

**FLOODS IN WEST VIRGINIA, VIRGINIA,  
PENNSYLVANIA, AND MARYLAND,  
NOVEMBER 1985**

**By D.H. Carpenter**

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U.S. DEPARTMENT OF THE INTERIOR

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## CONTENTS

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	Page
Abstract.....	1
Introduction.....	2
Purpose and scope.....	6
Acknowledgments.....	6
Description of storm.....	6
History.....	9
Distribution of precipitation.....	10
General description of flood.....	10
Flood frequency.....	17
Description of flooding, by State.....	18
West Virginia.....	18
Virginia.....	36
Pennsylvania.....	53
Maryland.....	61
Summary.....	64
Selected references.....	65
Glossary.....	67

---

## ILLUSTRATIONS

---

Figures 1-3. Photographs showing:

1. The aftermath..... 3
2. Tree on Cheat River bridge, State Highway 22,  
    Albright, W. Va..... 4
3. Cattle on temporary island, James River, Va... 5

4-6. Maps showing:

4. Location of streamflow-gaging stations  
    in flood area..... 7
5. Total storm rainfall,  
    October 31-November 6, 1985..... 8
6. Location of selected rain gages..... 11
  
7. Rainfall mass curves for two gages in West Virginia,  
    October 31-November 6, 1985..... 13
8. Rainfall mass curves for two gages in Virginia,  
    October 31-November 6, 1985..... 14
9. Rainfall mass curves for gages in Pennsylvania  
    and Maryland, October 31-November 6, 1985..... 15

ILLUSTRATIONS--Continued

	Page
Figures 10-12. Photographs showing Cheat River damage:	
10. Pennsylvania Avenue, Parsons, W. Va.....	21
11. Railroad truss bridge, Rowlesburg, W. Va.....	22
12. Before and after flood at Albright, W. Va....	23
13-18. Hydrographs showing discharge at gaging stations:	
13. Shavers Fork at Parsons, W. Va., October 31-November 15, 1985.....	24
14. South Fork South Branch Potomac River at Brandywine, W. Va., October 31-November 15, 1985.....	26
15. Greenbrier River at Durbin, W. Va., October 31-November 15, 1985.....	28
16. Greenbrier River at Buckeye, W. Va., October 31-November 15, 1985.....	30
17. Greenbrier River at Alderson, W. Va., October 31-November 15, 1985.....	32
18. Tygart Valley River at Belington, W. Va., November 1-15, 1985.....	34
19-20. Photographs showing:	
19. Williamson Road in Boxley Hills section, Roanoke, Va., metropolitan area.....	38
20. Rescue operation on East Main Street, Salem, Va.....	39
21-24. Hydrographs showing discharge at gaging stations:	
21. Roanoke River at Niagara, Va., October 30-November 15, 1985.....	40
22. Back Creek near Sunrise, Va., November 1-15, 1985.....	42
23. Calfpasture River above Mill Creek at Goshen, Va., November 1-15, 1985.....	44
24. James River at Holcombs Rock, Va., October 30-November 15, 1985.....	46
25. Photograph showing confluence of Shenandoah and Potomac Rivers at Harpers Ferry, W. Va.....	48
26-27. Hydrographs showing discharge at gaging stations:	
26. Middle River near Grottoes, Va., November 1-15, 1985.....	49
27. North Fork Shenandoah River at Mount Jackson, Va., October 31- November 15, 1985.....	51

ILLUSTRATIONS--Continued

	Page
Figures 28-29. Photographs showing:	
28. Monongahela River at bridge on State Highway 88, Point Marion, Pa.....	54
29. Pittsburgh's Three River Stadium on Ohio River at confluence of Monongahela and Allegheny Rivers, Pa.....	55
30-32. Hydrographs showing discharge at gaging stations:	
30. Monongahela River at Greensboro, Pa., October 31-November 18, 1985.....	56
31. Monongahela River at Elizabeth, Pa., October 31-November 18, 1985.....	58
32. Potomac River at Paw Paw, W. Va., October 31-November 15, 1985.....	62

---

TABLES

---

Tables 1-9. Gage height and discharge for flood of November 1985 at gaging stations:	
1. Shavers Fork at Parsons, W. Va.....	25
2. South Fork South Branch Potomac River at Brandywine, W. Va.....	27
3. Greenbrier River at Durbin, W. Va.....	29
4. Greenbrier River at Buckeye, W. Va.....	31
5. Greenbrier River at Alderson, W. Va.....	33
6. Tygart Valley River at Belington, W. Va.....	35
7. Roanoke River at Niagara, Va.....	41
8. Back Creek near Sunrise, Va.....	43
9. Calfpasture River above Mill Creek at Goshen, Va.....	45
10. Daily mean discharge for flood of November 1985 at gaging station James River at Holcombs Rock, Va.....	47
11-12. Gage height and discharge for flood of November 1985 at gaging stations:	
11. Middle River near Grottoes, Va.....	50
12. North Fork Shenandoah River at Mount Jackson, Va.....	52

TABLES--Continued

	Page
Table 13. Daily mean discharge for flood of November 1985 at gaging station Monongahela River at Greensboro, Pa.....	57
14. Gage height and discharge for flood of November 1985 at gaging station Monongahela River at Elizabeth, Pa.....	59
15. Daily mean discharge for flood of November 1985 at gaging station Potomac River at Paw Paw, W. Va....	63
16. Summary of flood stages and discharges.....	69

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FACTORS FOR CONVERTING INCH-POUND UNITS TO  
INTERNATIONAL SYSTEM OF METRIC UNITS (SI)

For those readers who may prefer to use metric (International System) units rather than the inch-pound units used in this report, the following conversion factors may be used:

<u>Multiply inch-pound unit</u>	By	<u>To obtain metric unit</u>
<u>Length</u>		
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
<u>Area</u>		
square foot (ft <sup>2</sup> )	0.09294	square meter (m <sup>2</sup> )
square mile (mi <sup>2</sup> )	2.590	square kilometer (km <sup>2</sup> )
<u>Velocity</u>		
foot per second (ft/s)	0.3048	meter per second (m/s)
<u>Volume</u>		
million gallons (Mgal)	3,785	cubic meters (m <sup>3</sup> )
<u>Flow</u>		
cubic foot per second (ft <sup>3</sup> /s)	0.02832	cubic meter per second (m <sup>3</sup> /s)
cubic foot per second per square mile [(ft <sup>3</sup> /s)/mi <sup>2</sup> ]	0.01093	cubic meter per second per square kilometer [(m <sup>3</sup> /s)/km <sup>2</sup> ]

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ABSTRACT

Heavy rainfall during the period October 31-November 6, 1985, caused record-breaking floods over a large region covering eastern West Virginia, western and northern Virginia, southwestern Pennsylvania, and western Maryland. The rainfall, most of which fell on November 4 and 5 and was indirectly related to Hurricane Juan, exceeded 10 inches over large areas. A maximum of 19.77 inches was recorded at the U.S. National Weather Service gage, Montebello 2 NE, in the Blue Ridge Mountains in Virginia.

