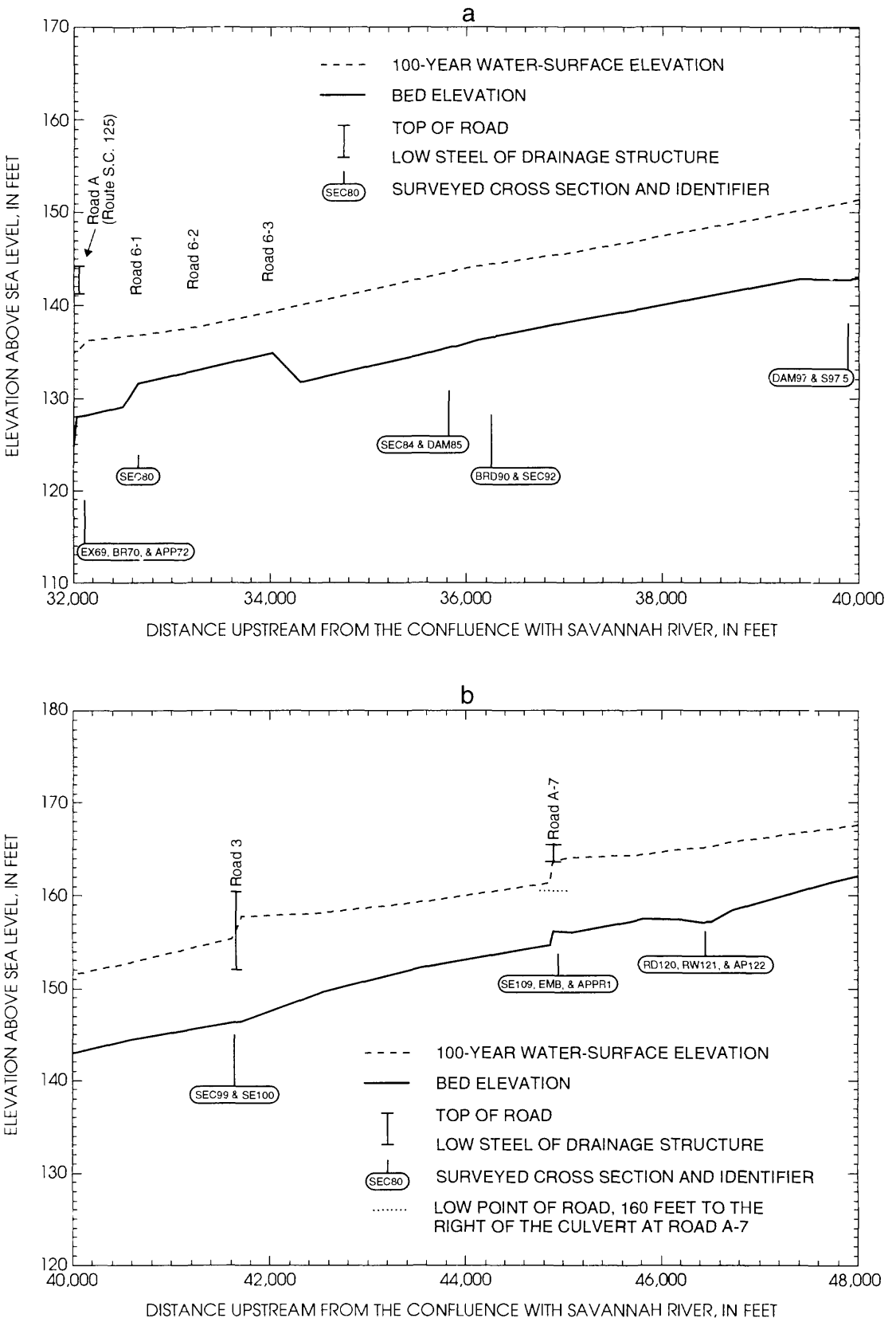

Figure 5. Flood profile of Fourmile Branch, Savannah River Site, S.C., from (a) Station 32000 to Station 40000 and (b) Station 40000 to Station 48000.

