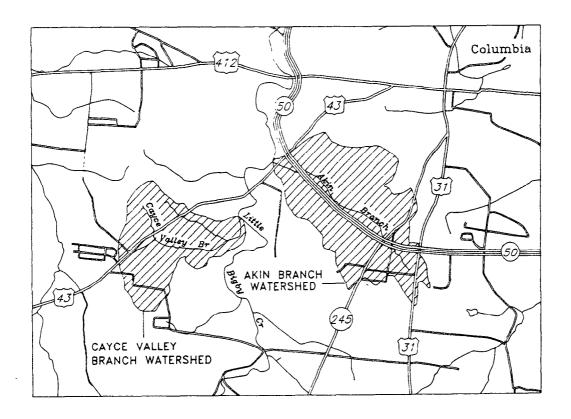
Open-File Report 92-648

Hydrologic and Hydraulic Analyses at Akin Branch and Cayce Valley Branch, Columbia, Tennessee



Prepared by the U.S. GEOLOGICAL SURVEY

in cooperation with the CITY OF COLUMBIA





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By GEORGE S. OUTLAW

U.S. GEOLOGICAL SURVEY Open-File Report 92-648

Prepared in cooperation with the CITY OF COLUMBIA

Nashville, Tennessee 1993

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U.S. GEOLOGICAL SURVEY

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CONTENTS

Abstract 1 Introduction 1 Purpose and scope 2 Approach 3 Hydrologic and hydraulic analysis 3 Akin Branch 4 Flood discharges 4 Flood profiles 6	
Simulation of effects of alternative drainage structures 8 Cayce Valley Branch 24 Flood discharges 24	
Flood profiles 35 Simulation of effects of alternative drainage structures 47 Summary 47 Selected references 56	
ILLUSTRATIONS	
 Map showing location of the Akin Branch and the Cayce Valley Branch watersheds, Columbia, Tennessee 2 Map showing location of drainage structures in the Akin Branch study reach 3. Akin Branch flood discharges for selected recurrence intervals 7 Graphs showing: Computed flood profiles, existing conditions, with February 3, 1990, high-water marks for Akin Branch 9 Computed flood profiles for Akin Branch, simulation 1 23 Computed flood profiles for Akin Branch, simulation 2 23 Computed flood profiles for Akin Branch, simulation 3 24 Map showing location of drainage structures in the Cayce Valley Branch study reach 9. Cayce Valley Branch flood discharges for selected recurrence intervals 36 Graphs showing: Computed flood profiles, existing conditions, for Cayce Valley Branch 11. Computed flood profiles for Cayce Valley Branch, simulation 1 48 Computed flood profiles for Cayce Valley Branch, simulation 2 48 	34
TABLES	
1. Akin Branch culvert and bridge inventory 2. Akin Branch high-water mark elevations for the February 3, 1990 flood 3. Selected data from hydraulic analysis of Akin Branch, existing conditions 4. Selected data from hydraulic analysis of Akin Branch, simulation 1 25 5. Selected data from hydraulic analysis of Akin Branch, simulation 2 28 6. Selected data from hydraulic analysis of Akin Branch, simulation 3 31 7. Cayce Valley Branch culvert and bridge inventory 35 8. Selected data from hydraulic analysis of Cayco Velley Branch, existing conditions	39
 Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions Selected data from hydraulic analysis of Cayce Valley Branch, simulation 1 Selected data from hydraulic analysis of Cayce Valley Branch, simulation 2 53 	J y

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	Ву	To obtain
inch (in.)	2.540	centimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square foot (ft ²)	0.0929	square meter
square mile (mi ²)	2.590	square kilometer
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second
foot per second (ft/s)	0.3048	meter per second

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 both the United States and Canada, formerly called Sea Level Datum of 1929.

HYDROLOGIC AND HYDRAULIC ANALYSES AT AKIN BRANCH AND CAYCE VALLEY BRANCH, COLUMBIA, TENNESSEE

By George S. Outlaw

Abstract

The U.S. Geological Survey, in cooperation with the City of Columbia, Tennessee, conducted hydrologic and hydraulic analyses at Akin Branch and Cayce Valley Branch in the Little Bigby Creek watershed, Columbia, Tennessee, from 1990 through 1991. Results of the analyses can be used by city planners in the development of plans to replace several deteriorating and inadequate drainage structures.

Akin Branch and Cayce Valley Branch drain small watersheds of 1.69 and 1.04 square miles, respectively. Flood discharges for 5-, 10-, and 25-year recurrence-interval storm events were calculated at the stream mouths using flood-frequency relations developed for use at small urban streams in Tennessee. For each stream, flood discharges at locations upstream from the mouth were calculated by subdividing the watershed and assigning a percentage of the discharge at the mouth, based on drainage area, to each subarea.

Flood profiles for the selected recurrence-interval flood discharges were simulated for Akin Branch and Cayce Valley Branch for existing conditions and conditions that might exist if drainage improvements such as larger culverts and bridges and channel improvements are constructed. The results of the simulations were used to predict changes in flood elevations that might result from such drainage improvements. Analyses indicate that reductions in existing flood elevations of as much as 2.1 feet for the 5-year flood at some sites on Akin Branch and as much as 3.8 feet for the 5-year flood at some sites on Cayce Valley Branch might be expected with the drainage improvements.

INTRODUCTION

Local flooding due to poor drainage conditions affects many communities in Tennessee. Frequently, local flooding is caused and enhanced by the encroachment of buildings and other structures into natural flood channels, and the constriction of channels at culverts and bridges. Such conditions are present within the Little Bigby Creek watershed of Maury County, Tennessee (fig. 1), and particularly in the urban reaches of two tributaries, Akin Branch and Cayce Valley Branch, in the City of Columbia.

The U.S. Geological Survey (USGS), in cooperation with the City of Columbia, conducted a hydrologic and hydraulic study of Akin Branch and Cayce Valley Branch to determine existing conditions which lead to local flooding, and to evaluate hydrologic and hydraulic conditions that might exist with possible drainage improvements. Objectives of the study were to estimate flood discharges and flood profiles along these two streams for storms with recurrence intervals of 5, 10, and 25 years under present

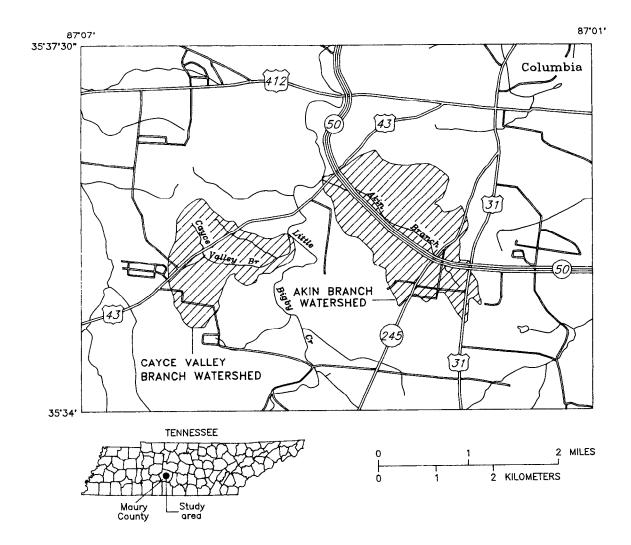


Figure 1. Location of the Akin Branch and the Cayce Valley Branch watersheds, Columbia, Tennessee.

and possible future conditions that include larger culverts and bridges and other channel improvements. The study is one of several urban hydrology investigations being conducted by the USGS in Tennessee and in other states.

Purpose and Scope

This report presents data on the hydraulic characteristics of Akin Branch and Cayce Valley Branch and estimates of flood discharge at numerous points along the streams. The report describes model-simulated flood profiles for 5-, 10-, and 25-year storms, and includes an analysis of changes in flood profiles resulting from possible drainage improvements.

Approach

The following approach was used to meet the objectives of the investigation:

- 1. The watershed boundary and amount of impervious area within Akin Branch and Cayce Valley Branch watersheds were determined from USGS topographic maps and validated with field data.
- 2. Hydraulic characteristics of segments of the channels of Akin Branch and Cayce Valley Branch were determined from field surveys. These characteristics included cross-sectional areas, bed profiles, roughness coefficients, and location and dimensions of bridges and culverts.
- 3. Flood discharges for 5-, 10-, and 25-year recurrence interval storm events were computed for Akin Branch and Cayce Valley Branch using equations developed by Robbins (1984).
- 4. The USGS Water-Surface Profile (WSPRO) computation model (Shearman and others, 1986; Shearman, 1990) was used to compute flood profiles for 5-, 10-, and 25-year recurrence interval storm events for existing conditions at Akin Branch and Cayce Valley Branch.
- 5. WSPRO was used to study the effects of drainage improvements at Akin Branch and Cayce Valley Branch.

HYDROLOGIC AND HYDRAULIC ANALYSIS

Flood discharges with 5-, 10-, and 25-year recurrence intervals were estimated at the mouths of Akin Branch and Cayce Valley Branch using regional equations and techniques described by Robbins (1984). For each stream, flood discharges at locations upstream from the mouth were calculated by subdividing the watershed and assigning a percentage of the discharge at the mouth, based on drainage area, to each subarea. Robbins' equations were developed to estimate flood discharges along urban streams in Tennessee with drainage areas from 0.21 to 24.3 mi². Using the flood discharges, flood profiles were computed with the WSPRO model. Critical depth was used as the starting elevation for the profile computations. The effects of culverts, bridges, and other obstructions in the channel were included in the computation of the profiles for each flood discharge.

The following equations developed by Robbins (1984) were used to estimate flood discharges.

$$Q_5 = 5.55(A)^{0.75}(IA)^{0.44}(P_{2_24})^{2.53}$$

$$Q_{10} = 11.8(A)^{0.75}(IA)^{0.43}(P_{2_24})^{2.12}$$

$$Q_{25} = 21.9(A)^{0.75}(IA)^{0.39}(P_{2_24})^{1.89}$$

where

- Q_n is the estimated flood discharge, in cubic feet per second, for the indicated recurrence interval; n, in years;
- A is the area of the watershed, in square miles;

IA is the percentage of the drainage area that is impervious to infiltration of rainfall; and

 $P_{2,24}$ is the 2-year 24-hour rainfall, in inches.

Values for watershed area and percentage of impervious area of the watershed were determined using topographic maps, aerial photographs, and field data. The rainfall for the 2-year 24-hour recurrence interval was estimated as 3.6 inches using maps developed for Tennessee by the U.S. Department of Commerce and published by Robbins (1984).

Flood profiles were calculated using the WSPRO model. The model can be used to analyze onedimensional, gradually varied, steady flow in open channels. WSPRO also can be used to analyze flow through bridges and culverts, and to simulate road overflow.

WSPRO data requirements include: discharge, channel cross sections and distances, bridge and culvert geometry, road surface elevations, and channel-roughness coefficients. Discharges were estimated using equations developed by Robbins (1984). Channel cross sections and distances, bridge and culvert geometry, road surface elevations, and channel-roughness coefficients were obtained from field surveys.

Once the model is calibrated using observed storm data, the hydraulic model can be used to study the effects caused by changes in channel characteristics on the flood profile for a particular flood discharge. For example, changes in the size and aperture of bridges and culverts can be simulated to determine the effects on the flood profiles.

Akin Branch

Akin Branch drains a small urban watershed with a contributing drainage area of 1.7 mi². At present, residential and commercial development account for about 10 percent of the basin. However, the potential for continued development could result in 20 percent of the contributing drainage area becoming impervious to infiltration of rainfall in the future. This value of imperviousness was used to estimate flood discharges for future developed conditions.

The study reach (fig. 2) begins at a point approximately 59 feet downstream from the culvert at James Campbell Boulevard (structure 1), and extends upstream approximately 7,300 feet (measured along the centerline of the stream) to a point just upstream from the culvert under the lumberyard at the corner of Highland Avenue and Nicholas Long Drive (structure 13) (table 1). The study reach contains a total of 13 culverts and bridges.

Flood Discharges

Flood discharges for Akin Branch were computed by assigning a percentage of the total basin flood discharge to each basin subarea based on the percentage of the watershed occupied by the subarea (fig. 3). The watershed was subdivided on the basis of topography and the location of tributaries and culverts draining into the creek. Flood discharges for the 5-, 10-, and 25-year recurrence intervals for each basin

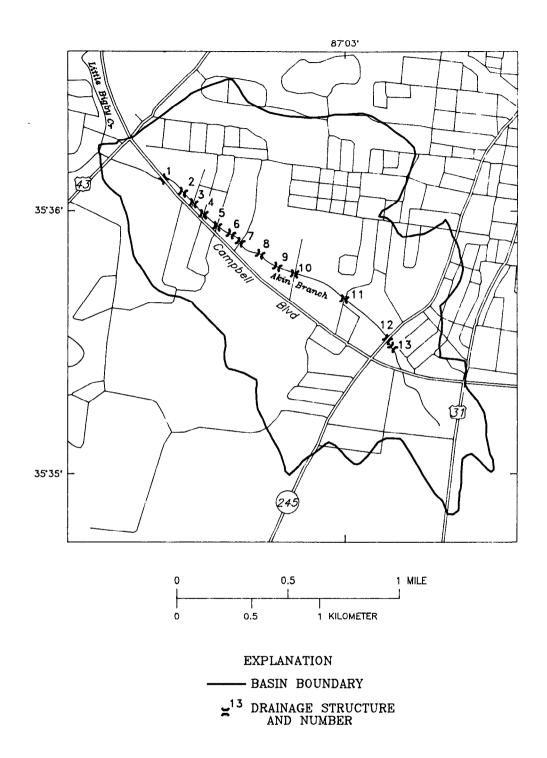


Figure 2. Location of drainage structures in the Akin Branch study reach.

Table 1. Akin Branch culvert and bridge inventory

[Stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

Structure number	Structure name	Stream stationing	Structure description
1	James Campbell Boulevard culvert.	0+59 - 2+00	Two-barrel concrete box culvert. Average barrel inlet, 8 feet x 6 feet. Length, 141 feet.
2	Store entrance culvert	9+10 - 9+50	Two-barrel concrete box culvert. Average barrel inlet, 8 feet x 6.6 feet. Length, 40 feet.
3	Bank entrance culvert	13+37 - 13+63	Three-barrel concrete box culvert. Average barrel inlet, 8.5 feet x 5.5 feet. Length, 26 feet.
4	Wedgewood Drive bridge	15+85 - 16+07	Single span concrete bridge. Inlet, 15.5 feet x 4 feet. Length, 22 feet.
5	Alpine Drive bridge	20+00 - 20+22	Single span concrete bridge. Inlet, 15 feet x 5 feet. Length, 22 feet.
6	Store entrance culvert	22+50 - 22+84	Two-barrel concrete box culvert. Barrel inlet, 8 feet x 8.2 feet. Length, 34 feet.
7	Shady Brook Lane culvert	25+50 - 26+21	One-barrel concrete box culvert. Barrel inlet, 14 feet x 5 feet. Length, 71 feet.
8	Mall entrance culvert	30+23 - 32+18	One-barrel concrete box culvert. Barrel inlet, 14 feet x 4.4 feet. Length, 195 feet.
9	Mall parking lot culvert	35+80 - 42+20	One-barrel concrete box culvert. Barrel inlet, 14 feet x 5.1 feet. Length, 640 feet.
10	Brookmeade Road culvert	43+37 - 44+22	One-barrel concrete box culvert. Barrel inlet, 10 feet x 5.9 feet. Length, 85 feet.
11	Denise Drive culvert	55+10 - 55+44	One-barrel concrete box culvert. Barrel inlet, 12 feet x 6.8 feet. Length, 34 feet.
12	Highland Avenue culvert	69+44 - 69+84	One-barrel corrugated metal pipe. Average pipe diameter, 3.5 feet. Length, 40 feet.
13	Lumberyard culvert	69+90 - 71+70	One-barrel corrugated metal pipe. Average pipe diameter, 4.5 feet. Length, 180 feet.

subarea were calculated using the equations developed by Robbins (1984). These values were input to the WSPRO model for the calculation of the water-surface profiles.