Record-breaking flood discharges occurred at many locations within the Potomac, James, Roanoke, Monongahela, and Kanawha River basins. Flood-peak data were obtained at 190 sites within the affected area. New maximum peak discharges were recorded at 63 streamflow gaging stations; peaks exceeded 100-year recurrence intervals at 63 sites. The new record peaks exceeded the previous maximum recorded discharges by more than 50 percent at 40 of the gaging stations and were, on the average, 89 percent greater than the previous maximums.

A total of 62 lives were lost because of the flooding in the four-State region, and storm damage was estimated to be \$1,400 million. Damage to the Roanoke-Salem, Virginia, area alone was estimated to be \$440 million. Several small towns in West Virginia were almost totally destroyed. The U.S. Army Corps of Engineers reported that the operation of flood-control projects in several river basins, including North Branch Potomac, James, Tygart Valley, and Kanawha, reduced total damage substantially.

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## INTRODUCTION

Multiple storms during the period from October 31 through November 6, 1985, caused extremely destructive flooding over large areas of West Virginia and Virginia. Pennsylvania and Maryland also experienced severe, but more localized, flooding.

The flood in West Virginia was the worst in the State's history. It has been nicknamed the "Killer Flood of 1985" in that State. In Virginia, because of the extraordinary fury of earlier Hurricanes Camille (1969) and Agnes (1972), it is a matter of conjecture as to whether this storm was the most devastating. Although Maryland and Pennsylvania experienced some severe, localized flooding in their western regions from this storm, they were spared widespread devastation. Photographs (figs. 1-3) provide some insight into the overall effect of the flood.

As much as 19 in. of rain fell over the affected region during the 7-day multiple-storm period. Virtually all the precipitation was related either directly or indirectly to an otherwise unimpressive hurricane named "Juan." The maximum rainfall recorded (at an official U.S. National Weather Service gage) was 19.77 in. at Montebello 2 NE, in the Blue Ridge Mountains of Virginia. More than 10 in. of rainfall (official) was recorded over a fairly widespread area in north-central Virginia and eastern West Virginia.

Record-breaking floods occurred on many streams (including the main-stem rivers) in the Potomac, James, Roanoke, Monongahela, and Kanawha River basins. Many communities in West Virginia, such as Albright and Parsons along the Cheat River, and Petersburg along the South Branch Potomac River, were nearly destroyed. In Virginia, the cities of Roanoke and Lynchburg, along the Roanoke and James Rivers, respectively, experienced extremely severe damage. In the four-State affected area, 62 people lost their lives and property damage was estimated to be \$1,400 million.

Flood-discharge data were recorded at 190 streamflow-gaging stations operated in the affected area. The locations of the gaging stations, the pattern of which virtually delineates the affected area, are shown in figure 4. Peak stage and discharge figures are presented in this report for the 190 gaging stations. Recurrence-interval data and discharge hydrographs for selected sites also are included.

This report is an outgrowth of U.S. Geological Survey Open-File Report 86-486, "Flood of November 1985 in West Virginia, Pennsylvania, Maryland, and Virginia," by Joseph B. Lescinsky. The original report presented only basic information to allow for its early release to the public. This report provides more detailed coverage of the flooding and damage with more complete confirmation of the data presented.



Figure 1.-- The aftermath. (Photograph by Aubrey Wiley, The News and Daily Advance, Lynchburg, Va.)



**Figure 2.-- Tree on Cheat River bridge, State Highway 22, Albright, W. Va. (Photograph by Dale Sparks, Dominion Post, Morgantown, W. Va.)**



**Figure 3.-- Cattle on temporary island, James River, Va. (Photograph by Dan Doughtie, Roanoke Times and World News.)**

### Purpose and Scope

The purpose of this report is to document the significant rainfall and streamflow data, along with general damage information including costs and fatalities, related to the flood of November 1985. The data provide a technical basis on which to make flood-plain management decisions.

The report documents the flooding over a region covering eastern West Virginia, western and northern Virginia, southwestern Pennsylvania, and western Maryland. Flood data are evaluated for 190 streamflow-gaging stations within the flood-affected region. A description of the storm-related rainfall is provided in the report along with a map of its distribution (see fig. 5).

### Acknowledgments

Precipitation data were provided by the National Weather Service of the National Oceanic and Atmospheric Administration (NOAA). Data from the Virginia State-operated streamflow-gaging network were compiled by the Charlottesville office of the Virginia Water Control Board. Flood data including peak stages and discharges, recurrence intervals, and hydrograph data were compiled by U.S. Geological Survey personnel as part of the cooperative programs with West Virginia, Virginia, Pennsylvania, and Maryland. The isohyetal map of the storm period was derived from a computer-generated map provided by Robert B. Jacobson, geomorphologist with the Geologic Division, U.S. Geological Survey. Thanks are given to the newspapers and individuals who provided photographs used in the report.

### DESCRIPTION OF STORM

The flooding of November 1985 in the four-State area of West Virginia, Virginia, Pennsylvania, and Maryland resulted from a rather complex sequence of meteorological events (Virginia State Climatology Office, 1986). Three separate but related low-pressure systems contributed to the problem.

The first event, which only set the stage for the record flood, received the most public notice. This event was Hurricane Juan and the publicity resulted because its associated windspeed gave it hurricane status, though barely. Hurricane Juan came ashore from the Gulf of Mexico over southern Mississippi and followed a generally northerly path until its remnants ultimately reached Michigan.

During its northern passage, Juan spawned a small secondary low-pressure system which moved eastward across North Carolina and passed offshore. This system, together with Juan, produced primarily moderate rainfall in the study area.

A third low-pressure system, which also was an outgrowth of the influence of Juan on the atmosphere, then transformed what would have been a very minor flood event into a major disaster.