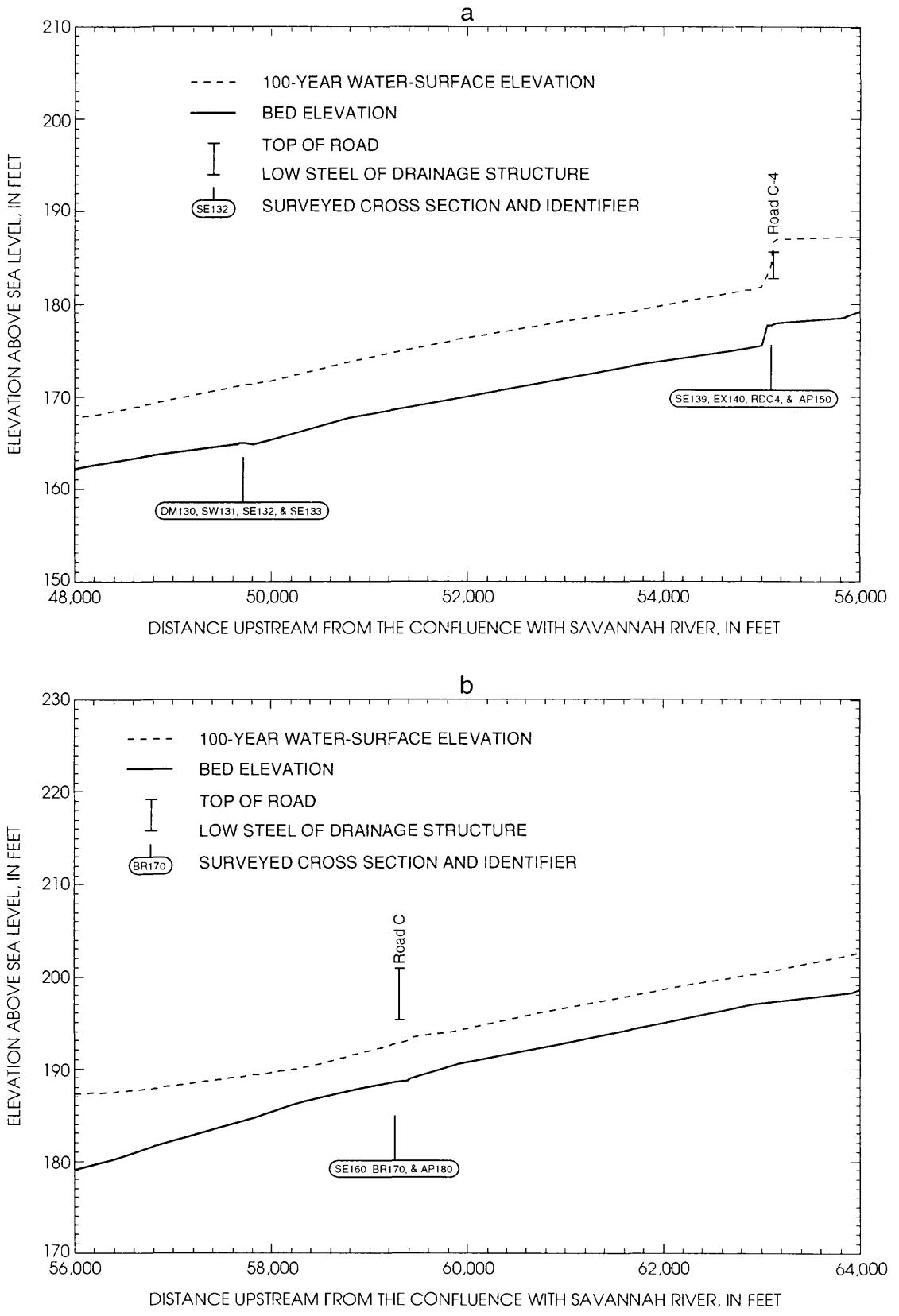

Figure 6. Flood profile of Fourmile Branch, Savannah River Site, S.C., from (a) Station 48000 to Station 56000 and (b) Station 56000 to Station 64000.