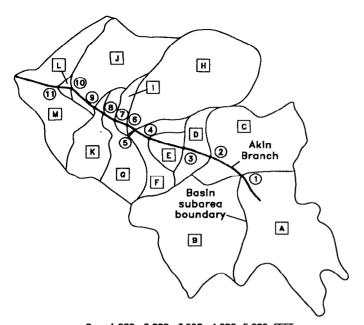
Flood Profiles

6

The hydraulic model was calibrated for existing conditions based on high-water marks that were obtained shortly after the flood of February 3, 1990 (table 2). The recurrence interval of this flood was approximately 5 years (fig. 4). Highwater marks shown for the February 3, 1990 flood in the vicinity of Denise Drive (stream station 55+00) are higher than the completed profiles because a new culvert was constructed at that location between February 3, 1990, and the time the profiles were computed.

Discharge, in cubic

AKIN BRANCH WATERSHED



1,000 2,000 3,000 4,000 5,000 FEET 200 400 600 800 1,000 METERS

EXPLANATION

- (1) NODE AND NUMBER
- **B** BASIN SUBAREA DESIGNATION

URBAN RUNOFF EQUATIONS (Robbins, 1984)

 $\begin{array}{ll} Q_5 & = 5.55 \ (\text{A})^{0.75} \ (\text{IA})^{0.44} \ (\text{P2_24})^{2.53} \\ Q_{10} & = 11.8 \ (\text{A})^{0.75} \ (\text{IA})^{0.43} \ (\text{P2_24})^{2.12} \end{array}$

 $Q_{25} = 21.9 \text{ (A)}^{0.75} \text{ (IA)}^{0.39} \text{ (P2_24)}^{1.89}$

 $P2_24 = 3.6$ inches

Where

Qn is the estimated flood discharge, in cubic feet per second, for the indicated recurrence interval, in years:

A is the area of the watershed, in square miles;

IA is the percentage of the drainage area that is impervious to infiltration of rainfall; and

P2_24 is the 2-year 24-hour rainfall amount, in inches.

Average basin impervious area is 20 percent Total basin area is 1.69 square miles

Total basin flows

 $Q_5 = 5.55 \times 1.483 \times 3.74 \times 25.6 = 790$ cubic feet per second $Q_{10} = 11.8 \text{ x } 1.483 \text{ x } 3.63 \text{ x } 15.1 = 960 \text{ cubic feet per second}$

 $Q_{25} = 21.9 \text{ x } 1.483 \text{ x } 3.22 \text{ x } 11.3 = 1,180 \text{ cubic feet per second}$

feet per second, for Percent indicated recur-Basin Area, in subarea of total rence interval, square miles flow in vears Q₂₅ Q₅ Qto A 0.305 18.1 140 175 210 В .292 17.3 140 165 205 C 95 .207 12.2 115 145 D .050 3.0 25 30 35 15 Ε .034 2.0 20 25 F 25 .058 3.4 35 40 G .084 5.0 40 50 60 .280 130 160 195 Н 16.6 I .020 1.2 10 10 15 9.5 75 90 110 T .161 K .074 4.4 35 40 50 L .006 .4 5 5 5 M .119 7.0 55 65 85

BASIN FLOOD DISCHARGES

Node number	Stream stationing	feet pe indica	BF 88C0	n cubic ond, for currence years
		Q ₅	Q ₁₀	Q ₂₅
0 - 1	72+75 - 63+58	140	175	210
1 - 2	63+58 - 54+90	280	340	415
2 - 3	54+90 - 43+00	400	485	595
3 - 4	43+00 - 35+12	400	485	595
4 - 5	35+12 - 29+82	415	505	620
5 - 6	29+82 - 24+74	440	5 40	660
6 - 7	24+74 - 22+22	580	710	870
7 - 8	22+22 - 18+58	620	760	930
8 - 9	18+58 - 15+56	655	800	980
9 - 10	15+56 - 4+55	655	800	980
10 - 11	4+55 - 0+00	735	895	1,100

Figure 3. Akin Branch flood discharges for selected recurrence intervals.

Using the calibrated model for the February 3 flood discharge, flood profiles were computed for existing channel conditions for 5-, 10-, and 25-year recurrence intervals (fig. 4a-4g). Selected output from the hydraulic model has been tabulated to aid in interpretation of results (table 3). The computed flood profiles indicate road overtopping of as much as 2.5 feet at Wedgewood Drive and as much as 1.5 feet at Alpine Drive for the 25-year flood. The profiles also indicate that backwater (hydraulic head buildup) of about 1.4 feet occurs at the upstream side of Alpine Drive. These adverse hydraulic conditions are attributed to undersized structures and flood-plain development.

Simulation of Effects of Alternative Drainage Structures

The calibrated hydraulic model was used to simulate the flood profiles at Akin Branch that would result from possible alternative designs for selected drainage structures. Data on existing structure sizes are listed in table 1, and the alternative drainage improvement designs evaluated using the model are described below for model simulations 1 through 3.

Simulation 1: A three-barrel concrete box culvert with a total barrel width of 24 feet, barrel height of 7 feet, and culvert length of 30 feet was simulated at Wedgewood and Alpine Drives.

Table 2. Akin Branch high-water mark elevations for the February 3, 1990 flood

[High-water mark elevations, in feet. Add 564.29 to convert elevation to sea level. Stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

Stream stationing	High- water mark elevation	Stream stationing	High- water mark elevation	Stream stationing	High- water mark elevation
0+35	43.9	18+58	59.9	43+30	80.9
2+45	46.3	20+00	60.4	44+50	83.6
3+06	47.6	20+75	61.9	44+90	83.6
4+40	51.2	22+30	63.0	52+80	91.3
5+00	52.6	23+28	64.7	55+10	92.0
5+70	53.0	23 + 75	65.1	56+30	94.1
6+50	53.8	24+74	65.2	58+35	94.4
7+10	54.5	25+50	64.7	60+50	94.5
7+25	54.7	26+36	66.5	65+60	98.6
9+10	56.7	30+23	71.8	67+00	100.5
11+00	57.2	32+38	73.5	67+40	101.3
13+37	58.7	33+25	73.7	71+80	107.9
14+60	59.1	34+10	73.7	72+75	108.7
15+85	59.1	35+27	73.9	73+20	108.8
16+20	59.7	42+55	81.3		

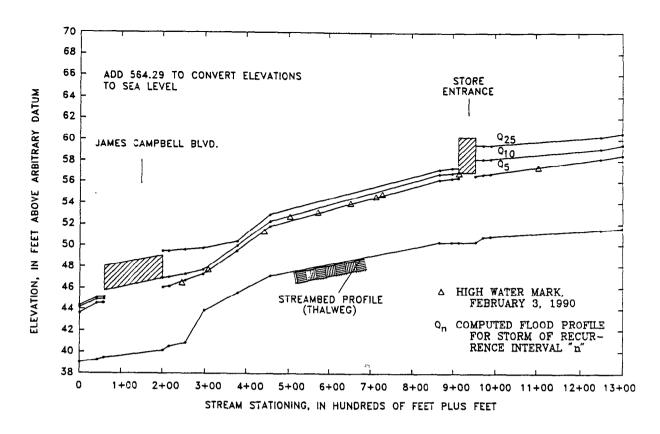


Figure 4a. Computed flood profiles, existing conditions, with February 3, 1990, high-water marks for Akin Branch.

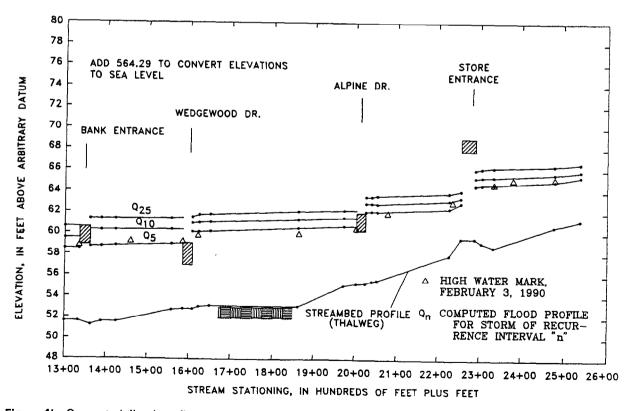


Figure 4b. Computed flood profiles, existing conditions, with February 3, 1990, high-water marks for Akin Branch--Continued.

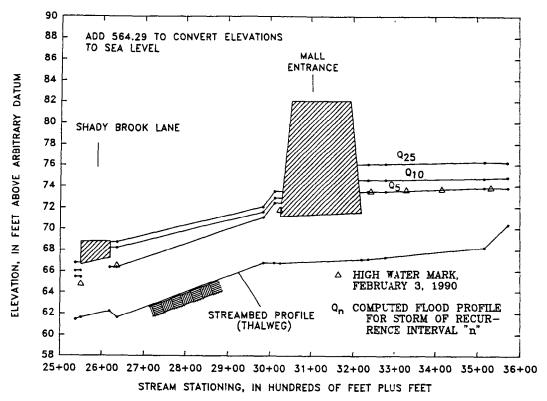


Figure 4c. Computed flood profiles, existing conditions, with February 3, 1990, high-water marks for Akin Branch--Continued.

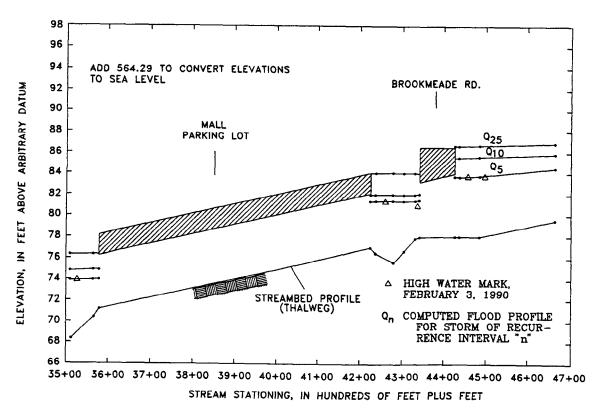


Figure 4d. Computed flood profiles, existing conditions, with February 3, 1990, high-water marks for Akin Branch--Continued.

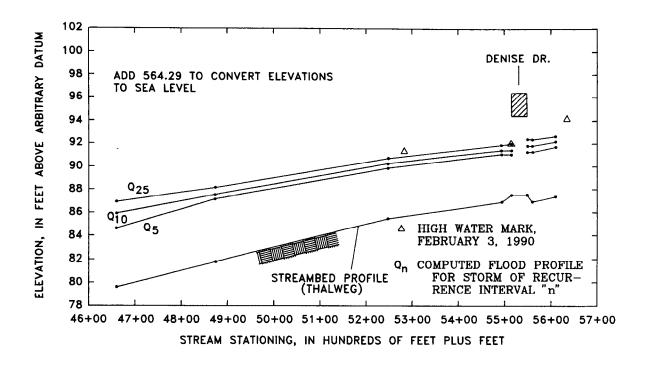


Figure 4e. Computed flood profiles, existing conditions, with February 3, 1990, high-water marks for Akin Branch--Continued.

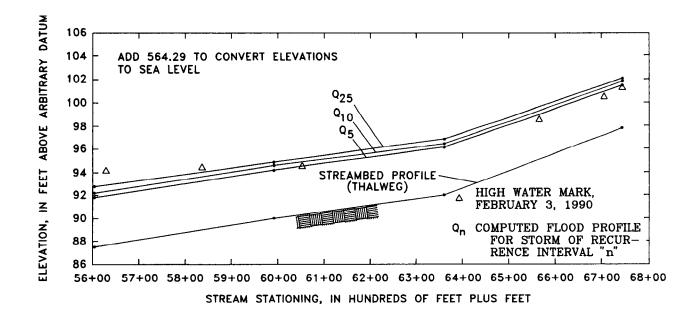


Figure 4f. Computed flood profiles, existing conditions, with February 3, 1990, high-water marks for Akin Branch--Continued.

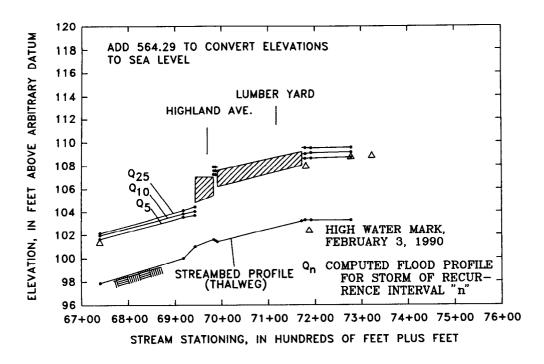


Figure 4g. Computed flood profiles, existing conditions, with February 3, 1990, high-water marks for Akin Branch--Continued.

Simulation 2: A three-barrel concrete box culvert with a total barrel width of 21 feet, barrel height of 6.5 feet, and length of 30 feet was simulated at Wedgewood Drive. A three-barrel concrete box culvert with a total barrel width of 22.5 feet, barrel height of 6.5 feet, and length of 30 feet was simulated at Alpine Drive.

Simulation 3: A three-barrel concrete box culvert with a total barrel width of 24 feet, barrel height of 6 feet, and culvert length of 30 feet was simulated at Wedgewood Drive with maximum channel excavation of 0.8 foot between stations 14+25 and 16+48. A three-barrel concrete box culvert with a total barrel width 24 feet, barrel height of 6 feet, and culvert length of 30 feet was simulated at Alpine Drive.