## History

Juan was a rather typical late-season hurricane which matured in the Gulf of Mexico and moved ashore over coastal Louisiana and Mississippi early on the morning of October 31, 1985. Some distinguishing characteristics of this hurricane were its large size (for a hurricane) and its relatively moderate winds which only slightly exceeded 73 miles per hour (hurricane force) and did so only for a short time, which was prior to landfall. This storm was also notable in that it moved rather aimlessly off the Louisiana coast for a couple of days (October 29 and 30) before it moved inland. This hesitation was particularly significant because it resulted in a strong flow of moisture and heat into the study area, creating the potential for the excessive rainfall which occurred later.

After Hurricane Juan moved inland, it crossed southern Mississippi in a northeasterly direction and then continued on a more northerly path through northern Alabama, central Tennessee, Kentucky, and Indiana. The hurricane, in following this track, had sufficient energy to move the jetstream into a north-south orientation; as a result, even more moisture was carried northward, making the final storm even more intense and devastating.

On November 2, the remnants of the hurricane moved from Indiana into Michigan where it no longer directly contributed any significant rainfall to the study area. In the course of Juan's passage, generally less than 2 in. of rain fell throughout the four-State region except for 2 to 3 in. in a substantial area of south and west-central Virginia, and as much as 5 in. in two small areas of the Blue Ridge Mountains. This rainfall, which was associated with the hurricane, includes the rainfall related to the small, secondary low-pressure system which developed in connection with Juan's passage. The secondary system developed on November 1 in the vicinity of the Tennessee-North Carolina State line (along the warm frontal temperature discontinuity associated with the passage of Juan). This smaller system moved rapidly across North Carolina and out to sea, but was responsible for many of the greater rainfall totals in southern and central Virginia.

The third storm that developed moved inland from the Gulf of Mexico, and crossed the Florida panhandle on the morning of November 3. This system moved through central Georgia and South Carolina and then into southwestern North Carolina early on November 4. This third storm, an intense low-pressure system, was fed by excess moisture in the atmosphere brought in by the hurricane and by the associated secondary storm system. A massive rain shield developed to the north of this third low-pressure system as the abundant moist Gulf air overran the cooler air north of the system center. This intense low-pressure system tracked very slowly northward across southwestern Virginia to southeastern West Virginia on November 4. The storm then traveled in an east-northeasterly direction through the eastern panhandle of West Virginia and across northern Virginia and northern Maryland. This third system produced as much as 9 in. of rain in West Virginia and 12 in. in Virginia (official National Weather Services gages) on saturated ground.

## Distribution of Precipitation

Rainfall for the storm period (October 31-November 6) varied considerably over the four-State study area as shown on the isohyetal map in figure 5. This map was derived from a computer plot generated by an interpolating algorithm, MINC--a program widely used within the geophysical science community (Godson and Webring, 1982). The map was developed from rainfall data from the official network of U.S. National Weather Service precipitation gages in the four-State region. Because of orographic effects, somewhat more rainfall probably occurred in some areas than is reflected by the isohyetal map.

Rainfall in West Virginia, recorded by National Weather Service stations, ranged from 3 in. in the western part of the State to greater than 11 in. in the northeastern part of the State; 14 in. was recorded at an unofficial site in the eastern panhandle (Federal Emergency Management Agency, 1985c). Rainfall in the affected area of Virginia ranged from 4 in. in the east-central part of the State to greater than 18 in. at two separate locations in the Blue Ridge Mountains in the west-central part of the State. In the affected regions of Maryland and Pennsylvania, amounts ranged from 2 in. at various locations up to 7 in. at one site in western Maryland.

There is widespread belief within the technical community involved with the flood that actual rainfall in many ungaged areas exceeded the officially documented values by significant amounts, especially in West Virginia. Unfortunately, virtually no well-documented bucket survey data were available to augment the official National Weather Service network data. Graphs of accumulated rainfall values for the entire storm period (October 31-November 6) are presented in figures 7-9 for six representative sites (official recording rain gages) in the four-State area. The rain-gage locations are shown in figure 6.

## GENERAL DESCRIPTION OF FLOOD

The October-November 1985 storm period caused extremely severe flooding over large areas of West Virginia and Virginia. Flooding in Pennsylvania and Maryland was somewhat less severe and widespread but very damaging. Exclusive of indirectly related coastal flooding resulting from unusually high tides (damage estimated to be \$35 million), this storm was the fourth most costly hurricane-type storm (tropical cyclone) in United States history. Sixty-two lives were lost, and damage was estimated to be \$1,400 million. The damage has been exceeded only by Hurricane Agnes (1972), 117 lives lost and \$3,103 million damages; Camille (1969), 258 lives lost and \$1,421 million damages; and Betsy (1965), 75 lives lost and \$1,420 million damages (Bailey, Patterson, and Paulhus, 1975). The costs of these three previous storms would, of course, be substantially greater if translated into the 1985 dollars of the subject event.

The most severe flooding of the November 1985 event occurred November 3-7 over an area encompassing eastern West Virginia, northern and west-central Virginia, the Maryland panhandle, and part of southwestern Pennsylvania. Peak stages and discharges for the flooding are presented in table 16 for selected gaging stations. Recurrence intervals also are