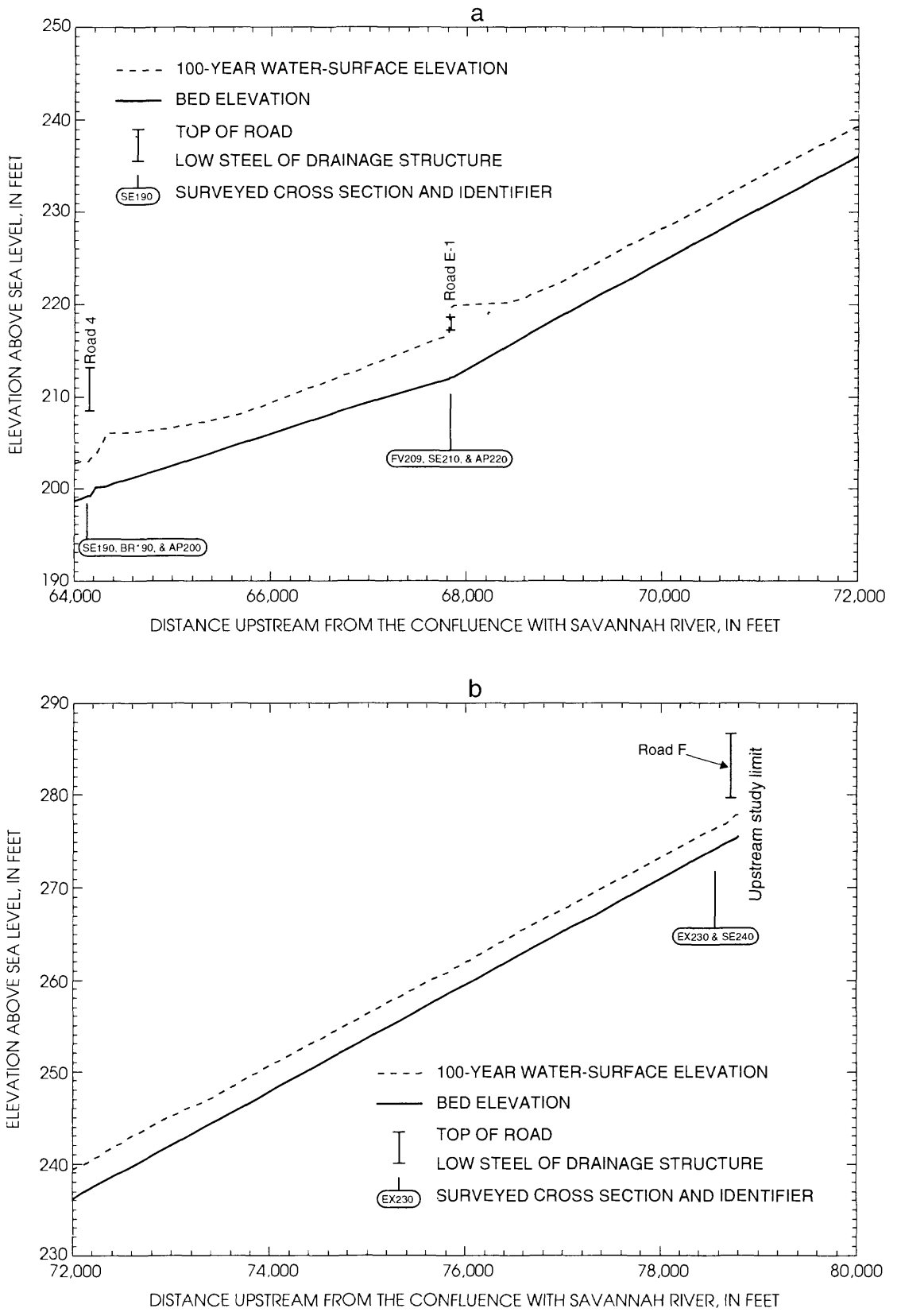

Figure 7. Flood profile of Fourmile Branch, Savannah River Site, S.C., from (a) Station 64000 to Station 72000 and (b) Station 72000 to Station 78771.

Table 2.--Cross-section name, station, location, type, and 100-year flow, flood-plain width, and water-surface elevation for selected cross sections of Fourmile Branch, Aiken and Barnwell Counties, S.C.