The simulated flood profiles for the three conditions (fig. 5, 6, and 7) indicate that during the 25-year flood: Drainage improvements modeled in simulation 1 would result in an increase of 0.3 foot in the water-surface elevation upstream from Wedgewood Drive and a decrease of 0.7 foot in the water-surface elevation upstream from Alpine Drive (table 4, fig. 5). No culvert overtopping would occur. Drainage improvements modeled in simulation 2 would result in an increase of 0.6 foot in the water-surface elevation upstream from Wedgewood Drive and a decrease of 0.2 foot in the water-surface elevation upstream from Alpine Drive (table 5, fig. 6). About one-half foot of culvert overtopping would occur at Wedgewood Drive. Drainage improvements modeled in simulation 3 would result in a decrease of 0.2 foot in the water-surface elevation upstream from Wedgewood Drive and a decrease of 0.9 foot in the water-surface elevation upstream from Wedgewood Drive and a decrease of 0.9 foot in the water-surface elevation upstream from Alpine Drive (table 6, fig. 7). Two feet of culvert overtopping would occur at Wedgewood Drive.

For existing conditions, culvert overtopping of approximately 2.5 feet at Wedgewood Drive and 1.5 feet at Alpine Drive can be expected during the 25-year flood. These analyses indicate that culvert overtopping at Wedgewood Drive is necessary to reduce upstream water-surface elevations for existing downstream conditions.

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions

[Add 564.29 to convert elevations to sea level; yr, year; -, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

43.6 10 y 26 y 10 y 26 y 10 y 26 y 6 y 10 y 26 y 10 y 26 y 10 y 26 y 10 y 26 y 10 y 114 44.3 44.3 735 895 950 8.5 8.2 8.4 87 109 114 110 123 138 114 44.5 44.5 45.0 735 895 950 10.9 11.2 11.7 67 80 81 128 11.8 11.2 11.7 67 80 81 82	Stream station-	Water	Water-surface elevation (feet)	elevation	F	Flow (cubic feet per second)	eet per])	N (fe	Mean velocity (feet per second)	ity nd)	Cross.	Cross-sectional area of flow (square feet)	area of feet)	Channet	Bank full elevation	Low steel elevation	Deck eleva-	
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44.5 44.9 45.0 735 895 950 6.7 7.3 7.4 110 123 128 39.2 42.0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	00+0	43.6	4.1	44.3	735	895	950	8.5	8.2	4.8	87	109	114	39.0	41.5	1	1	
44.5 44.9 45.0 735 895 950 10.9 11.2 11.7 67 80 81 39.4 - 45.7 48.0 1 1 46.0 46.9 46.9 735 895 950 9.0 9.2 9.8 82 97 97 40.1 - 46.9 49.0 1 1 46.9 49.4 735 895 1100 8.3 8.5 6.1 89 106 180 40.5 46.5 735 895 1100 8.4 5.6 4.6 135 160 242 40.8 47.0 - 44.9 49.9 50.3 735 895 1100 8.4 6.3 88 94 6.3 88 96 176 45.5 51.0 - 7 8 9 104 49.9 50.3 735 895 1100 8.3 9.8 10.4 79 91 106 45.5 51.0 - 7 8 9 102 10.1 66 79 97 47.1 52.0 - 7 8 9 102 10.1 66 79 97 47.1 52.0 - 7 8 9 104 105 10.1 66 79 97 47.1 52.0 - 7 9 1 105 10.1 66 79 97 47.1 52.0 - 7 9 1 105 10.1 66 79 97 47.1 52.0 - 7 9 1 105 10.1 66 79 97 47.1 52.0 - 7 9 1 105 10.1 66 79 97 47.1 52.0 - 7 9 1 105 10.1 66 79 97 47.1 52.0 - 7 9 7 97 97 97 97 97 97 97 97 97 97 97	0+43	44.5	44.9	45.0	735	895	950	6.7	7.3	7.4	110	123	128	39.2	42.0	1	1	James
44.5 44.9 45.0 735 895 950 10.9 11.2 11.7 67 80 81 39.4 - 45.7 48.0 1 46.0 46.9 46.9 735 895 950 9.0 9.2 9.8 82 97 97 40.1 - 46.9 49.0 9.0 9.2 9.8 82 97 97 40.1 - 46.9 49.0 9.0 9.2 9.8 82 97 97 40.1 - 46.9 49.0 9.2 9.8 82 97 97 40.1 - 46.9 49.0 9.0 9.2 9.8 8.2 97 40.1 - - 49.0 9.0																		Campbell Blvd culvert tailwater.
46.0 46.9 46.9 735 895 950 9.0 9.2 9.8 82 97 97 40.1 - 46.9 49.0 J - 46.1 46.9 49.4 735 895 1100 8.3 8.5 6.1 89 106 180 40.5 40.8 47.0 - 40.8 47.0 40.4 49.9 50.3 735 895 1100 8.8 9.4 6.3 89. 104 735 895 1100 8.8 9.4 6.3 89. 104 735 895 1100 8.8 9.4 6.3 89. 104 735 89. 105 980 9.9 10.2 10.1 66 79 97 47.1 52.0	0+59	44.5	6.9	45.0	735	895	950	10.9	11.2	11.7	29	08	81	39.4	ı	45.7	0.8	James Campbell Blvd culvert
46.6 47.2 49.7 735 895 1100 8.3 8.5 6.1 89 106 180 40.5 46.5 - - 49.0 1 - 49.0 1 - - 49.0 1 - - 49.0 - - 49.0 - - 49.0 - - 49.0 - - 49.0 - - 40.0 - - 49.0 - - - 49.0 - - 49.0 - - - 49.0 - - - 49.0 - - - 49.0 -	2+00	46.0	46.9	46.9	735	895	950	9.0	9.2	8.6	83	97	76	40.1	t	46.9	49.0	James Campbell Blvd culvert inlet.
46.1 46.9 49.4 735 895 1100 8.3 8.5 6.1 89 106 180 40.5 46.5 -	2+00	1	1	49.4	1	1	150	i	1	&	ŀ	ı	17	1	I	1	49.0	James Campbell Blvd road deck.
46.647.249.573589511005.45.64.613516024240.847.0-47.247.649.773589511008.89.46.3839617643.848.0-49.449.950.373589511009.39.810.4799110645.551.0-51.752.352.86558009809.910.210.166799747.152.0-	2+16	46.1	46.9	49.4	735		1100	& &	8. 2.	6.1		106	180	40.5	46.5	1	ı	James Campbell Blvd culvert headwater.
47.2 47.6 49.7 735 895 1100 8.8 9.4 6.3 83 96 176 43.8 48.0 - 49.4 49.9 50.3 735 895 1100 9.3 9.8 10.4 79 91 106 45.5 51.0 - 51.7 52.3 52.8 655 800 980 9.9 10.2 10.1 66 79 97 47.1 52.0 -	:+52	46.6	47.2	49.5	735	895	1100	5.4	5.6	4.6		160	242	40.8	47.0	ŀ	1	
49.4 49.9 50.3 735 895 1100 9.3 9.8 10.4 79 91 106 45.5 51.0 - 51.7 52.3 52.8 655 800 980 9.9 10.2 10.1 66 79 97 47.1 52.0 -	96+3	47.2	47.6	49.7	735		1100	8.8	9.4	6.3	83	96	176	43.8	48.0	1	ı	
51.7 52.3 52.8 655 800 980 9.9 10.2 10.1 66 79 97 47.1 52.0 -	9+4	49.4	49.9	50.3	735		1100	9.3	8.6	10.4	79	91	106	45.5	51.0	!	1	
	1+55	51.7	52.3	52.8	655	800	086	6.6	10.2	10.1	99	62	26	47.1	52.0	1	ı	

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions--Continued

Add 564.29 to convert elevations to sea level; yr, year; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard

,	Remarks		Store culvert tailwater.	Store culvert outlet.	Store culvert inlet.	Store culvert road deck.	Store culvert headwater.			Bank culvert tailwater.	Bank culvert outlet.	Bank culvert inlet.	Bank culvert road deck.	Bank culvert headwater.	
Deck eleva-	tion (feet)	 	ı	60.2	60.2	60.2	t	1	:	ŀ	60.5	60.5	60.5	1	1 .
Low steel elevation	(feet)	:	i	56.9	56.9	I	I	I	1	1	58.8	58.8	l	i	I
Bank full elevation	(feet)	58.0	58.0	I	ŀ	ı	59.0	59.0	0.09	0.09	!	!	:	56.0	56.0
Channel bed	elevation (feet)	50.3	50.3	50.3	50.3	1	50.8	6.05	51.5	51.6	51.6	51.2	i	51.5	51.5
Cross-sectional area of flow (square feet)	25 yr	121	116	107	107	I	183	173	165	226	147	140	64	364	363
oss-sectional area flow (square feet)	10 yr	110	105	107	107	1	143	137	137	177	147	140	ł	284	288
Cross- flow	5 yr	86	94	104	104	ŀ	105	101	114	143	140	135	1	187	191
ity ond)	25 yr	8.1	8.4	9.2	9.2	ł	4.2	5.7	0.9	4.3	5.5	5.8	3.5	2.7	2.7
Mean velocity (feet per second)	10 yr	7.3	7.6	75	7.5	1	5.6	5.8	5.8	4.5	5.4	5.7	ı	2.8	2.8
M (fee	5 yr	6.7	7.0	6.3	6.3	1	6.2	6.5	5.8	4.6	4.7	6.4	1	3.5	3.4
set per	25 yr	086	086	086	086	1	086	086	086	086	810	810	170	086	086
Flow (cubic feet per second)	10 yr	800	800	800	800	1	800	800	800	800	800	800	1	800	800
Flow	5 yr	655	655	655	929	1	655	655	655	655	655	655	I	655	929
levation	25 yr	57.1	57.2	56.9	56.9	1	59.4	59.4	60.2	60.5	58.8	58.8	61.3	61.3	61.3
Water-surface elevation (feet)	10 yr	56.6	56.8	56.9	56.9	1	58.1	58.1	59.1	59.4	58.8	58.8	;	60.2	60.2
Water	5 yr	56.1	56.3	56.4	56.5	1	56.6	56.6	58.1	58.4	58.4	58.6	ł	58.6	58.7
Stream station-	Bu	8+65	8+93	9+10	05+6	0+6	6+67	6+85	12+50	13+00	13+37	13+63	13+63	13+90	14+25

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions--Continued

[Add 564.29 to convert elevations to sea level; yr, year; -, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

	Remarks	Wedgewood Drive bridge tailwater.	Wedgewood Drive bridge outlet.	Wedgewood Drive bridge inlet.	Wedgewood Drive road deck.	Wedgewood Drive bridge headwater.		House on right bank.		House on right bank.
Deck	tion (feet)	1	59.0 V	59.0 V	59.0 W	1	;	Floor H 61.6	1	Floor E
Low steel	elevation (feet)	1	56.9	56.9	I	I	ŀ	Ground F 59.5	ŀ	Ground F 59.3
Bank full	elevation (feet)	56.0	1	1	I	56.0	9.99	t	57.0	1
Channel	bed elevation (feet)	52.7	52.8	52.8	1	53.0	53.1	f	53.1	ı
area of	25 yr	305	65	9	108	292	297	1	224	ı
Cross-sectional area of	riow (square reet)	252	65	59	67	257	292	ŧ	190	ı
Cross	TIOW 5 yr	178	8	89	43	214	219	1	151	1
ity	25 yr	3.2	4. %.	4. ∞.	6.2	4.6	3.3	1	4.2	1
Mean velocity	110 yr 25	3.2	5.9	5.9	5.3	3.1	3.1	t	4.0	ı
2	5 yr	3.7	7.5	7.5	4.1	3.1	3.0	I	4.1	I
et per	25 yr	086	310	310	029	086	086	I	930	ı
Flow (cubic feet per	10 yr	008	380	380	420	008	800	t	760	ı
Flow	5 yr	655	480	480	175	655	655	ı	, 029	ı
evation	25 yr	61.4	56.9	56.9	61.5	61.7	8.19	1	62.1	t
Water-surface elevation	10 yr	60.3	56.9	56.9	6.09	61.0	61.1	1	61.3	ı
Water-	5 yr	58.9	56.9	56.9	60.1	60.1	60.2	ı	60.5	1
Stream	Bui	15+56	15+85	16+07	16+07	16+23	16+48	16+60	18+58	18+60
	•					Hydrole	ogic	and Hydra	ulic /	Analysis

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions--Continued

[Add 564.29 to convert elevations to sea level; yr, year; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

Water-surface elevation Flow (cubic feet per (feet) second) 5 yr 10 yr 25 yr 5 yr 10 yr 25 y	5	5	(cubic secon	우유	et per 25 yr	(fee	Mean velocity (feet per second) 10 yr 25	ty and) 25 yr	Cross-4 flow 5 yr	Cross-sectional area of flow (square feet) 5 yr 10 yr 25 yr	feet)	Channel bed elevation (feet)	Bank full elevation (feet)	Low steel elevation (feet)	Deck eleva- tion	Remarks
760 930	62.2 620 760 930 4.8	760 930 4.8	930 4.8	8.4		4.6		8.4	128	164	195	55.0	58.0	1		Alpine Drive bridge tailwater.
60.3 60.3 580 590 590 7.7 7.8	60.3 580 590 590 7.7	590 590 7.7	7.7	7.7		7.8		7.8	75	75	75	55.3	i	60.3	62.0	Alpine Drive bridge outlet.
60.3 60.3 580 590 590 7.7 7.8	60.3 580 590 590 7.7	590 590 7.7	7.7 069	7.7		7.8		7.8	75	75	75	55.3	1	60.3	62.0	Alpine Drive bridge inlet.
62.1 62.9 63.5 40 170 340 5.3 4.2	63.5 40 170 340 5.3	170 340 5.3	340 5.3	5.3		4.2		6.4	∞	40	69	1	ı	I	62.0	Alpine Drive road deck.
62.1 62.9 63.5 620 760 930 3.9 3.9	63.5 620 760 930 3.9	760 930 3.9	930 3.9	3.9		3.9		2.4	160	195	223	55.5	60.5	I	1	Alpine Drive bridge headwater.
62.1 62.9 63.6 620 760 930 3.9 4.0	63.6 620 760 930 3.9	760 930 3.9	930 3.9	3.9		4.0		4.2	157	192	220	55.6	60.5	ı	1	
	;	1	i i	I		1		1	1	1	1	I	ł	Ground 63.4	Floor 67.1	House on right bank.
62.5 63.2 63.9 580 710 870 4.5 4.3	63.9 580 710 870 4.5	710 870 4.5	870 4.5	2.		4.3		4.5	130	164	194	58.0	63.0	ł	1	Store culvert tailwater.
63.0 63.5 64.1 580 710 870 10.5 11.3	64.1 580 710 870 10.5	710 870 10.5	870 10.5	10.5		11.3		12.0	55	63	72	59.6	ı	67.8	0.69	Store culvert outlet.