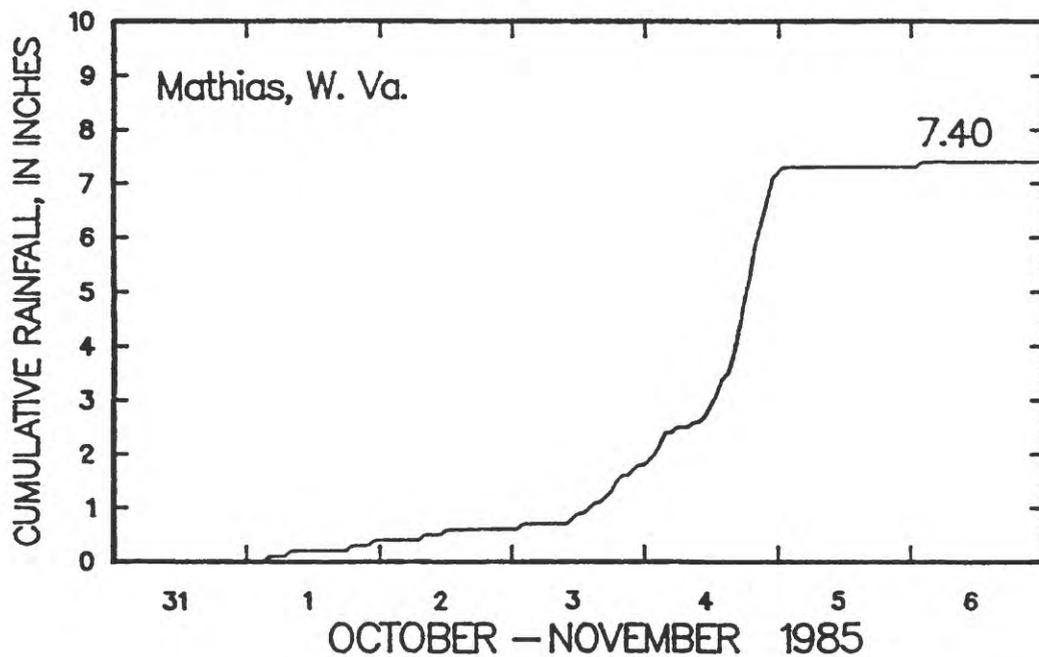
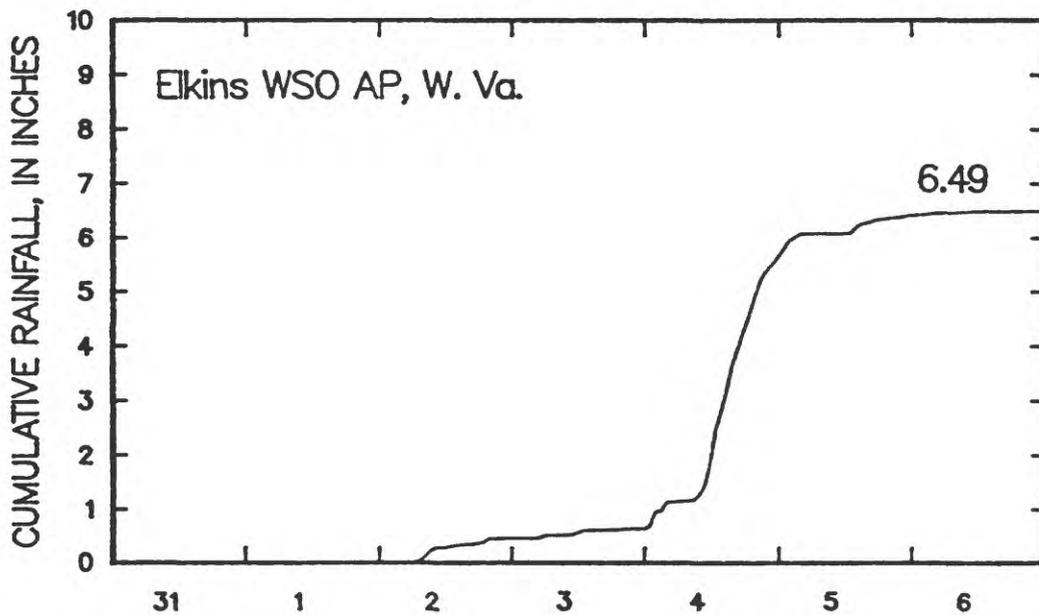


Figure 7.-- Rainfall mass curves for two gages in West Virginia, October 31 - November 6, 1985.

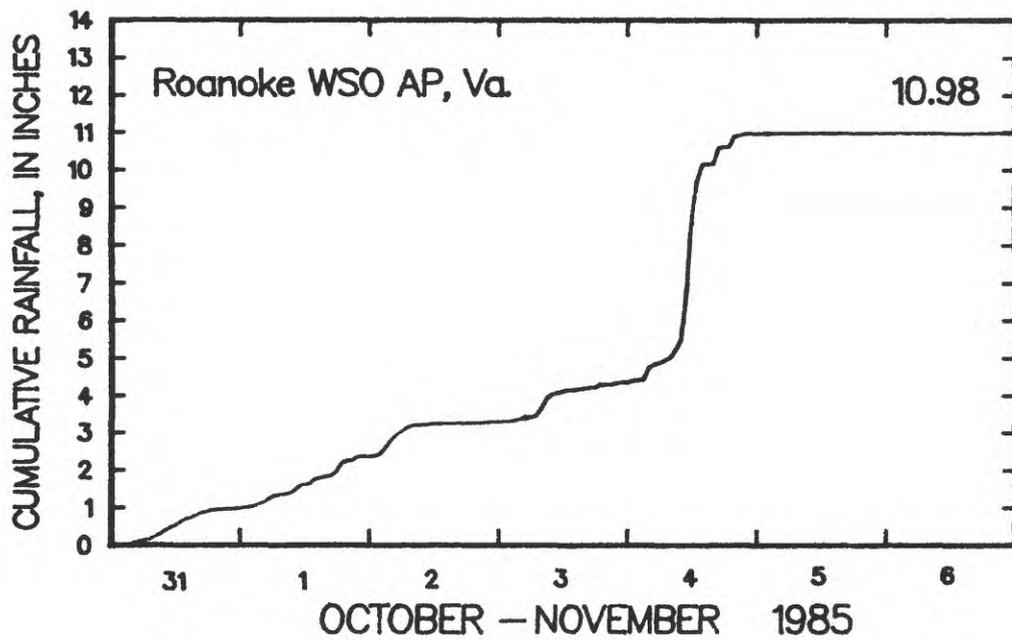
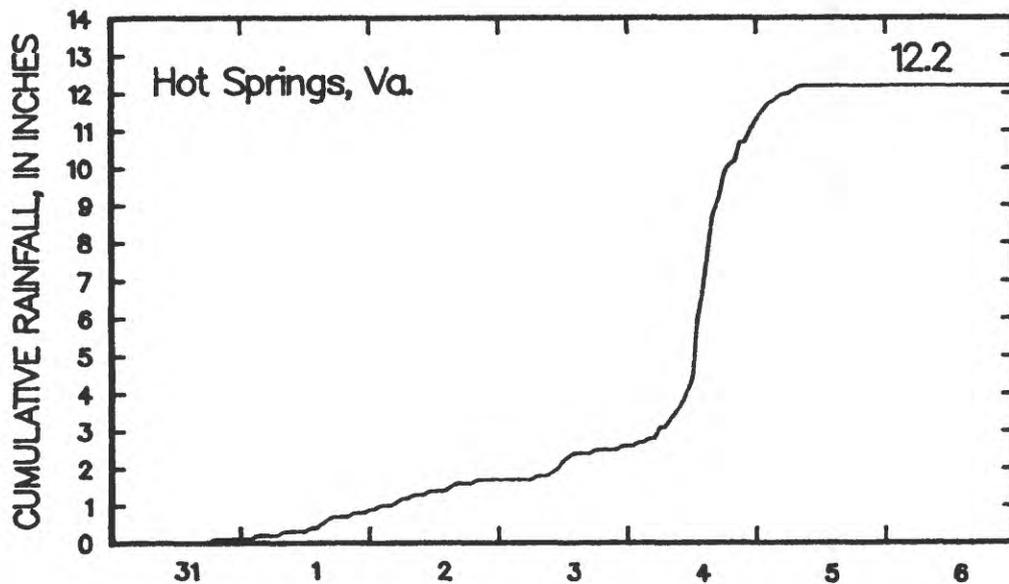