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

Cross-section name	Cross-section station	Cross-section location	Type of cross section[1]	100-year flow (ft^3/s)	100-year flood-plain width (ft)	100-year water-surface elevation (ft, above sea level)
SEC10	18287	170 ft downstream from a breached dam	surveyed	1,380	636	[2]106.0
DAM15	18457	Breached dam, 3,250 ft downstream from Road A-12.2	surveyed	1,380	73	[2]106.0
S17.3	19000	543 ft upstream from a breached dam	synthetic	1,380	541	[2]106.0
SYN19	20283	57 ft downstream from an unnamed powerline	synthetic	1,380	318	106.64
SEC20	20340	Unnamed powerline, 1,367 ft downstream from Road A-12.2	surveyed	1,380	320	106.74
SYN21	20390	50 ft upstream from an unnamed powerline	synthetic	1,380	318	106.81
EX29	21602	105 ft downstream from Road A-12.2	synthetic	1,380	523	110.06
BR30	21707	Bridge at Road A-12.2	surveyed	1,380	85	[3]110.09
S31.5	21885	Breached dam, 178 ft upstream from Road A-12.2	surveyed	1,380	108	111.25
SEC32	21955	248 ft upstream from Road A-12.2	surveyed	1,380	548	111.75
SYN37	24790	17 ft downstream from a breached dam	synthetic	1,380	521	117.86
DAM38	24807	Breached dam, 3,100 ft upstream from Road A-12.2	surveyed	1,380	[4]83	117.85
SEC39	24847	40 ft upstream from a breached dam	surveyed	1,380	526	118.09
EX40	25680	126 ft downstream from CSX railway bridge	surveyed	1,380	375	120.20

Table 2.--Cross-section name, station, location, type, and 100-year flow, flood-plain width, and water-surface elevation for selected cross sections of Fourmile Branch, Aiken and Barnwell Counties, S.C.--Continued

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

Cross-section name	Cross-section station	Cross-section location	Type of cross section[1]	100-year flow (ft^3/s)	100-year flood-plain width (ft)	100-year water-surface elevation (ft, above sea level)
RBR50	25806	CSX railway bridge	surveyed	1,380	38	[3]120.50
APP55	25933	127 ft upstream from CSX railway bridge	synthetic	1,380	474	122.62
SYN59	27112	20 ft downstream from an unnamed powerline	synthetic	1,380	432	123.31
RD60	27132	Unnamed powerline road, 1,326 ft upstream from the CSX railway bridge	surveyed	1,380	167	[5]123.38
SEC61	27152	20 ft upstream from an unnamed powerline	surveyed	1,380	443	123.66
EX69	31995	62 ft downstream from Road A	surveyed	1,400	354	134.89
BR70	32057	Bridge at Road A, (Route S.C. 125)	surveyed	1,400	38	[3]134.89
APP72	32119	62 ft upstream from Road A	surveyed	1,400	374	136.11
SEC80	32650	Road 6-1	surveyed	1,400	278	[5]136.68
S80.5	33250	Road 6-2	synthetic	1,400	244	[5]137.58
SYN81	34020	Road 6-3	synthetic	1,400	221	[5]139.23
SEC84	35845	25 ft downstream from a breached dam	surveyed	1,400	434	143.56
DAM85	35870	Breached dam, 3,813 ft upstream from Road A	surveyed	1,400	99	143.59
SY85B	35890	20 ft upstream from a breached dam	synthetic	1,400	436	143.76
SYN89	36295	12 ft downstream from a breached road	synthetic	1,320	414	144.42
BRD90	36307	Breached road, 4,250 ft upstream from Road A	surveyed	1,320	277	[5]144.43
SEC92	36319	12 ft upstream from a breached road	surveyed	1,320	414	144.46

Table 2.--Cross-section name, station, location, type, and 100-year flow, flood-plain width, and water-surface elevation for selected cross sections of Fourmile Branch, Aiken and Barnwell Counties, S.C.--Continued

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

Cross-section name	Cross-section station	Cross-section location	Type of cross section[1]	100-year flow (ft^3/s)	100-year flood-plain width (ft)	100-year water-surface elevation (ft, above sea level)
S96.5	39910	20 ft downstream from a breached dam	synthetic	1,320	514	151.16
DAM97	39930	Breached dam, 1,720 ft downstream from Road 3	surveyed	1,320	[4]148	151.18
S97.5	39950	20 ft upstream from a breached dam	surveyed	1,320	514	151.29
SEC99	41495	155 ft downstream from Road 3	surveyed	1,170	369	155.08
SE100	41650	Road 3	surveyed	1,170	324	157.72
APP99	41716	66 ft upstream from Road 3	synthetic	1,170	389	157.72
SE109	44672	216 ft downstream from Road A-7	surveyed	1,110	404	161.05
EMB	44888	Road A-7	surveyed	1,110	132	[6]163.37
APPR1	44927	39 ft upstream from Road A-7	surveyed	1,110	327	163.80
RW119	46439	36 ft downstream from Road A-6	synthetic	1,060	281	165.16
RD120	46475	Road A-6	surveyed	1,060	250	[5]165.21
RW121	46511	36 ft upstream from Road A-6	surveyed	1,060	279	165.28
AP122	46735	260 ft upstream from Road A-6	surveyed	1,060	422	165.78
DM130	49654	Breached dam, 66 ft downstream from the downstream edge of an unnamed powerline	surveyed	1,060	245	171.11
SW131	49669	51 ft downstream from the downstream edge of an unnamed powerline	surveyed	1,060	308	171.21