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions-Continued

[Add 564.29 to convert elevations to sea level; yr, year; -, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

Stream station-	ı	Water-surface elevation (feet)	levation	Flow	Flow (cubic feet per second)	set per	M (fee	Mean velocity (feet per second)	y) hd)	Cross-4	Cross-sectional area of flow (square feet)	area of feet)	Channel bed	Bank full elevation	Low steel elevation	Deck eleva-	
ğ	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feat)	tion (feet)	Remarks
22 + 84	64.6	65.3	66.1	580	710	870	7.3	7.8	4.8	8	91	101	59.6	1	67.8	0.69	Store culvert inlet.
22+84	1	1	ı	I	ı	ł	ŀ	ı	1	1	l	1	1	ı	1	0.69	Store culvert road deck.
23+00	64.7	65.4	66.2	580	710	870	4.2	2.4	4.2	139	168	205	59.2	65.0	ı	ı	Store culvert headwater.
23+28	64.7	65.4	66.3		710	870	4.0	4.1	4.1	146	175	212	58.8	65.0	i	ì	
24+74	65.1	65.7	66.5	440	540	099	5.6	5.3	8.	82	102	137	8.09	65.0	i	ı	
25+36	65.4	0.99	66.7	440	540	099	5.5	5.4	5.1	81	100	130	61.4	65.0	1	1	Shady Brook Lane culvert tailwater.
25+50	65.4	0.09	9.99	440	540	099	8.3	8.7	4.	53	62	20	61.6	I	9.99	8.8	Shady Brook Lane culvert outlet.
26+21	66.3	67.2	67.2	044	540	099	7.7	7.7	4.	57	07	70	62.2	1	67.2	8.8	Shady Brook Lane culvert inlet.
26+21	ì	ı	ŧ	1	ı	i	1	ı	1	I	1	i	ı	I	ı	8.8	Shady Brook Lane road deck.

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions--Continued

[Add 564.29 to convert elevations to sea level; yr, year; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

	ubic feet per econd)	Flow (cubic feet second)
5 yr 10 yr 25 yr	25 yr 5 yr 10 yr	5 yr 10 yr
4.7 3.3	660 4.7	4.7
9.5 9.9	620 9.5	9.5
4.6 4.9	620 4.6	9.4
6.7 8.1	620 6.7	6.7
6.7 8.1	620 6.7	6.7
:	1	I
3.0 2.9	620 3.0	3.0
3.0 2.9	620 3.0	3.0
4.1 3.8	595 4.1	4.1
6.0 5.4	595 6.0	6.0

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions--Continued

[Add 564.29 to convert elevations to sea level; yr, year; -, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

w (cubic feet per second) 10 yr 25 yr 5 yr	N 9		ž <u>š</u>	Mean velocity (feet per second) 10 yr 25	5	Cross-s flow 5 yr	Cross-sectional area of flow (square feet) 5 yr 10 yr 25 yr	ires of eet) 25 yr	Channel bed elevation (feet)	Bank full elevation (feet)	Low steel elevation (feet)	Deck eleva- tion (feet)	Remarks Mall parking
400	485	595	8. 8.	9.2	∞ 4.	4	53	17	71 .1	:	7.9/	1.8/	Main parking lot culvert outlet.
400 485		295	6.5	6.9	4.	62	02	11	77.0	1	82.1	84.0	Mall parking lot culvert inlet.
1		I	1	1	1	ı	ı	1	i	I	1	84.0	Mall parking lot culvert road deck.
400 485		595	3.1	3.1	2.5	131	155	240	76.5	84.0	ı	ı	Mall parking lot culvert headwater.
400 485 ;	٠.	595	3.0	3.1	2.6	133	155	231	75.7	84.0	ı	ı	
400 485 5	٧n	595	4.5	4.6	3.5	68	106	170	76.7	84.0	ł	ı	
400 485 5	Ň	595	7.1	6.9	5.0	26	0/	120	6.77	84.0	ı	ı	Brookmeade Road culvert tailwater.
400 485 5	٧ñ	260	11.8	12.1	11.0	46	40	51	78.1	I	83.2	86.5	Brookmeade Road culvert outlet.
400 485 5	δ 1	260	7.1	8.2	9.5	26	29	59	78.1	I	84.0	86.5	Brookmeade Road culvert inlet.
1		35	1	t	5.0	ŀ	t	7	t	1	I	86.5	Brookmead Road road deck.

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions--Continued

[Add 564.29 to convert elevations to sea level; yr, year; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

	Remarks	Brookmeade Road culvert headwater.					Denise Drive culvert tailwater.	Denise Drive culvert outlet.	Denise Drive culvert inlet.	Denise Drive road deck.	Denise Drive culvert headwater.	
Deck eleva-	tion (feet)		1	ł	ı	1	1	96.4	96.4	96.4	1	1
Low steel elevation	(feet)	1	i	1	I	ŀ	1	94.4	94.4	i	ı	ı
Bank full elevation	(feet)	85.0	85.0	86.0	86.0	89.0	90.0	I	I	1	0.09	90.0
Channel	elevation (feet)	78.1	78.1	9.62	81.8	85.5	87.0	87.6	87.6	i	87.0	87.5
area of feet)	25 yr	165	161	96	85	66	115	83	88	!	06	100
Cross-sectional area of flow (square feet)	10 yr	135	131	72	70	85	100	47	20	1	89	82
Cross	5 yr	68	87	49	62	71	88	42	4	ı	20	89
ty ind)	25 yr	3.6	3.7	6.2	7.0	6.0	3.6	7.8	7.2	1	9.4	4.2
Mean velocity (feet per second)	10 yr	3.6	3.7	6.7	6.9	5.7	3.4	7.2	8.	1	5.0	4.2
M (fee	5 yr	4.5	4.6	8.1	6.4	5.7	3.2	6.7	4.9	1	5.6	4.1
et per	25 yr	595	595	595	595	595	415	415	415	ı	415	415
Flow (cubic feet per second)	10 yr	485	485	485	485	485	340	340	340	ı	340	340
Flow	5 yr	400	400	400	400	400	280	280	280	1	280	280
evation	25 yr	9.98	2.98	6.98	88.1	7.06	92.0	92.0	92.4	1	92.4	92.7
Water-surface elevation (feet)	10 yr	85.5	9.58	85.9	87	90.3	91.5	91.5	91.8	1	91.8	92.2
Water-1	5 yr	83.7	83.8	84.5	87.1	6.68	91.1	91.1	91.3	1	91.3	91.8
S ts	50 . <u>C</u>	rdraulic Analys	44+80	46+60	48+73	52+45	54+90	55+10	55+44	55+44	55+56	56+05

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions--Continued

[Add 564.29 to convert elevations to sea level; yr, year; -, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

Deck eleva-	t) tion Remarks (feet)		1	1	- Highland Avenue culvert tailwater.	4.8 107.0 Highland Avenue culvert outlet.	5.4 107.0 Highland Avenue culvert inlet.	- 107.0 Highland Avenue road deck.	- Highland Avenue culvert headwater.	Lumber yard culvert tailwater.	5.2 107.6 Lumber yard
==	(feet) (feet)	92.0	94.0	100.0	102.5	- 104.8	- 105.4	1	1	1	- 106.2
Channel	elevation (feet)	90.0	92.1	97.9	100.0	101.0	101.6	I	101.5	101.5	101.4
l area of feet)	25 yr	82	73	34	47	16	17	16	79	67	5 6
Cross-sectional area of flow (square feet)	10 yr	72	63	53	42	15	17	10	£7	23	56
Cross	5 yr	63	54	25	36	13	17	4	8	8	56
ity ond)	25 yr	5.0	2.9	6.1	4.5	9.4	∞	%. %	2.7	2.7	7.5
Mean velocity (feet per second)	10 yr	4.7	2.8	0.9	4.2	10.0	8.5	3.1	2.4	2.4	6.7
N (fe.	5 yr	4.4	5.6	5.7	3.9	10.0	7.6	2.5	2.1	2.1	5.4
et per	25 yr	415	210	210	210	150	150	8	210	210	195
Flow (cubic feet per second)	10 yr	340	175	175	175	145	145	30	175	175	175
Flow	5 yr	280	140	140	140	130	130	10	140	140	140
levation	25 yr	94.8	6.96	102.1	104.1	104.4	105.4	107.9	107.9	107.9	106.2
Water-surface elevation (feet)	10 yr	94.6	96.5	101.9	103.8	104.0	105.4	107.6	107.6	107.6	106.2
Water	5 yr	94.2	96.2	9'101	103.5	103.7	105.4	107.2	107.2	107.2	106.2
Stream station-	8	29+90	63+58	67+40	69+18	69+44	69 + 84	69 +84	28+ 69 Ogic and Hydr	69+87	06+69

Table 3. Selected data from hydraulic analysis of Akin Branch, existing conditions--Continued

[Add 564.29 to convert elevations to sea level; yr, year; -, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

iy																	İ	
1	Stream station-	Water-	Water-surface elevation (feet)	levation	Flow	Flow (cubic feet per second)	et per	N (fee	Mean velocity (feet per second)	ity ind)	Cross-	Cross-sectional area of flow (square feet)	area of feet)	Channel bed	Bank full elevation	Low steel elevation	Deck eleva-	
c and !	.i.	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
│	02+1	71+70 108.0	108.0	108.0	140	175	195	5.4	6.7	7.5 26	26	26	26	103.2	l	108.0	109.2	Lumber yard culvert inlet.
	71+70	I	ŀ	109.5	t	ı	15	ŀ	ŀ	3.1	ŧ	ı	5	1	1	1	109.2	Lumber yard road deck.
	1+76	71+76 108.6	109.0	109.5	140	175	210	2.4	2.6	2.8	59	<i>L</i> 9	27	103.3	106.0	i	ı	Lumber yard culvert headwater.
	71+90	108.6	109.1	109.5	140	175	210	2.4	2.6	5.8	28	<i>L</i> 9	74	103.3	106.0	1	ı	
	72+75	108.7	109.2	109.6	140	175	210	2.6	2.8	2.9	55	2	71	103.3	107.0	t	1	

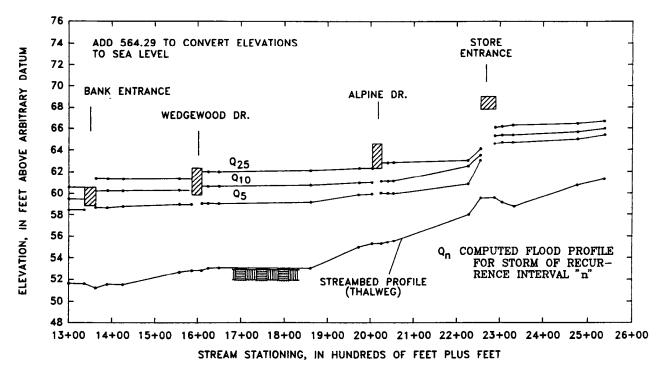


Figure 5. Computed flood profiles for Akin Branch, simulation 1.

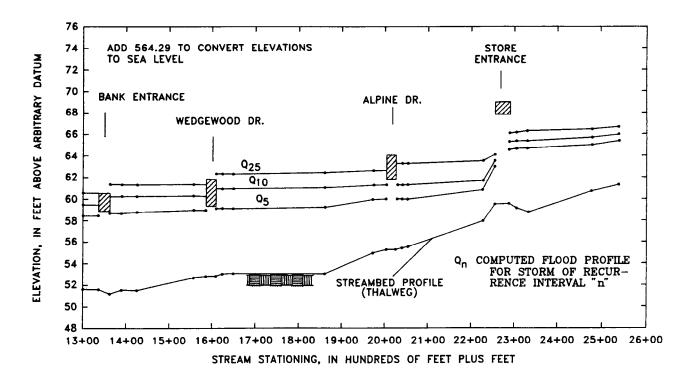


Figure 6. Computed flood profiles for Akin Branch, simulation 2.

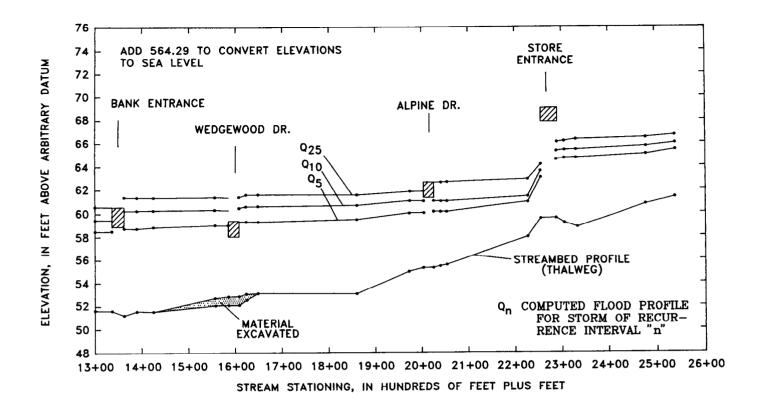


Figure 7. Computed flood profiles for Akin Branch, simulation 3.

Cayce Valley Branch

Cayce Valley Branch drains a small urban watershed with a contributing drainage area of 1.04 mi². At present, residential and commercial development account for about 5 percent of the basin. However, the potential for continued development could result in 10 percent of the contributing drainage area becoming impervious to infiltration of rainfall in the future. This value of imperviousness was used to estimate flood discharges for future developed conditions.

The study reach (fig. 8) begins at a point approximately 100 feet downstream from Whitney Drive (structure 1), and extends upstream approximately 5,000 feet (measured along the centerline of the stream) to a point just upstream of the culvert under Jewell Drive (structure 11) (table 7). The study reach contains a total of 11 culverts and bridges.

Flood Discharges

Flood discharges for Cayce Valley Branch were computed by assigning a percentage of the total basin flood discharge to each basin subarea based on the percentage of the watershed occupied by the subarea (fig. 9). The watershed was subdivided on the basis of topography and the location of tributaries draining into the creek. Flood discharges for the 5-, 10-, and 25-year recurrence intervals for each basin subarea were calculated using the equations developed by Robbins (1984). These values were input to the WSPRO model for the calculation of water-surface profiles.