Figure 8.-- Rainfall mass curves for two gages in Virginia, October 31 - November 6, 1985.

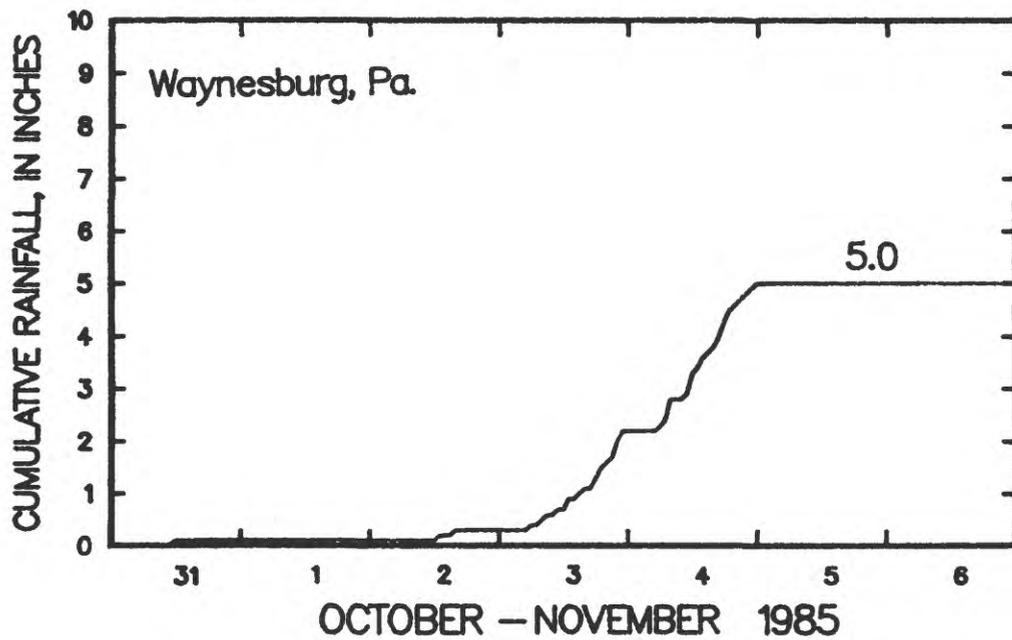
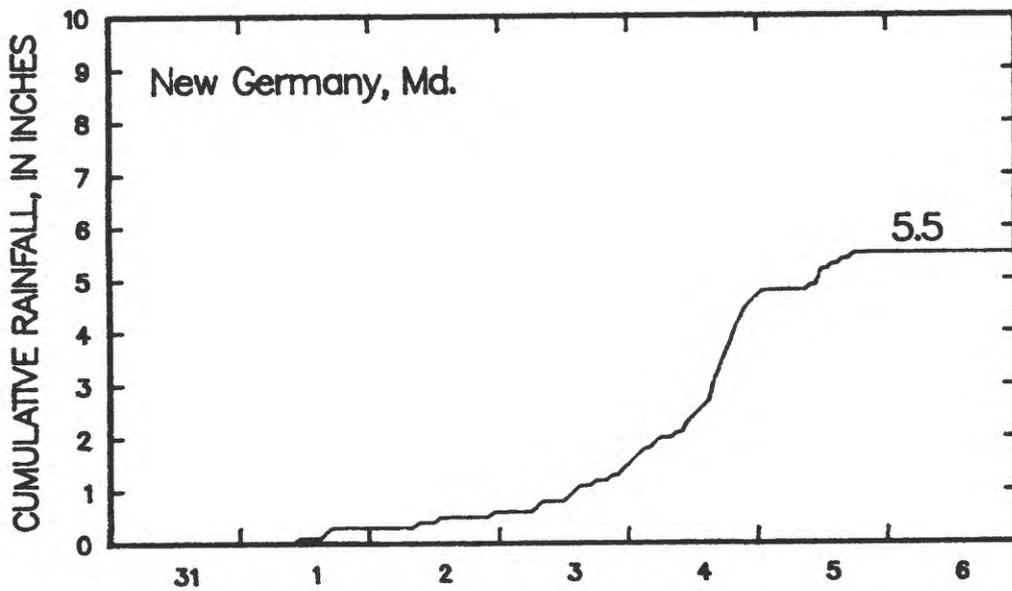


Figure 9.-- Rainfall mass curves for gages in Pennsylvania and Maryland, October 31 - November 6, 1985.

listed, along with previous maximum peaks of record at these stations. Recurrence intervals are described later in the section on Flood Frequency. Peak-discharge data for some miscellaneous sites also are given in table 16.

New maximum peak discharges were recorded at 63 gaging stations; peaks exceeded 100-year recurrence intervals at 63 sites. The 63 new record peaks were, on the average, 89 percent greater than the previous maximum discharges, exceeding the previous maximums by more than 50 percent at 40 stations.

In West Virginia, the Cheat River and South Branch Potomac River basins were particularly hard hit. For example, peak runoff of 170,000 ft<sup>3</sup>/s (cubic feet per second) from a 718-mi<sup>2</sup> (square mile) site was estimated in the Cheat River basin. Peaks up to 110,000 ft<sup>3</sup>/s from 283 mi<sup>2</sup> and 240,000 ft<sup>3</sup>/s from 1,471 mi<sup>2</sup> were recorded in the South Branch Potomac River basin. New maximum peak discharges occurred at 25 of the 50 gaging stations in the affected area of West Virginia. Peak flows equaling or exceeding 100-year recurrence intervals occurred at 27 of the 41 stations not affected by significant regulation. Damage was estimated to be \$578 million and 38 people died as a result of the flooding in West Virginia (Federal Emergency Management Agency, 1985c).