Table 2.--Cross-section name, station, location, type, and 100-year flow, flood-plain width, and water-surface elevation for selected cross sections of Fourmile Branch, Aiken and Barnwell Counties, S.C.--Continued

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

Cross-section name	Cross-section station	Cross-section location	Type of cross section[1]	100-year flow (ft^3/s)	100-year flood-plain width (ft)	100-year water-surface elevation (ft, above sea level)
SE132	49735	15 ft upstream from the downstream edge of an unnamed powerline	surveyed	1,060	391	171.31
SE133	49804	26 ft downstream from the upstream edge of an unnamed powerline	surveyed	1,060	406	171.37
SW133	49810	20 ft downstream from the upstream edge of an unnamed powerline	synthetic	1,060	405	171.37
SE139	54827	295 ft downstream from Road C-4	surveyed	1,030	326	181.38
EX140	55056	66 ft downstream from Road C-4	surveyed	1,030	[7]52	183.01
RDC4	55122	Road C-4	surveyed	1,030	315	[6]186.75
AP150	55149	27 ft upstream from Road C-4	surveyed	1,030	378	186.98
SE160	58916	392 ft downstream from Road C	surveyed	590	571	191.67
BR170	59308	Bridge at Road C	surveyed	590	60	[3]192.70
AP180	59391	Old Road bed, 83 ft upstream from Road C	surveyed	590	37	192.95
SE190	63910	243 ft downstream from Road 4	surveyed	570	322	202.37
BR190	64153	Bridge at Road 4	surveyed	570	45	[3]203.22
AP200	64218	Old road bed, 65 ft upstream from Road 4	surveyed	570	54	203.61
FV209	67813	19 ft downstream from Road E-1	surveyed	327	266	216.61
SE210	67832	Road E-1	surveyed	327	93	[6]219.59
AP220	67868	36 ft upstream from Road E-1	surveyed	327	315	219.80

Table 2.--Cross-section name, station, location, type, and 100-year flow, flood-plain width, and water-surface elevation for selected cross sections of Fourmile Branch, Aiken and Barnwell Counties, S.C.--Continued

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

Cross-section name	Cross-section station	Cross-section location	Type of cross section[1]	100-year flow (ft^3/s)	100-year flood-plain width (ft)	100-year water-surface elevation (ft, above sea level)
EX230	78659	61 ft downstream from Road F	surveyed	119	176	[2]76.88
SE240	78720	Road F	surveyed	119	10	[3]277.82
APPF	78771	51 ft upstream from Road F	synthetic	119	183	277.82

[1]All surveyed cross sections are shown on plate 1; synthetic cross sections are not shown on plate 1.
[2]Backwater from the Savannah River.
[3]Road or railway is not overtopped.
[4]Due to more than one breach in the dam, the flood-plain width may not match plate 1.
[5]Road does not cross Fourmile Branch.
[6]Road is overtopped.
[7]Due to road overflow, this flood-plain width is increased to the same flood-plain width as cross section RDC4.

SUMMARY

In 1951, the U.S. Department of Energy, formerly the Atomic Energy Commission, created the Savannah River Site to produce nuclear materials for national defense. The Savannah River Site occupies approximately 300 square miles along the Georgia-South Carolina border in parts of Aiken, Barnwell, and Allendale Counties, South Carolina. In 1992, the U.S. Geological Survey, U.S. Department of the Interior, in cooperation with the U.S. Department of Energy, initiated an investigation to determine the areal and vertical extent of inundation caused by the 100-year recurrence-interval flood for the Savannah River along the Savannah River Site southwestern boundary, and for the major streams and their tributaries on the Savannah River Site, with the exception of Lower Three Runs.