[Add 564.29 to convert elevations to sea level; -, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard] Table 4. Selected data from hydraulic analysis of Akin Branch, simulation 1

	Remarks		Wedgewood Drive culvert tailwater.	Wedgewood Drive culvert outlet.	Wedgewood Drive culvert inlet.	Wedgewood Drive road deck.	Wedgewood Drive culvert headwater.		House on right bank.		House on right
Deck eleva-	tion (feet)	1	1	62.3	62.3	62.3	!	1	Floor 61.6	ı	Floor 65.7
Low steel	(feet)	 	I	59.8	59.8	ı	ı	ı	Ground 59.5	ı	Ground 59.3
Bank full elevation	(feet)	56.0	56.0	1	ı	1	56.0	56.0	I	57.0	1
Channel	elevation (feet)	51.5	52.7	52.8	52.8	ı	53.0	53.1	ı	53.1	ı
area of feet)	25 yr	360	346	168	168	ı	362	362	1	225	i
Cross-sectional area of flow (square feet)	10 yr	288	288	168	168	ı	295	295	ı	161	ţ
Cross	5 yr	189	220	146	149	I	214	215	ı	8	ı
ity ond)	25 yr	2.7	% %	& %	2. 8.	;	2.7	2.7		4.1	;
Mean velocity (feet per second)	10 yr	2.8	2.8	4 . 8.	8 .	ł	2.7	2.7	ı	4.7	ı
(fee	5 yr	3.5	3.0	5.5	4. 4.	ł	3.1	3.1	ŀ	6.9	ı
st per	25 yr	086	086	086	086	ı	086	086	ı	930	1
Flow (cubic feet per second)	10 yr	800	800	800	008	1	008	800	1	992	l
Flow	5 yr	655	655	655	655	ŀ	\$ 655	8 559	ŀ	620	1
evation	25 yr	61.3	61.3	59.8	59.8	ı	62.0	62.0	ı	62.1	ı
Water-surface elevation (feet)	10 yr	60.2	60.2	59.8	59.8	1	9.09	9.09	1	60.7	1
Water-6	5 γτ	58.7	58.9	58.9	59.0	1	59.0	59.0	1	59.1	1
Stream station-	3	14+25	15+56	15+85	16+07	16+07	16+23	16+48	16+60	18+58	18+60

	Remarks	Alpine Drive culvert tailwater.	Alpine Drive culvert outlet.	Alpine Drive culvert inlet.	Alpine Drive road deck.	Alpine Drive culvert headwater.		House on right bank.	Store culvert tailwater.	Store culvert outlet.	Store culvert
Deck eleva-	tion (feet)	1	64.5	64.5	64.5	I	1	Floor 67.1	1	0.69	0.69
Low steel elevation	(feet)	!	62.3	62.3	ı	1	ŀ	Ground 63.4	1	67.8	67.8
Bank full elevation	(feet)	58.0	!	1	;	60.5	60.5	ì	63.0	1	1
Channel bed	elevation (feet)	55.0		55.3	ı	55.5	55.6	ł	58.0	59.6	59.6
l area of feet)	25 yr	255	168	168	ŀ	238	216	i	152	72	104
Cross-sectional area of flow (square feet)	10 yr	199	137	140	ı	164	152	ı	91	. 63	91
Cros	5 yr	154	110	113	ı	126	118	1	02	55	08
ty ond)	25 yr	3.6	5.5	5.5	ı	3.9	4.3	I	5.7	12.1	8.4
Mean velocity (feet per second)	10 yr	3.8	5.5	5.4	I	4.6	5.0	1	7.8	11.3	7.8
M. (fee	5 yr	4.0	5.6	5.5	I	4.9	5.3	ł	8.3	10.5	7.3
et per	25 yr	930	930	930	I	930	930	ł	870	870	870
Flow (cubic feet per second)	10 yr	760	760	09/	ı	760	09/	ı	710	710	710
Flow	5 yr	620	620	970	1	620	620	1	580	580	580
vation	25 yr	62.3	62.3	62.3	1	62.8	62.8	ı	63.0	64.1	66.1
Water-surface elevation (feet)	10 yr	61.0	61.0	61.1	!	61.1	61.1	1	61.5	63.5	65.3
Water-€	5 yr	59.9	6'65	0.09	ŀ	0.09	0.09	ŀ	6.09	63.0	64.6
Stream station-	B u	19+70	20+00	20+22	20+22	20+37	20+50	20+60	22+22	22+50	22 +84

[Add 564.29 to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard] Table 4. Selected data from hydraulic analysis of Akin Branch, simulation 1--Continued

	Remarks	Store culvert road deck.	Store culvert headwater.
Deck eleva-	tion (feet)	0.69	ı
Low steel elevation	(feet)	1	I
Bank full elevation	(feet)	1	65.0
Channel	elevation (feet)		59.2
Cross-sectional area of flow (square feet)	5 yr 10 yr 25 yr 5 yr 10 yr 25 yr	* 1	205
ross-sectional area of flow (square feet)	10 yr		168
Cross	5 yr	 	139
ity ond)	25 yr	!	4.2 139
Mean velocity (feet per second)	10 yr	1	4.2
M. (fee	5 yr	l l	4.2
et per	25 yr	I	870
Flow (cubic feet per second)	10 yr	ı	710
Flow	5 yr	1	580
evation	25 yr		66.2
Water-surface elevation (feet)	5 yr 10 yr 25 yr 5 yr 10 yr 25 yr	1	64.7 65.4 66.2
Water-4	5 yr	1	64.7
Stream station-	gui	22 + 84	23+00

& Table 5. Selected data from hydraulic analysis of Akin Branch, simulation 2

[Add 564.29 to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

	Remarks		Wedgewood Drive culvert tailwater.	Wedgewood Drive culvert outlet.	Wedgewood Drive culvert inlet.	Wedgewood Drive culvert road deck.	Wedgewood Drive culvert headwater.		House on right bank.		House on right bank.
Deck eleva-	tion (feet)	T South year /	ı	61.8	61.8	61.8	ŀ	i	Floor 61.6	;	Floor 65.7
Low steel elevation	(feet)	1	I	59.3	59.3	ſ	i	1	Ground 59.5	1	Ground 59.3
Bank full elevation	(feet)	56.0	56.0	1	1	ı	56.0	26.0	1	57.0	1
Channel	elevation (feet)	51.5	52.7	52.8	52.8	t	53.0	53.1	ī	53.1	1
l area of feet)	25 yr	360	346	136	136	83	374	374	ı	237	1
Cross-sectional area of flow (square feet)	10 yr	288	288	136	136	ì	308	308	1	174	1
Cross	5 yr	189	220	128	130	i	217	218	ı	25	1
sity sond)	25 yr	2.7	8	6.7	6.7	3,0	5.6	2.6	1	3.9	1
Mean velocity (feet per second)	10 yr	2.8	86	6.5	5.9	ı	2.6	5.6	1	4.4	1
≥ <u>0</u>	5 4	3.5	3.0	5.1	5.0	ı	3.0	3.0	I	8.9	i
et per	25 yr	086	086	910	910	70	086	086	ł	930	ı
Flow (cubic feet per second)	10 yr	800	008	800	008	ı	800	800	ı	092	1
Flow	15. 15.	655	925	655	655	ı	655	655	1	970	1
vation	25 yr	61.3	61.3	59.3	59.3	62.3	62.3	62.3	ı	62.3	t
Water-surface elevation (feet)	10 yr	60.2	60.2	59.3	59.3	1	6.09	6.09	:	61.0	ŀ
Water-6	5 yr	58.7	58.9	58.9	59.0	1	59.0	59.0	!	59.2	ı
Stream station-	i Bi	. 14+25	15+56	SS + ST Akin Branc	16+07	16+07	16+23	16+48	16+60	18+58	18+60

[Add 564.29 to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard] Table 5. Selected data from hydraulic analysis of Akin Branch, simulation 2.-Continued

Stream station-	Water-	Water-surface elevation (feet)	levation	Flo	Flow (cubic feet per second)	eet per	M (fee	Mean velocity (feet per second)	ity and)	Cross-	Cross-sectional area of flow (square feet)	area of feet)	Channel	Bank full elevation	Low steel elevation	Deck eleva-	
B	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
19+70	0.09	61.3	62.5	620	760	930	4.0	3.7	3.5	155	208	265	55.0	58.0	1	1	Alpine Drive culvert tailwater.
20+00	0.09	61.3	61.8	620	092	930	5.8	5.6	4.9	106	135	146	55.3	i	61.8	64.0	Alpine Drive culvert outlet.
20+22	0.09	61.3	61.8	620	092	930	5.8	5.6	4.9	106	135	146	55.3	1	61.8	64.0	Alpine Drive culvert inlet.
20+22	1	ı	ŀ	1	:	ı	1	1	ı	1	I	ŀ	1	1	1	64.0	Alpine Drive road deck.
20+37	0.09	61.3	63.3	620	760	930	4.9	4.	3.6	128	173	261	55.5	60.5	ı	ŀ	Alpine Drive culvert headwater.
20+50	0.09	61.3	63.3	620	760	930	5.2	8.	3.9	120	160	240	55.6	60.5	:	;	
20+60	1	ı	ı	ł	ŧ	ı	ı	f	1	1	1	t	i	i	Ground 3.4	Floor 67.1	House on right bank.
22 + 22	6.09	61.7	63.5	280	710	870	8.3	7.3	5.0	70	86	174	58.0	63.0	ł	i	Store culvert tailwater.
22+50	63.0	63.5	64.1	280	710	870	10.5	11.3	12.1	55	ಜ	72	59.6	1	8.79	0.69	Store culvert

outlet.

8 Table 5. Selected data from hydraulic analysis of Akin Branch, simulation 2-Continued

Stream station-	Water	Water-surface elevation (feet)	levation	Flo	Flow (cubic feet per second)	eet per	(fec	Mean velocity (feet per second)	ity Sud)	Cross-flow	Cross-sectional area of flow (square feet)	area of feet)	Channel	Bank full elevation	Low steel elevation	Deck eleva-	
gui	5 yr	10 yr	25 yr	5 yr	10 yr 25 yr 5 yr 10 yr 25 yr	25 yr	5 yr	5 yr 10 yr 25 yr 5 yr 10 yr 25 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
22+84 64.6 65.3 66.1 580	64.6	65.3	66.1	580	710	870	7.3	7.8	4.8	08	16	104	59.6	ı	67.8	0.69	Store culvert inlet.
22 +84	i	1	1	ı	I	I	ı	1	1	ı	ı	ţ	ı	ŀ	ı	0.69	Store culvert road deck.
23+00 64.7 65.4 66.2 580	64.7	65.4	66.2	280	710	870	4.2	4.2	4.2 139		168	20.5	59.2	65.0	i	ı	Store culvert headwater.

Table 6. Selected data from hydraulic analysis of Akin Branch, simulation 3

[Add 564.29 to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

1.84	face e	Water-surface elevation		Flow (cubic feet per	set per	¥	Mean velocity	_ ≥	Cross-	Cross-sectional area of	area of	Channel	Bank full	Low steel	Deck	
(feet)				second)	- 1	(fee	(feet per second)	g g		flow (square feet)	(eet)	bed elevation	elevation (feet)	elevation	eleva-	Remarks
10 yr		25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	(feet)			(feet)	Maille
60.2		61.3	655	800	086	3.5	2.8	2.7	189	288	360	51.5	56.0		1	
60.2		61.3	655	800	086	2.7	2.6	2.7	239	307	364	52.0	56.0	1	ı	Wedgewood Drive culvert tailwater.
58.0		58.0	655	580	490	5.4	0.4	4.	144	44	144	52.0	i	58.0	59.3	Wedgewood Drive culvert outlet.
58.0		58.0	655	580	490	5.4	4.0	4.6	144	144	144	52.0	I	58.0	59.3	Wedgewood Drive culvert inlet.
60.4		61.3	ı	220	490	1	4.2	5.3	1	52	92	1	1	I	59.3	Wedgewood Drive culvert road deck.
60.5		61.5	655	800	086	2.7	2.7	6, 80	243	302	349	52.5	56.0	i	1	Wedgewood Drive culvert headwater.
60.5		61.5	655	800	086	2.9	2.8	2.9	228	788	335	53.1	56.0	ŀ	1	•
I		I	1	ł	ı	;	t		ı	1	1	ļ	i	Ground Fl 59.5	Floor 61.6	House on right bank.
9.09		61.5	970	092	930 6	602	4.7	4.7	100	155	199	53.1	57.0	I	1	
1		1	ı	ı	ı	ı	ı	ŀ	1	i	i	ı	1	Ground Flo 59.3	Floor 65.7	House on right bank.

α Table 6. Selected data from hydraulic analysis of Akin Branch, simulation 3--Continued

[Add 564.29 to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard]

Stream station-	Water₁	Water-surface elevation (feet)	evation	Flow	Flow (cubic feet per second)	et per	Me (feet	Mean velocity (feet per second)	(pu	Cross-6	Cross-sectional area of flow (square feet)	area of 'eet)	Channel	Bank full elevation	Low steel elevation	Deck eleva-	
B	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 74	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
19+70	0.09	61.0	61.8	620	760	930	3.9	3.9	0.4	158	195	234	55.0	58.0	ı	ı	Alpine Drive culvert tailwater.
20+00	0.09	61.0	61.3	620	760	930	5.5	5.5	6.5	113	137	144	55.3	ı	61.3	62.6	Alpine Drive culvert outlet.
20+22	60.1	61.0	61.3	620	092	930	4.2	5.5	6.5	115	137	144	55.3	İ	61.3	62.6	Alpine Drive culvert inlet.
20+22	1	t	:	i	t	ı	ı	i	ı	1	1	I	t	i	1	62.6	Alpine Drive culvert road deck.
20+37	60.1	61.0	62.6	620	760	930	8 .	4.7	4.1	129	160	228	55.5	60.5	I	ŧ	Alpine Drive culvert headwater.
20+50	60.1	61.0	62.6	620	760	930	5.1	5.1	4.4	121	150	210	55.6	60.5	1	ı	
20+60	1	1	1	ŧ	1	1	ı		ı	1	ŧ	1	i	ı	Ground F 63.4	Floor 67.1	House on right bank.
22+22	6.09	61.4	62.8	280	710	870	& 6.	8.0	6.1	6	68	143	280	63.0	ł	ı	Store culvert tailwater.

[Add 564.29 to convert elevations to sea level; -, no data; stream stationing is given in hundreds of feet plus feet from a point 59 feet downstream from James Campbell Boulevard] Table 6. Selected data from hydraulic analysis of Akin Branch, simulation 3--Continued

Water-surface elevation Flow (cubic feet per (feet)			Flow (ct.	8 CCL	cubic fe second)	et per	M(fee	Mean velocity (feet per second)	ity ond)	Cross	Cross-sectional area of flow (square feet)	area of feet)	Channel bed elevation	Bank full elevation (feet)	Low steel elevation (feet)	Deck eleva- tion	Remarks
5 yr 10 yr 25 yr 5 yr 10 yr 25 yr	5 yr 10 yr	5 yr 10 yr	5 yr 10 yr		25 yr		5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	(feet)			(feet)	
63.0 63.5 64.1 580 710 870	64.1 580 710	210	210		870		10.5	11.3	12.1 55	55	83	72	59.6	ţ	8.7.8	0.69	Store culvert outlet.
64.6 65.3 66.1 580 710 870	65.3 66.1 580 710	66.1 580 710	710		870		7.3	7.8	8.4	80	91	104	59.6	1	67.8	0.69	Store culvert inlet.
1	1 1	1	1	f			1	ı	1	1	t	t	I	1	ı	0.69	Store culvert road deck.
64.7 65.4 66.2 580 710 870	65.4 66.2 580 710 870	66.2 580 710 870	710 870	870			4.2	2.4	4.2 139	139	168	205	59.2	65.0	1	1	Store culvert headwater.