In Virginia, the James River and the Roanoke River basins were especially hard hit. Peak discharges as high as 13,000 ft<sup>3</sup>/s from 13.6 mi<sup>2</sup>, 25,200 ft<sup>3</sup>/s from 47.6 mi<sup>2</sup>, and 179,000 ft<sup>3</sup>/s from 2,075 mi were documented in the James River basin. Peaks of 10,400 ft<sup>3</sup>/s from 11.7 mi<sup>2</sup> and 20,000 ft<sup>3</sup>/s from 56.8 mi<sup>2</sup> were recorded in the Roanoke River basin. New maximum peak discharges occurred at 34 of the 109 gaging stations in the affected area of Virginia. Peak flows equaling or exceeding 100-year recurrence intervals occurred at 32 of the 102 gaging stations having minimal or no regulation. A total of 22 deaths were attributed to the flooding in Virginia, and damage was estimated to be \$753 million (Federal Emergency Management Agency, 1985b), including approximately \$19 million estimated to have been caused by tide-related flooding in coastal areas.

In Pennsylvania, severe flooding occurred along the Monongahela River, with peak flow ranging up to 220,000 ft<sup>3</sup>/s from 4,407 mi<sup>2</sup> (gaging station at Greensboro). One fatality was attributed to the flooding in Pennsylvania, and damage was estimated to be \$83 million (Federal Emergency Management Agency, 1985a).

In Maryland, the upper Potomac River basin experienced severe flooding, with peak discharges ranging as high as 50,400 ft<sup>3</sup>/s from 225 mi<sup>2</sup> and 235,000 ft<sup>3</sup>/s from 3,109 mi<sup>2</sup>. One death resulted from the flooding in Maryland. Damage was estimated at \$5 million, plus another \$16 million related to tidal-coastal flooding (Maryland Emergency Management and Civil Defense Agency, written commun., 1986).

One extraordinary aspect of the November 1985 floods was the extremely high discharge rates that occurred in some of the larger drainage basins (in the 200- to 2,000-mi<sup>2</sup> range) in the South Branch Potomac and Cheat River basins. Peaks at these sites generally exceeded the largest peaks that resulted from Hurricane Agnes in similar size basins (Bailey, Patterson, and Paulhus, 1975). It is reasonable to infer, therefore, that the peaks of 170,000 ft<sup>3</sup>/s, Cheat River at Parsons, West Virginia, and 240,000 ft<sup>3</sup>/s, South Branch Potomac River near Springfield, West Virginia (sites 146 and 14, table 16), for example, were extremely rare events.

## FLOOD FREQUENCY

Flood-frequency information is an important consideration in the design of a wide variety of water-related structures including bridges, culverts, and dams, and also in design and management of all structures located in flood plains. Flood frequency is a general term usually used to indicate how often a given flood discharge will be exceeded during a given period of time. Because the terminology is widely understood and accepted, flood frequencies in this report are expressed in terms of recurrence intervals. A recurrence interval is defined as the average interval of years during which a given flood peak can be expected to be exceeded once. The recurrence interval is inversely related to the probability of the peak being exceeded in any given year. Thus, a flood with a 25-year recurrence interval would have 1 chance in 25, or a 4-percent probability, of being exceeded in any given year. Though unlikely, such a flood could occur 2 or even several years in a row. Probability terminology is sometimes used in describing flood frequencies to avoid any inference of regularity of occurrence.

Flood-frequency information is given in table 16 for gaging stations in this report. The flood-frequency data shown were determined using procedures recommended in U.S. Water Resources Council (1981). Flood-frequency information is not shown for a few stations because of insufficient length of record (nominally 10 years) at the sites. At some stations with short records, flood frequencies are given based on regional flood-frequency regression analyses. At sites where flood peaks are affected significantly by regulation, flood frequencies (recurrence intervals) are not shown because they generally are not meaningful and can be misleading.

At many of the stations, recurrence intervals for the November 1985 flood peaks were greater than 100 years. Because of the relatively short lengths of long-term record available at streamflow-gaging stations, flood-frequency estimates are not considered reliable beyond the 100-year recurrence interval. Therefore, at stations where peak discharge exceeded 100-year values, recurrence intervals are shown in table 16 as >100.

## DESCRIPTION OF FLOODING, BY STATE

### West Virginia

The storm period of October 31 through November 6, 1985, caused major flooding throughout eastern West Virginia in what was described by the Governor of the State as the worst flood in West Virginia history. Record-breaking floods occurred on several rivers within the Potomac, Monongahela, and Kanawha River basins. The most severe flooding occurred in the Cheat River and South Branch Potomac River basins. However, major flooding with record peaks also occurred in the Tygart, Greenbrier, and Little Kanawha River basins.

The flooding in the Cheat River basin was particularly devastating. Towns along the Cheat River suffered extremely heavy damage. Figures 10 and 11 reflect the aftermath of the flooding in Parsons and Rowlesburg, respectively. Figure 12 shows the town of Albright, W. Va., before and after much of it was destroyed. At five of the six streamflow-gaging stations operated in the Cheat River basin, the peak discharge exceeded the 100-year recurrence interval and also set a new record for magnitude (see table 16). The peak flow of 100,000 ft<sup>3</sup>/s at the gaging station Dry Fork at Hendricks was more than twice the previous maximum (47,000 ft<sup>3</sup>/s), from records available since 1940, and the peak stage of 20.74 ft was more than 5 ft higher. The peak discharge of the Cheat River at Parsons, 170,000 ft<sup>3</sup>/s, was more than double the previous maximum (82,000 ft<sup>3</sup>/s), from records available since 1913. The peak discharge of the Cheat River at Rowlesburg, 190,000 ft<sup>3</sup>/s, was 1.5 times the previous maximum of 125,000 ft<sup>3</sup>/s (in 1844). The 1985 peak at the gaging station Shavers Fork at Parsons, 43,000 ft<sup>3</sup>/s was 1.7 times the previous peaks of record (25,000 ft<sup>3</sup>/s in both 1888 and 1907). A discharge hydrograph of the flood at Shavers Fork at Parsons is shown in figure 13, with corresponding unit discharge values given in table 1.