This report includes a map of the 100-year flood plain and flood profile on Fourmile Branch. The results also are provided in tabular format. The 100-year flood-plain map and flood profile provide water-resource managers with a technical basis for making flood-plain management decisions that could minimize future flood problems and provide a basis for designing and constructing drainage structures along roadways.

A hydrologic analysis was made to estimate the 100-year recurrence-interval flow for Fourmile Branch and its tributaries. This analysis showed the U.S. Geological Survey regional rural- and urban-regression equations for South Carolina reasonably describe the 100-year flows of Fourmile Branch.

Throughout the reach, cross sections were surveyed and other pertinent data such as flow resistance and land-use data were collected. The computed 100-year flows and surveyed cross sections were used in a step-backwater model to compute the 100-year flood plain for Fourmile Branch. The profiles computed by the step-backwater model were used to delineate the 100-year flood plain on topographic maps.

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APPENDIX

List of Elevation Reference Marks

APPENDIX--List of Elevation Reference Marks

[ft, feet; USGS, U.S. Geological Survey; mi, mile; USC&GS, U.S. Coastal and Geodetic Survey]
(In this report, the words "right" and "left" refer to directions that would be reported by an observer facing downstream.)

Benchmark	Location	Elevation above sea level (ft)
FMB30	Chiseled square in the downstream left end of the Road A-12.2 bridge crossing Fourmile Branch; 10,326 ft downstream from Road A. Established by the USGS.	112.49
FMB50	Chiseled square in the downstream left abutment headwall of the CSX Railway bridge crossing Fourmile Branch, 6,257 ft downstream from Road A. Established by the USGS.	146.67
FMB70	Chiseled square in the upstream left abutment headwall of the Road A bridge crossing Fourmile Branch. Established by the USGS.	146.02
FMB170	Chiseled square on the downstream left abutment headwall of the Road C bridge crossing Fourmile Branch. Established by the USGS.	202.68
R102	Brass tablet located 3.15 mi southwest of the junction of Road C and Road 3, about 0.4 mi northeast of four 6-ft diameter concrete pipes over Fourmile Branch, at the junction of the woods road leading north, 59 ft north of the center line of Road 3, 37 ft west of the center line of the woods road, 2 ft east of the metal witness post, 1.5 ft below the level of the highway. Established by the USC&GS.	200.154
U102	Brass tablet located at the junction of Roads C and 5, set in the junction Y of Road 5, 80.5 ft southwest of the centerline of the southwest two of four lanes of Road C north, 77 ft southeast of the center line of Road 5, 71 ft northwest of the centerline of the southeast leg of the junction. Established by the USC&GS.	301.213

APPENDIX--List of Elevation Reference Marks--Continued

[ft, feet; USGS, U.S. Geological Survey; mi, mile; USC&GS, U.S. Coastal and Geodetic Survey]
(In this report, the words "right" and "left" refer to directions that would be reported by an observer facing downstream.)

Benchmark	Location	Elevation above sea level (ft)
M101	Brass tablet located at crossing of CSX Railway and Road 3, 259 degrees north and across the track from mile post Number 438, 33 ft northeast of northeast rail, 49.5 ft southeast of the centerline of the road, 60.5 ft east of the center of the crossing. Established by the USC&GS.	153.372
L101	Brass tablet located 0.6 mi southeast along the CSX railway from the Road 3 crossing, thence 0.15 mi south on a spur track to Area D, at the crossing of Road A-12 (a black top road), the road passes between the main line track and the Area D, 114 ft southeast of the southeast rail of the spur track, in the top of a concrete block 18 ft wide by 27 ft long by 1 ft high, 188 ft northeast of the center line of the road. Established by USC&GS.	152.218
H101	Brass tablet located 4.75 miles northwest along CSX railway from the railway station at Robbins, at the crossing of Road A-13 and CSX Railway, 24 ft northeast of the northeast rail, 27 ft southwest of the center line of the road, 69 ft north of the center of the crossing, and 1 ft southeast of a metal witness post. Established by the USC&GS.	150.193
X102	Brass tablet located 1.35 mi north on Road 4 from junction of Road C and Road 4, thence 0.9 mi northwest on M Line U.S. Government Railway track, about 0.1 mi northwest of milepost No. 12, 85 ft southwest from the southwest rail of track, 2 ft southeast of the metal witness post, 1 ft above the level of the track. Established by the USC&GS.	249.350