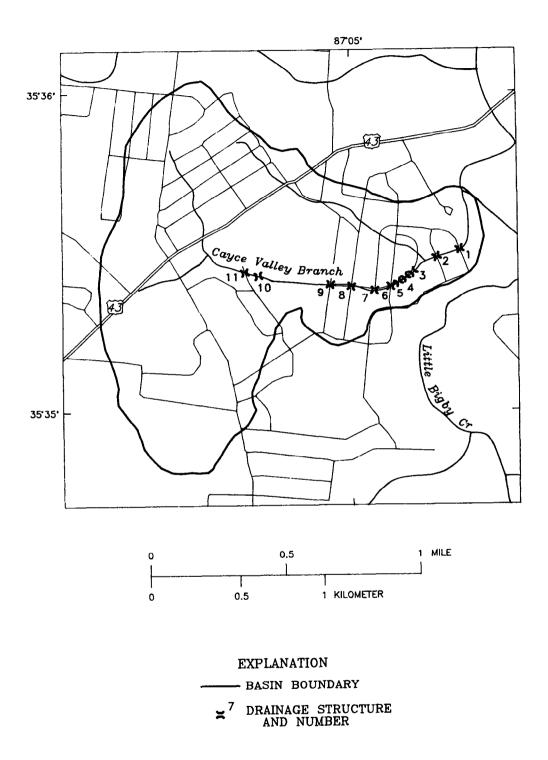


Figure 8. Location of drainage structures in the Cayce Valley Branch study reach.

Table 7. Cayce Valley Branch culvert and bridge inventory

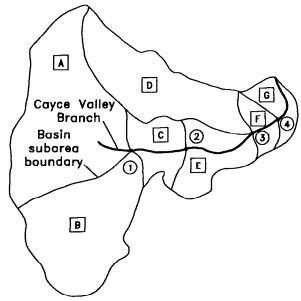
[Stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive]

Structure number	Structure name	Stream stationing	Structure description
1 .	Whitney Drive culvert.	4+12 - 4+46	Two-barrel concrete pipe culvert. Barrel diameter, 4 feet. Length, 34 feet.
2	Mariner Drive culvert.	8+47 - 8+86	Three-barrel corrugated metal pipe culvert. Average barrel diameter, 4 feet. Length, 39 feet
3	Foot bridge	12+06 - 12+22	Two-barrel smooth metal pipe culvert. Barrel diameter, 2 feet. Length, 16 feet.
4	Private driveway culvert.	13+06 - 13+22	Two-barrel concrete box culvert. Average barrel inlet, 5.4 feet x 4.1 feet. Length, 16 feet.
5	Private driveway culvert.	18+58 - 18+75	Two-barrel concrete box culvert. Average barrel inlet, 5.8 feet x 4.2 feet. Length, 17 feet.
6	Manor Road culvert.	21+16 - 21+36	One-barrel concrete box culvert. Barrel inlet, 13.6 feet x 4.1 feet. Length, 20 feet.
7	Cayce Valley Drive culvert.	24+36 - 24+68	One-barrel concrete box culvert. Barrel inlet, 12 feet x 3.2 feet. Length, 32 feet.
8	Windemere Drive culvert.	28+40 - 28+66	One-barrel concrete box culvert. Barrel inlet, 12 feet x 3.7 feet. Length, 26 feet.
9	Timberwood Drive culvert.	33+40 - 33+64	One-barrel concrete box culvert. Barrel inlet, 12 feet x 4.2 feet. Length, 24 feet.
10	Farm driveway culvert.	47+09 - 47+22	One-barrel timber deck culvert. Inlet, 9.2 feet x 4.7 feet. Length, 13 feet.
11	Jewell Drive culvert.	49+64 - 49+77	Two-barrel, corrugated metal pipe culvert. Barrel cross-sectional area, 11.5 ft ² . Length, 13 feet.

Flood Profiles

Flood profiles were computed for existing channel conditions for 5-, 10-, and 25-year recurrence interval floods at Cayce Valley Branch (fig. 10a-10d). No observed flood data are available for Cayce Valley Branch to use in calibrating the WSPRO model. The computed profiles indicate road overtopping of as much as 0.9 foot at Whitney Drive and 0.9 foot at Mariner Drive for the 25-year flood. The flood profiles also indicate the occurrence of backwater of as much as 5.3 feet at the upstream side of Whitney Drive and as much as 2.5 feet at Mariner Drive for the 25-year flood discharge. Hydraulic problems at these locations are attributed to undersized structures at both streets and a clogged channel downstream from Whitney Drive. Selected output from the hydraulic model has been tabulated to aid in interpretation of results (table 8).

CAYCE VALLEY BRANCH WATERSHED



0 1,000 2,000 3,000 4,000 5,000 FEET 0 200 400 600 800 1,000 METERS EXPLANATION

(1) NODE AND NUMBER

B BASIN SUBAREA DESIGNATION

URBAN RUNOFF EQUATIONS (Robbins, 1984)

 $Q_5 = 5.55 (A)^{0.75} (IA)^{0.44} (P2_24)^{2.53}$ $Q_{10} = 11.8 (A)^{0.75} (IA)^{0.43} (P2_24)^{2.12}$ $Q_{25} = 21.9 (A)^{0.75} (IA)^{0.39} (P2_24)^{1.89}$

 $P2_24 = 3.6$ inches

Where

On is the estimated flood discharge, in cubic feet per second, for the indicated recurrence interval, in years;

A is the area of the watershed, in square miles;

IA is the percentage of the drainage area that is impervious to infiltration of rainfall; and

P2_24 is the 2-year 24-hour rainfall amount, in inches.

Average basin impervious area is 10 percent Total basin area is 1.04 square miles

Total basin flows

 $Q_5 = 5.55 \text{ x } 1.028 \text{ x } 2.75 \text{ x } 25.6 = 400 \text{ cubic feet per second}$ $Q_{10} = 11.8 \text{ x } 1.028 \text{ x } 2.69 \text{ x } 15.1 = 495 \text{ cubic feet per second}$ $Q_{25} = 21.9 \text{ x } 1.028 \text{ x } 2.45 \text{ x } 11.3 = 625 \text{ cubic feet per second}$

BASIN SUBAREA FLOOD DISCHARGES

Basin subarea	Area, in square miles	Percent of total flow	feet pe indic rend	rge, in r secon ated re e inten n years	d, for cur-
			Q ₅	Q ₁₀	Q ₂₅
Α	0.345	33.2	135	165	210
В	.256	24.7	100	120	155
С	.072	6.9	25	35	40
D	.206	19.8	80	100	125
E	.090	8.7	35	45	55
F	.032	3.0	10	15	20
G	.039	3.7	15	20	25

BASIN FLOOD DISCHARGES

Node number	Stream stationing	feet p indica	arge, in er seco ted rec val, in y	nd, for urrence
		Q ₅	Q ₁₀	Q ₂₅
0 - 1	49+93 - 48+36	135	165	210
1 - 2	48+36 - 33+22	260	320	405
2 - 3	33+22 - 11+96	295	365	460
3 - 4	11+96 - 4+00	385	480	605

Figure 9. Cayce Valley Branch flood discharge for selected recurrence intervals.

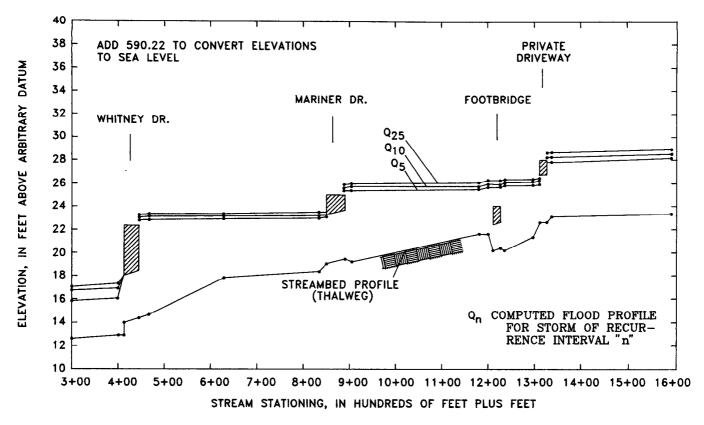


Figure 10a. Computed flood profiles, existing conditions, for Cayce Valley Branch.

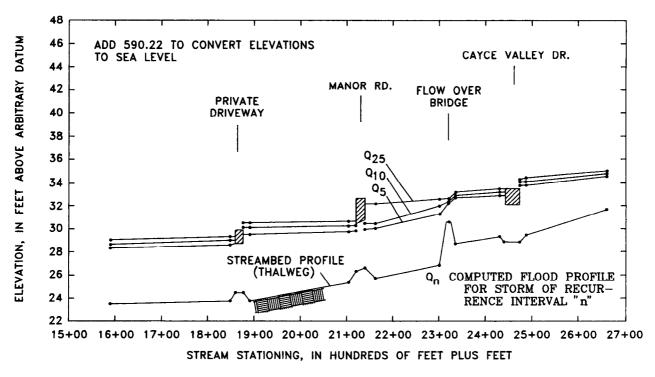


Figure 10b. Computed flood profiles, existing conditions, for Cayce Valley Branch--Continued.

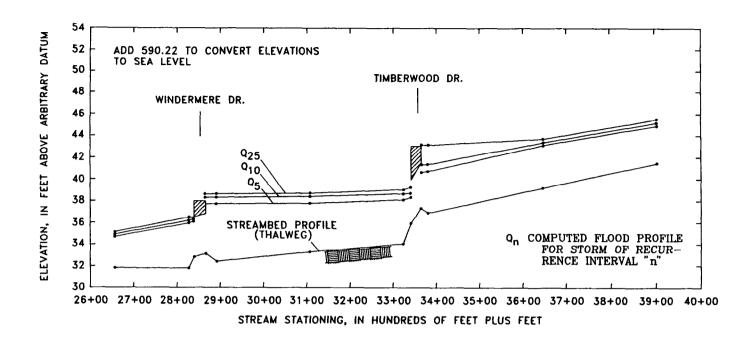


Figure 10c. Computed flood profiles, existing conditions, for Cayce Valley Branch--Continued.

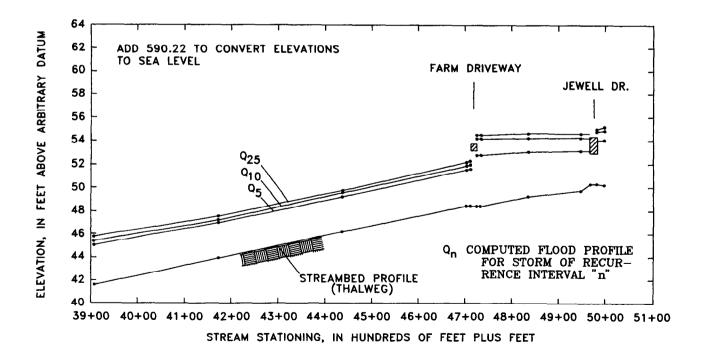


Figure 10d. Computed flood profiles, existing conditions, for Cayce Valley Branch--Continued.

[Add 590.22 feet to convert elevations to sea level; -, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive] Table 8. Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions

Stream station-	Water	Water-surface elevation (feet)	evation	Flow	Flow (cubic feet per second)	set per	M _e	Mean velocity (feet per second)	ty nd)	Cross	Cross-sectional area of flow (square feet)	area of leet)	Channel	Bank full elevation	Low steel elevation	Deck eleva-	
ğu	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
3+00	15.8	16.7	17.0	385	480	\$09	8.9	7.1	7.4	43	89	82	12.6	16.2	1	ı	
3+00	ı	ŀ	1	I	1	1	t	ŧ	1	1	1	1	1	ı	ۇ ا	Ground 17.4	House 250 feet left of channel.
3+25	ı	i	1	I	ı	1	1	t	1	1	1	1	1	1	i I	Ground 17.6	House 130 feet right of channel.
4+00	16.1	16.9	17.3	385	480	909	8.9	7.1	7.4	43	19	82	12.9	16.5	1	ı	Whitney Drive culvert tailwater.
4+12	18.0	18.0	18.0	260	265	275	10.4	10.6	11.0	25	25	25	14.0	ı	18.0	22.3	Whitney Drive culvert outlet.
4+46	18.4	18.4	18.4	260	265	275	10.4	10.6	11.0	25	25	25	14.4	ŀ	18.4	22.3	Whitney Drive culvert inlet.
4+46	22.8	23.0	23.2	125	215	330	2.7	3.3	3.7	46	\$9	68	1	I	1	22.3	Whitney Drive culvert road deck.
4 + 66	22.8	23.1	23.3	385	480	909	1.1	1.3	1.5	354	378	401	14.7	18.5	1	1	Whitney Drive culvert headwater.
05+5 and Hydrau	1	ı	ı	1	1	t	ı	1	t	1	1	!	ŀ	1	G	Ground 20.9	House 120 feet right of channel.
6+26	22.9	23.1	23.3	385	480	605	1.9	2.1	5.6	199	217	234	17.8	21.0	ı	ı	
7+87	1	ı	1	ı	1	1	1	1	ı	1	1	1	1	1	- Gr	Ground 24.3	House 30 feet left of channel.

A Table 8. Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions--Continued

Stream station-	Water⊣	Water-surface elevation (feet)	levation	Flow	Flow (cubic feet per second)	eet per	M _{(fee}	Mean velocity (feet per second)	ity and)	Cross-	Cross-sectional area of flow (square feet)	area of feet)	Channel	Bank full elevation	Low steel	Deck eleva-	
B	5 yr	10 yr	25 yr	5 14	10 yr	25 yr	5 yr	10 yr	25 yr	5 γι	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
7+87	:	. 1		;	:	I	i	ı	; }	ł	ŀ	i	ı	ı	.	Ground 24.6	House 30 feet right of channel.
8+32	23.0	23.2	23.5	385	480	909	1.1	4.6	5.3	94	104	114	18.4	21.0	1	1	Mariner Drive culvert tailwater.
8+47	23.1	23.3	23.3	300	310	320	6.8	8.4	8.6	35	37	37	19.1	I	23.3	25.0	Mariner Drive culvert outlet.
98+8	23.7	23.7	23.7	300	310	320	8.1	8 .4	8.6	37	37	37	19.5	ı	23.7	25.0	Mariner Drive culvert inlet.
8+86	25.4	25.6	25.9	88	170	285	2.3	3.0	3.8 8	37	57	27	t	f	ı	25.0	Mariner Drive culvert road deck.
9+01	25.4	25.7	26.0	385	480	909	1.6	1.8	2.2	234	261	280	19.2	21.0	i	I	Mariner Drive culvert headwater.
99+6	ŀ	i	1	i	ı	1	ı	1	ŀ	t	ı	1	1	1		Ground 25.9	House 30 feet left of channel.
11+36	1	i	ı	i	i	t	i	I	I	ı	ŀ	:	1	ı	រ	Ground 28.5	House 150 feet left of channel.
11+76	25.5	25.8	26.1	385	480	605	4.7	5.2	6.1	82	93	100	21.7	24.0	1	1	10 feet below tributary.
11+96	25.7	26.0	26.3	295	365	460	3.5	3.7	4.3	98	76	108	21.7	24.0	ı	ŀ	Footbridge tailwater.

House 50 feet right of channel.