Flooding in the South Branch Potomac River basin was also devastating, with flood peaks of extraordinary magnitude. The towns of Petersburg and Moorefield were particularly hard hit. At five of the six gaging stations operating in the South Branch Potomac basin, new peak discharge records were set (by wide margins), and at those five stations (all without significant upstream regulation) the peaks exceeded 100-year recurrence intervals. For example, the peak discharge of 44,000 ft<sup>3</sup>/s at the gaging station South Branch Potomac River at Franklin was nearly 3 times the previous maximum (15,000 ft<sup>3</sup>/s), from records available since 1940, and the peak stage was 11 ft higher. The flood peak of 110,000 ft<sup>3</sup>/s at the gaging station South Fork South Branch Potomac River near Moorefield was 2.8 times the previous maximum discharge from records since 1928. The peak discharge at South Branch Potomac River near Springfield (240,000 ft<sup>3</sup>/s) was almost twice the previous peak (143,000 ft<sup>3</sup>/s), from records since 1894, and the peak stage was 10 ft higher. The peak discharge for the gage at South Fork South Branch Potomac River at Brandywine (40,500 ft<sup>3</sup>/s) almost equaled the previous maximum (41,200 ft<sup>3</sup>/s), from records since 1943. A discharge hydrograph for South Fork South Branch Potomac River at Brandywine is presented in figure 14, and the data are given in table 2.

Flooding on the Greenbrier River (in the Kanawha River basin) was very severe, causing extensive damage to the towns of Marlinton, Ronceverte, and Alderson. New peak-discharge records were set at all five gaging stations operated in the basin (by a wide margin at three stations). The peaks exceeded 100-year recurrence intervals at all five sites. The peak discharge of 37,100 ft<sup>3</sup>/s at the gaging station Greenbrier River at Durbin was over 3 times the previous maximum, 12,200 ft<sup>3</sup>/s, from records since 1943, and the peak on the Greenbrier at Buckeye (82,000 ft<sup>3</sup>/s) was twice the previous maximum (41,500 ft<sup>3</sup>/s), from records since 1929. The peak flow at Greenbrier River at Alderson, 90,600 ft<sup>3</sup>/s, was the largest peak from records since 1895, exceeding the previous maximum (1918) by 17 percent. Discharge hydrographs for the Greenbrier River gaging stations at Durbin, Buckeye, and Alderson are given in figures 15-17; unit discharge data are given in tables 3-5.

Flooding in the Tygart Valley River basin (tributary to the Monongahela River) set new records for peak discharge at all five of the long-term unregulated gaging stations in the basin (see table 16). However, the peaks were not as extreme, relative to the previous peaks of record, as those in the Cheat River and South Branch Potomac River basins. Recurrence intervals for the peaks equaled or exceeded 50 years at all five of the aforementioned sites in the Tygart basin, and four were in excess of 100 years. Also, at one newly established gaging station, Three Forks Creek near Grafton, the peak discharge, 12,000 ft<sup>3</sup>/s, was estimated to exceed the 100-year recurrence interval. A discharge hydrograph for the flood at Tygart Valley River at Belington is shown in figure 18, and the corresponding unit discharge data are given in table 6.

The November 1985 storm also caused new peak discharges of record at four gaging stations not discussed thus far, two in the Kanawha River basin and two in the headwaters of the Little Kanawha River basin. The new maximums in the Kanawha River basin were at Gauley River near Craigsville (61,800 ft<sup>3</sup>/s), operated since 1964, and at Elk River at Webster Springs (27,000 ft<sup>3</sup>/s), operated from 1908 to 1916. In the Little Kanawha River basin, the new maximums were on the Little Kanawha River near Wildcat (10,500 ft<sup>3</sup>/s), from records since 1973, and at Glenville (26,900 ft<sup>3</sup>/s), from records on and off since 1915 and regulated since 1979.

One other gaged site, in the Potomac River basin, should receive special mention. The gaging station Stony River near Mount Storm, though highly regulated by two upstream reservoirs, still experienced a peak discharge of 14,000 ft<sup>3</sup>/s from only 48.8 mi<sup>2</sup>. This discharge was nearly double the previous peak of record (7,300 ft<sup>3</sup>/s), operated since 1961, and the peak stage was over 4 ft higher than the previous peak.

The damage from the November 1985 flood in West Virginia was extremely extensive. However, given the situation, with the worst flood in recent history (if not the worst ever) striking a region where most of the really livable land lies in the flood plain, widespread severe damage was virtually inevitable.

In West Virginia, 38 people lost their lives and damage was estimated at \$578 million (Federal Emergency Management Agency, 1985c). A total of 29 counties (essentially the entire eastern half of the State) were included in the declaration of disaster areas by the Federal Government.

Nearly 9,000 homes were damaged by the flooding, of which more than 4,000 were completely destroyed. Thousands of acres of productive farmland were literally stripped of their topsoil, leaving broad expanses of boulders and rubble often over 3 ft thick. Agricultural losses alone were estimated to be \$97 million. A total of 50 highway bridges were destroyed according to the West Virginia State Department of Highways, and damage to businesses was estimated at \$118 million.

As severe as the damage was in West Virginia, it would have been significantly worse if not for the presence of several flood-control projects. According to the U.S. Army Corps of Engineers (Federal Emergency Management Agency, 1985c), Tygart and Stonewall Jackson Lakes on the Tygart Valley and West Fork Rivers, respectively, functioned to reduce flood damage by an estimated \$69 million. Bluestone, Summersville, and Sutton Lakes were reported to have prevented flood damages of \$62 million in the Kanawha River basin, and Burnsville Lake was estimated to have prevented \$3.9 million in damages in the Little Kanawha basin.