-- Ground 28.5

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12+06

Table 8. Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions--Continued

[Add 590.22 feet to convert elevations to sea level; -, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive]

Low steel Deck elevation eleva-	(feet) tion Remarks (feet)	22.5 24.1 Footbridge culvert outlet.	22.7 24.1 Footbridge culvert inlet.	- 24.1 Footbridge culver deck.	Footbridge culvert headwater.	Private driveway	culvert tailwater.	culvert tailwater. 26.8 28.1 Private driveway culvert outlet.	28.1 F	28.1 H 28.1 H 28.1 H
∞ ⊕	elevation (feet) (feet)	20.3	20.5	i	20.3 24.0	21.4 25.0		22.7		
Cross-sectional area of flow (square feet)	r 10 yr 25 yr	7 7	7 7	76 87	134 145	99 95		39 41		
ļ	yr 25 yr 5 yr	1 2.1 7	1 2.1 7	5 5.1 64	7 3.2 122	5 6.8 46		8.5 35	8. 8.5	8.5
r Mean velocity (feet per second)	yr 5 yr 10 yr	2.1 2.1	2.1 2.1	4.4 4.6	2.4 2.7	6.4 6.5		8.4 8.5	4. 8. 8.	8.
Flow (cubic feet per second)	5 yr 10 yr 25	15 15 15	15 15 15	280 350 445	295 365 460	295 365 460		295 330 350	330	330 35 35
Water-surface elevation (feet)	10 yr 25 yr E	22.5 22.5	22.7 22.7	26.0 26.3	26.2 26.4	26.2 26.4 2		26.3 26.5 2	26.5	26.5 26.8 28.7
 E	5 yr	12+06 22.5	12+22 22.7	12+22 25.7	12+32 25.9	12+91 25.9		13+06 26.0	13 + 06	

[Add 590.22 feet to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive] Table 8. Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions--Continued

	Remarks		Private driveway culvert tailwater.	Private driveway culvert outlet.	Private driveway culvert inlet.	Private driveway culvert road deck.	Private driveway culvert headwater.	Manor Road culvert tailwater.	Manor Road culvert outlet.	Manor Road culvert inlet.
Deck eleva-	tion (feet)	1	I	29.9	29.9	29.9	ı	1	32.7	32.7
Low steel elevation	(feet)	1	I	28.7	28.7	ŧ	1	1	30.5	30.8
Bank full elevation	(feet)	27.0	27.0	1	;	1	27.0	28.5	i	1
Channel	elevation (feet)	23.5	23.8	24.5	24.5	ı	23.8	25.4	26.4	26.7
area of feet)	25 yr	117	111	64	49	35	178	85	26	99
Cross-sectional area of flow (square feet)	10 yr	101	96	49	49	13	153	71	53	52
Cross	5 yr	88	82	49	49	Į.	118	99	48	45
ity and)	25 yr	3.9	4.1	7.1	7.1	3.1	2.6	5.4	8.2	8.2
Mean velocity (feet per second)	10 yr	3.6	6. 8.	8.9	8.9	2.3	2.4	5.2	6.9	7.0
(fee	5 yr	3.4	3.6	6.1	6.1	1	2.5	5.3	6.1	9.9
at per	25 yr	460	460	350	350	110	460	460	460	460
Flow (cubic feet per second)	10 yr	365	365	335	335	30	365	365	365	365
Flow	5 yr	295	295	295	295	1	295	295	295	295
vation	25 yr	29.0	29.3	28.7	28.7	30.5	30.5	30.7	30.5	30.8
Water-surface elevation (feet)	10 yr	28.6	29.0	28.7	28.7	30.1	30.1	30.3	30.3	30.5
Water-s	5 yr	28.3	28.6	28.7	28.7	1	29.5	29.8	29.9	30.0
l o te	B . <u></u>	15+90	18 + 47	65 + 81 es at Akin Br	18+75	18+75	18+90	21 +01	21+16	21+36

[Add 590.22 feet to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive] Table 8. Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions--Continued

Stream station-	Water-	Water-surface elevation (feet)	levation	FIO	Flow (cubic feet per second)	eet per	M (fee	Mean velocity (feet per second)	ity and)	Cross-	Cross-sectional area of flow (square feet)	area of leet)	Channel	Bank full elevation	Low steel	Deck eleva-	
ם ב	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
21+36	ŀ	1	1	:	1	1	1	1	1	1	1	1	1	ł	1	32.7	Manor Road culvert road deck.
21+60	30.1	30.5	32.2	295	365	460	5.9	6.3	4.6	50	28	101	25.8	30.0	ı	1	Manor Road culvert headwater.
22+98	31.4	32.1	32.7	295	365	460	6.3	5.3	8.	47	69	95	27.0	31.0	ŧ	ı	Flow over bridge tailwater.
23+18	32.3	32.4	32.7	295	365	460	6.3	6.9	7.1	47	53	99	30.7	l	ı	1	Flow over bridge.
23 + 33	32.8	33.0	33.3	295	365	460	3.8 8.	4.2	9.4	79	88	100	28.8	ł	i	1	Flow over bridge headwater.
24+26	33.0	33.3	33.6	295	365	460	4.6	5.0	5.4	2	22	82	29.4	31.0	1	1	Cayce Valley Drive culvert tailwater.
24+36	32.2	32.2	32.2	230	230	225	0.9	6.0	5.9	38	38	38	29.0	I	32.2	33.6	Cayce Valley Drive culvert outlet.
24+68	32.2	32.2	32.2	230	230	225	0.9	0.9	5.9	38	38	38	29.0	1	32.2	33.6	Cayce Valley Drive culvert inlet.
15 Analysis + + 68	33.9	34.2	34.4	65	135	235	2.3	3.0	3.6	28	45	65	1	1	ı	33.6	Cayce Valley Drive culvert road deck.
24 + 83	33.9	34.2	34.5	295	365	460	2.1	2.2	2.5	142	164	187	29.6	31.5	I	1	Cayce Valley Drive culvert

headwater.

[Add 590.22 feet to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive] Table 8. Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions--Continued

Stream station-	Water	Water-surface elevation (feet)	levation	Flox	Flow (cubic feet per second)	et per	Me.	Mean velocity (feet per second)) (pu	Cross-s flow	Cross-sectional area of flow (square feet)	area of eet)	Channel bed	Bank full elevation	Low steel elevation	Deck eleva-	
•	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
26+56	34.7	34.9	35.1	295	365	460	6.0	6.3	6.9	49	58	19	31.8	33.0	1		
28+28	36.0	36.2	36.5	295	365	460	5.4	5.8	6.3	55	63	73	31.8	34.5	1	I	Windemere Drive culvert headwater.
28+40	36.1	36.3	36.5	295	335	395	7.6	8.0	9.0	39	42	44	32.8	ı	36.5	38.0	Windemere Drive culvert outlet.
28+66	36.8	36.8	36.8	295	335	395	6.7	7.6	9.0	44	4	44	33.1	ı	36.8	38.0	Windemere Drive culvert inlet.
28+66	i	38.3	38.6	ı	30	9	1	2.4	3.1	I	13	21	1	ı	ı	38.0	Windemere Drive culvert road deck.
28+91	37.7	38.3	38.6	295	365	460	2.5	2.5	3.0 1	118	144	154	32.4	35.0	ı	I	Windemere Drive culvert headwater.
31+07	37.8	38.4	38.7	295	365	460	3.6	3.4	3.9	83	108	119	33.3	35.5	ı	ì	
33+22	38.2	38.7	39.1	260	320	405	4.7	4.6	5.0	55	07	08	34.1	37.0	ŧ	ı	Timberwood Drive culvert tailwater.
33 + 40	38.4	38.8	39.3	260	320	390	0.6	9.5	10.0	53	34	39	36.0	i	40.2	41.5	Timberwood Drive culvert outlet.
33+64	40.7	41.4	41.6	260	320	390	6.7	6.8	7.8	39	47	20	37.4	ı	41.6	43.1	Timberwood Drive culvert inlet.
33+64	I	1	43.2	!	I	15	I	1	3.1	t	t	۶.	1	ı	ŀ	43.1	Timberwood Drive culvert road deck.

Table 8. Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions--Continued

[Add 590.22 feet to convert elevations to sea level; -, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive]

~	ter-surface (feet)	Water-surface elevation (feet)	5	Flow	Flow (cubic feet per second)	et per	Me	Mean velocity (feet per second)	ty (bu	Cross-	Cross-sectional area of flow (square feet)	area of feet)	Channel	Bank full elevation	Low steel	Deck eleve-	
5 yr 10		10 yr 25 yr		5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
40.8 4	I 🛶	41.4 43.2	1	260 3	320	405	4.3	3.9	2.7	61	82	153	37.0	40.0		1	Timberwood Drive culvert headwater.
43.2 4:	ω,	43.5 43.8		260 3	320	405	5.5	5.8	6.1	47	55	99	39.3	42.0	1	ŀ	
45.0 4	45.3	3 45.6		260 3	320	405	4.4	4.7	5.0	59	69	81	41.6	43.0	1	ŀ	
47.0 4	47.2	2 47.5		260 3	320	405	5.8	5.8	0.9	45	55	<i>L</i> 9	43.9	45.5	I	ŀ	
49.2 4	49.5	5 49.7		260 3	320	405	8.	5.0	5.4	55	2	75	46.2	47.5	I	ı	
51.6	51.9	9 52.2		260 3	320	405	5.6	5.9	6.1	94	54	99	48.5	50.5	i	f	Farm driveway culvert tailwater.
51.6	52.0	0 52.3		260 2	285	315	9.0	6.8	0.6	29	32	35	48.5	ŀ	53.2	53.8	Farm driveway culvert outlet.
52.8	53.2	2 53.2		260 2	285	315	6.5	9.9	7.3	40	43	43	48.5	1	53.2	53.8	Farm driveway culvert inlet.
	54.2	2 54.5		I	35	06	1	2.6	3.3	i	13	27	ı	I	I	53.8	Farm driveway culvert road deck.
\$2. 8	54.2	2 54.5		260 3	320	405	2.9	2.2	2.6	06	143	156	48.5	50.5	I	ı	Farm driveway culvert headwater.
53.1	54.3	3 54.7		135 1	165	210	1.7	1.3	1.5	80	127	142	49.3	52.0	:	i	

Table 8. Selected data from hydraulic analysis of Cayce Valley Branch, existing conditions--Continued

[Add 590.22 feet to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive]

Stream station-	Water-	Water-surface elevation (feet)	evation	FIO.	Flow (cubic feet per second)	set per	(fee	Mean velocity (feet per second)	ity and)	Cross flo	Cross-sectional area of flow (square feet)	area of feet)	Channel bed		Low steel elevation	Deck eleva-	
ing	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
49 + 44	53.2	54.3	54.7	135	165	210	2.0	1.6	1:8	19	104	119	49.8	53.0	l	1	Jewell Drive culvert tailwater.
49+64	53.0	53.0	53.0	135	115	110	5.9	5.0	4.8	23	23	23	50.4	ł	53.0	54.4	Jewell Drive culvert outlet.
49+77	53.0	53.0	53.0	135	115	110	5.9	5.0	4 .8	23	23	23	50.4	l	53.0	54.4	Jewell Drive culvert inlet.
49+77	l	54.9	55.1	I	20	100	ı	2.7	3.4	ı	19	29	1	1	1	54.4	Jewell Drive culvert road deck.
49+93	54.1	54.9	55.2	135	165	210	4.1	1.3	1.5	95	130	143	50.3	53.0	I	1	Jewell Drive culvert headwater.

Simulation of Effects of Alternative Drainage Structures

The hydraulic model was used to simulate the flood profiles at Cayce Valley Branch resulting from possible alternative designs for selected drainage structures. Data on existing structure sizes are listed in table 7, and the alternative drainage improvement designs evaluated using the model are described below for model simulations 1 and 2.

Simulation 1: A concrete box culvert with a barrel width of 10 feet, barrel height of 5 feet, and culvert length of 30 feet was simulated at Whitney Drive. A concrete box culvert with a barrel width of 10 feet, barrel height of 4.5 feet, and culvert length of 30 feet was simulated at Mariner Drive.

Simulation 2: A concrete box culvert with a barrel width of 10 feet, barrel height of 6 feet, and length of 30 feet was simulated at Whitney Drive. A concrete box culvert with a barrel width of 12 feet, barrel height of 4.5 feet, and length of 30 feet was simulated at Mariner Drive.

The simulated flood profiles for the two conditions (figs. 11 and 12) indicate that during a 25-year flood: Drainage improvements modeled in simulation 1 would result in a decrease of 0.6 foot in water-surface elevation upstream from Whitney Drive and a decrease of 0.3 foot in the water-surface elevation upstream from Mariner Drive (table 9, fig. 11). Drainage improvements modeled in simulation 2 would result in a decrease of 0.8 foot in water-surface elevation upstream from Whitney Drive and a decrease of 0.4 foot in water-surface elevation upstream from Mariner Drive (table 10, fig. 12).

SUMMARY

A flood study was conducted at Akin Branch and Cayce Valley Branch in the Little Bigby Creek watershed during 1990 and 1991. Major elements of the study included: estimation of flood discharges at points along Akin Branch and Cayce Valley Branch for selected recurrence intervals, simulation of flood profiles corresponding to estimated flood discharges for existing conditions at Akin Branch and Cayce Valley Branch, analysis of changes to flood profiles likely to result from possible drainage improvements such as enlarged box culverts at selected sites on Akin Branch and Cayce Valley Branch.

Flood discharges at the mouths of Akin Branch and Cayce Valley Branch were computed for 5-, 10-, and 25-year recurrence intervals using flood-frequency relations applicable to small urban streams in Tennessee. Flood discharges at points upstream from the mouth were estimated by subdividing the watershed and assigning a percentage of the discharge at the mouth, based on drainage area, to each subarea.

Flood profiles corresponding to the computed flood discharges were simulated for existing conditions at Akin Branch and Cayce Valley Branch using WSPRO, a computer model for water-surface profile computations. Computed flood profiles for existing conditions indicate excessive backwater problems at Wedgewood Drive and Alpine Drive on Akin Branch and at Whitney Drive and Mariner Drive on Cayce Valley Branch. On Akin Branch, these problems include road overtopping of as much as 2.5 feet at Wedgewood Drive and as much as 1.5 feet at Alpine Drive for the 25-year flood. The profiles also indicate backwater of about 1.4 feet at Alpine Drive. On Cayce Valley Branch, these problems include road overtopping of as much as 0.9 foot at Whitney Drive and Mariner Drive. Simulated backwater during a 25-year flood totaled as much as 5.3 feet at Whitney Drive and as much as 2.5 feet at Mariner Drive.

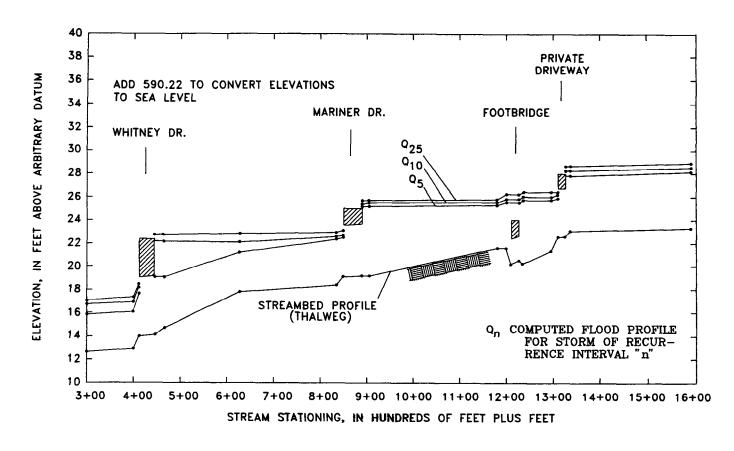


Figure 11. Computed flood profiles for Cayce Valley Branch, simulation 1.

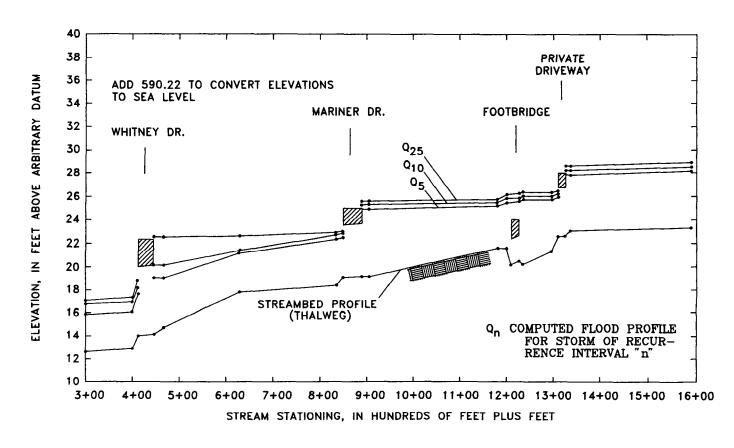


Figure 12. Computed flood profiles, for Cayce Valley Branch, simulation 2.

[Add 590.22 feet to convert elevations to sea level; -, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive] Table 9. Selected data from hydraulic analysis of Cayce Valley Branch, simulation 1

Stream station-	Water	Water-surface elevation (feet)	evation	Flov	Flow (cubic feet per second)	et per	Mee (fee	Mean velocity (feet per second)	ty ind)	Cross-	Cross-sectional area of flow (square feet)	area of ieet)	Channel bed	Bank full elevation	Low steel elevation	Deck eleva-	
B	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
3+00	15.8	16.7	17.0	385	480	909	8.9	7.1	7.4	43	89	82	12.6	16.2	1		
3+00	ı	1	1	1	1	1	1	ı	ı	1	I	1	1	ı	- G	Ground 17.4	House 250 feet left of channel.
3+25	i	1	1	ı	I	I	1	1	I	1	l	ı	ı	ı	- G	Ground 17.6	House 130 feet right of channel.
4+00	16.1	16.9	17.3	385	480	909	8.9	7.1	7.4	43	29	83	12.9	16.5	1	ł	Whitney Drive culvert tailwater.
4+12	17.6	18.2	18.4	385	480	505	10.7	11.4	11.5	36	42	4	14.0	i	19.0	22.3	Whitney Drive culvert outlet.
4+46	0.61	19.0	19.0	385	480	505	7.7	9.6	10.1	50	50	20	14.1	1	19.1	22.3	Whitney Drive culvert inlet.
4+46	1	1	22.7	1	!	100	:	1	2.5	1	1	40	ı	1	i	22.3	Whitney Drive culvert road deck.
Summary + + 99	0.61	22.1	22.7	385	480	909	7.0	1.7	1.8	55	279	343	14.7	18.5	1	1	Whitney Drive culvert

headwater.

g Table 9. Selected data from hydraulic analysis of Cayce Valley Branch, simulation 1--Continued

[Add 590.22 feet to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive]

Stream station-	Water-t	Water-surface elevation (feet)	evation	Flos	Flow (cubic feet per second)	eet per	M (fee	Mean velocity (feet per second)	ty nd)	Cross	Cross-sectional area of flow (square feet)	erea of eet)	Channel	Bank full elevation	Low steel elevation	Deck eleva-	
	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
ì	ı	1	1	1	1	ı	1	ı		ı	ı	1	1	!	: :	Ground 20.9	House 120 feet right of channel.
	21.2	22.1	22.8	385	480	605	5.0	3.3	3.1	11	147	194	17.8	21.0	:	i	
	1	ŧ	:	ı	ı	ı	ŀ	ı	1	1	1	ı	t	I	ب ا	Ground 24.3	House 30 feet left of channel.
	:	i	t	I	i	1	ı	ı	ı	ı	I	ı	1	ŧ	ن ا	Ground 24.6	House 30 feet right of channel.
	22.4	22.6	23.0	385	480	605	5.2	0.9	6.2	74	80	76	18.4	21.0	i	1	Mariner Drive culvert tailwater.
	22.5	22.7	23.1	345	360	380	10.1	10.0	9.5	34	36	04	19.1	I	23.6	25.0	Mariner Drive culvert outlet.
	23.7	23.7	23.7	345	360	380	7.7	8.0	8. 4.	45	45	45	19.2	ţ	23.7	25.0	Mariner Drive culvert inlet.
	25.2	25.4	25.7	04	120	225	1.9	2.6	3.3	21	46	89	1	ı	1	25.0	Mariner Drive culvert road deck.
	25.2	25.5	25.7	385	480	909	1.8	2.0	2.3	217	243	269	19.2	21.0	I	I	Mariner Drive culvert headwater.

[Add 590.22 feet to convert elevations to sea level; -, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive] Table 9. Selected data from hydraulic analysis of Cayce Valley Branch, simulation 1--Continued

	Remarks	House 30 feet left of channel.	House 150 feet left of channel.	10 feet below tributary.	Footbridge culvert tailwater.	House 50 feet right of channel.	Footbridge culvert outlet.	Footbridge culvert inlet.	Footbridge culvert deck.	Footbridge culvert headwater.
Deck eleva-	tion (feet)	Ground 25.9	Ground 28.5	1	1	Ground 28.5	24.1	24.1	24.1	i
Low steel elevation	(feet)	Ğ	l G	1	i	- Gr	22.5	22.7	ı	1
Bank full elevation	(feet)	1	1	24.0	24.0	i	ı	ı	I	24.0
Channel bed	elevation (feet)	1	I	21.7	21.7	1	203	205	I	20.3
area of feet)	25 yr	ŀ	ı	86	108	1	7	7	88	147
Cross-sectional area of flow (square feet)	10 yr	1	;	87	94	ı	7	7	73	128
Cross	5 yr		:	11	82	1	7	7	99	116
ity ond)	25 yr		ı	6.2	4.3	ł	2.1	2.1	5.1	3.1
Mean velocity (feet per second)	10 yr	1	I	5.5	3.9	1	2.1	2.1	8.4	2.9
M (fee	5 yr	1	ŀ	5.0	3.6	ŀ	2.1	2.1	7.4	2.5
et per	25 yr		ı	909	460	i	15	15	445	460
Flow (cubic feet per second)	10 yr	1	t	480	365	1	15	15	350	365
Flow	5 yr		I	385	295	ŀ	15	15	280	295
vation	25 yr	ı	i	25.9	26.3	1	22.5	22.7	26.3	26.5
Water-surface elevation (feet)	10 yr	ı	I	25.6	25.9	ı	22.5	22.7	25.9	26.1
Water-s	5 yr	ŀ	ı	25.4	25.6	ı	22.5	22.7	25.6	25.8
Stream station-	B L	99+6	11+36	11+76	11+96	12+06	12+06	12+22	12+22	12+32

ଅ Table 9. Selected data from hydraulic analysis of Cayce Valley Branch, simulation 1--Continued

[Add 590.22 feet to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive]

	Remarks	Cayce Valley Drive driveway culvert tailwater.
	tion (feet)	ŀ
	(feet)	ı
Bank full elevation	(feet)	25.0
Channel bed	elevation (feet)	21.4
area of feet)	25 yr	72
Cross-sectional area of flow (square feet)	5 yr 10 yr 25 yr 5 yr 10 yr 25 yr	54
Cross	5 yr	
sity ond}	25 yr	6.4
Mean velocity (feet per second)	10 yr	6.6 6.7 6.4 45
N (fe	5 yr	6.6
set per	25 yr	460
Flow (cubic feet per second)	5 yr 10 yr 25 yr 5 yr 10 yr 25	365
Flow	5 yr	295
levation	25 yr	26.5
Water-surface elevation (feet)	10 yr	26.1
	5 yr	25.8
 Stream station-	. <u>.</u>	12+91 25.8 26.1 26.5 295 365

Table 10. Selected data from hydraulic analysis of Cayce Valley Branch, simulation 2

[Add 590.22 feet to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive]

≥	ater-£	Water-surface elevation (feet)	evation	Flov	Flow (cubic feet per second)	eet per	(fee	Mean velocity (feet per second)	rt ud)	Cross-s flow	Cross-sectional area of flow (square feet)	area of leet)	Channel bed	Bank full elevation	Low steel	Deck eleva-	ē
5 yr		10 yr	25 yr	5 4	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
15.8		16.7	17.0	385	480	605	8.9	7.1	7.4	43	89	82	12.6	16.2	-	1	
ŀ		I	ı	I	I	1	1	1	ı	•	I	ı	ł	1	- Gr	Ground 17.4	House 250 feet left of channel.
1		1	ı	ŀ	;	1	1	ı	1	i	1	ı	I	I	1	Ground 17.6	House 130 feet right of channel.
16.1		16.9	17.3	385	480	605	6.8	7.1	4.7	43	<i>L</i> 9	82	12.9	16.5	I	I	Whitney Drive culvert tailwater.
17.6	10	18.2	18.8	385	480	995	10.7	11.4	11.7	36	5	84	14.0	ı	20.0	22.3	Whitney Drive culvert outlet.
19.0	0	20.1	20.1	385	480	999	4.9	8.0	9.3	50	09	09	14.1	ı	20.1	22.3	Whitney Drive culvert inlet.
1		1	22.5	1	1	45	1	1	1.9	I	1	24	ı	ı	i	22.3	Whitney Drive culvert deck road.
19.0	0	20.1	22.5	385	480	905	7.0	4 4.	1.9	55	108	320	14.7	18.5	t	I	Whitney Drive culvert headwater.
1		1	1	1	1	I	ł	ı	:	f	1	ŧ	1	1	- G	Ground 20.9	House 120 feet right of channel.

Table 10. Selected data from hydraulic analysis of Cayce Valley Branch, simulation 2--Continued

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Stream station-	Water	Water-surface elevation (feet)	levation	Flow	Flow (cubic feet per second)	set per	M. (fee	Mean velocity (feet per second)	ty nd)	Cross-f flow	Cross-sectional area of flow (square feet)	area of feet)	Channel	Bank full elevation	Low steel elevation	Deck eleva-	
ğui	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
6+26	21.2	21.4	22.6	385	480	605	5.0	5.4	3.4	77	68	177	17.8	21.0	:	1	
7+87	ı	ı	ı	ŀ	ı	1	:	I	I	:	1	1	ı	ŧ		Ground 24.3	House 30 feet left of channel.
7+87	1	ŀ	ŧ	ŀ	ı	1	1	ı	I	1	1	ł	I	I	!	Ground 24.6	House 30 feet right of channel.
8+32	22.4	22.7	22.9	385	480	909	5.2	5.8	6.5	47	83	93	18.4	21.0	ŧ	1	Mariner Drive culvert tailwater.
8+47	22.5	22.8	23.0	385	420	440	4.	5.6	4.6	41	4	47	19.1	ŧ	23.6	25.0	Mariner Drive culvert outlet.
98+8	23.7	23.7	23.7	385	420	440	7.1	7.8	8 2.2	54	54	54	19.2	ı	23.7	25.0	Mariner Drive culvert inlet.
8+86	1	25.3	25.6	1	99	165	•	2:2	3.0	ŧ	27	55	ı	1	i	25.0	Mariner Drive culvert road deck.
9+01	24.9	25.3	25.6	385	480	605	2.1	2.1	2.4	188	225	254	19.2	21.0	ī	;	Mariner Drive culvert headwater.
99+6	ı	ł	ł	ŀ	1	i	l	1	ı	1	1	1	ı	1	ق ا	Ground 25.9	House 30 feet left

[Add 590.22 feet to convert elevations to sea level; --, no data; stream stationing is given in hundreds of feet plus feet from a point 412 feet downstream from Whitney Drive] Table 10. Selected data from hydraulic analysis of Cayce Valley Branch, simulation 2--Continued

Stream station-	Water-	Water-surface elevation (feet)	evation	Flov	Flow (cubic feet per second)	set per	M	Mean velocity (feet per second)	ty ind)	Cross-4	Cross-sectional area of flow (square feet)	area of feet)	Channel bed	Bank full elevation	Low steel elevation	Deck eleva-	
B L	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	5 yr	10 yr	25 yr	elevation (feet)	(feet)	(feet)	tion (feet)	Remarks
11+36	I	1	1	ı	I	1	i.	ı	1	1	ı	ı	l	1	l Ā	Ground 28.5	House 150 feet left of channel.
11+76	25.2	25.5	25.8	385	480	605	5.5	8.8	6.5	70	82	93	21.7	24.0	1	ı	10 feet below tributary.
11+96	25.5	25.9	26.2	295	365	460	3.7	4.0	4.3	79	91	106	21.7	24.0	1	ı	Footbridge culvert tailwater.
2+06	1	1	ı	1	i	1	1	I	I	1	1	1	:	;	- Gr	Ground 28.5	House 50 feet right of channel.
12+06	22.5	22.5	22.5	15	15	15	2.1	2.1	2.1	7	7	7	20.3	1	22.5	24.1	Footbridge culvert outlet.
12+22	22.7	22.7	22.7	15	15	15	2.1	2.1	2.1	7	7	7	20.5	;	22.7	24.1	Footbridge culvert inlet.
12+22	25.6	25.9	26.3	280	350	445	8.	6.4	5.2	28	1.1	98	!	:	;	24.1	Footbridge culvert deck.
12+32	25.8	26.1	26.4	295	365	460	2.5	2.8	3.2	118	130	145	20.3	24.0	I	ı	Footbridge culvert headwater.
12+91	25.8	26.1	26.4	295	365	460	6.5	6.7	7.0	45	54	99	21.4	25.0	:	1	Cayce Valley Drive driveway culvert tailwater.

The USGS Water-Surface Profile (WSPRO) computation model was used to simulate the effects on existing flood profiles that might be expected if the culverts and bridges at these locations were enlarged. For the alternative designs studied, simulation 3 for Akin Branch indicated that the water-surface elevations during a 25-year flood would probably decrease by 0.2 foot upstream of Wedgewood Drive and would decrease by 0.9 foot upstream of Alpine Drive. For Cayce Valley Branch, simulation 2 indicated that the water-surface elevations during a 25-year flood would probably decrease by 0.8 foot upstream of Whitney Drive and decrease by 0.4 foot upstream of Mariner Drive. Reduced backwater was indicated at all locations.

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