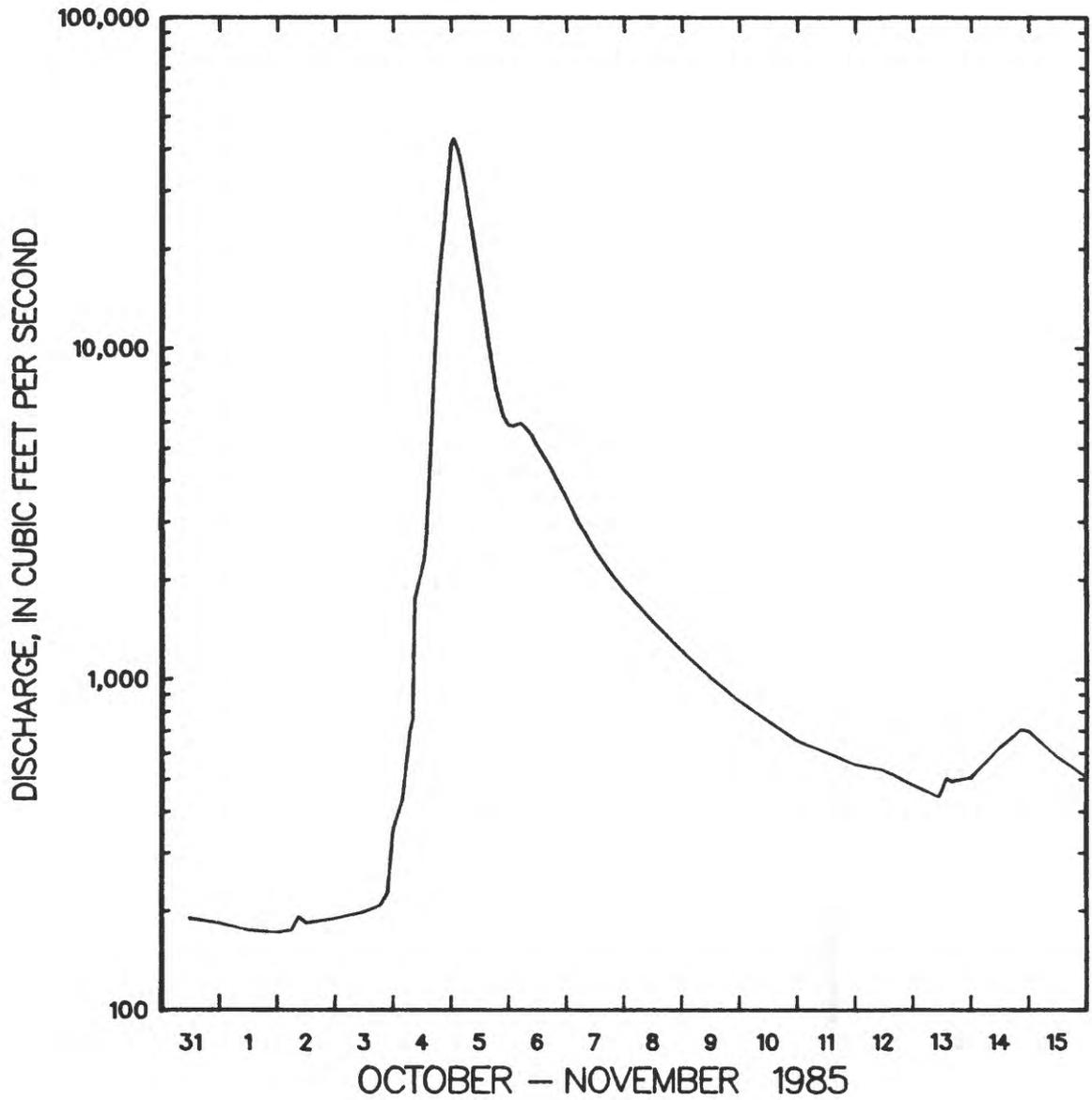
**Figure 10.-- Cheat River damage, Pennsylvania Avenue, Parsons, W. Va. (Photograph by Nancy J. Isner, The Inter-Mountain, Elkins, W. Va.)**



**Figure 11.-- Cheat River damage, railroad truss bridge, Rowlesburg, W. Va. (Photograph by Delbert Benson, Preston County Journal, and courtesy of McClain Printing Co., Parsons, W. Va.)**



**Figure 12.-- Cheat River damage, before and after flood at Albright, W. Va.  
(Photograph by Bob Sigler, Skyhawk Aerial Photos,  
Albright, W. Va., and courtesy of McClain Printing Co.,  
Parsons, W. Va.)**



**Figure 13.-- Discharge at gaging station Shavers Fork at Parsons, W. Va. (Site No. 145), October 31 - November 15, 1985.**

Table 1.--Gage height and discharge for flood of November 1985  
at gaging station Shavers Fork at Parsons, W. Va.  
(Site No. 145)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
October 31-----	1200	1.28	189
	2400	1.26	183
November 1-----	1200	1.23	174
	2400	1.22	171
November 2-----	0600	1.23	174
	0900	1.29	192
	1200	1.26	183
	2400	1.28	189
November 3-----	1200	1.31	198
	1900	1.34	208
	2200	1.40	227
	2400	1.71	353
November 4-----	0400	1.87	436
	0700	2.26	708
	0800	2.32	756
	0900	3.42	1,770
	1000	3.53	1,880
	1200	3.82	2,170
	1300	3.96	2,310
	1400	4.46	2,840
	1500	5.47	4,130
	1700	8.24	8,430
	1900	11.55	15,800
	2000	12.97	19,300
	2100	13.96	22,300
	2200	15.85	27,900
November 5-----	2400	19.56	41,600
	0100	19.85	43,000
	0300	18.93	39,100
	0500	17.53	33,800
	0700	15.73	27,600
	0900	14.08	22,600
	1100	12.58	18,300
	1300	11.18	14,800
	1600	9.13	10,100
	1900	7.68	7,460
	2200	6.88	6,200
November 6-----	2400	6.66	5,860
	0200	6.63	5,820
	0500	6.71	5,940
	0800	6.53	5,660
	1000	6.38	5,430
	1200	6.15	5,080
	1800	5.59	4,300
November 7-----	2400	5.04	3,570
	0600	4.52	2,910
	1200	4.10	2,450
	1800	3.78	2,130
November 8-----	2400	3.52	1,870
	1200	3.15	1,500
	2400	2.87	1,220
November 9-----	1200	2.63	1,010
	2400	2.45	860
November 10-----	1200	2.31	748
	2400	2.19	653
November 11-----	1200	2.12	604
	2400	2.05	555
November 12-----	1200	2.02	534
	2400	1.94	480
November 13-----	1100	1.88	442
	1400	1.98	507
	1600	1.96	493
November 14-----	2400	1.98	507
	1200	2.15	625
	2100	2.26	708
November 15-----	2400	2.25	700
	1200	2.09	583
	2400	1.98	507

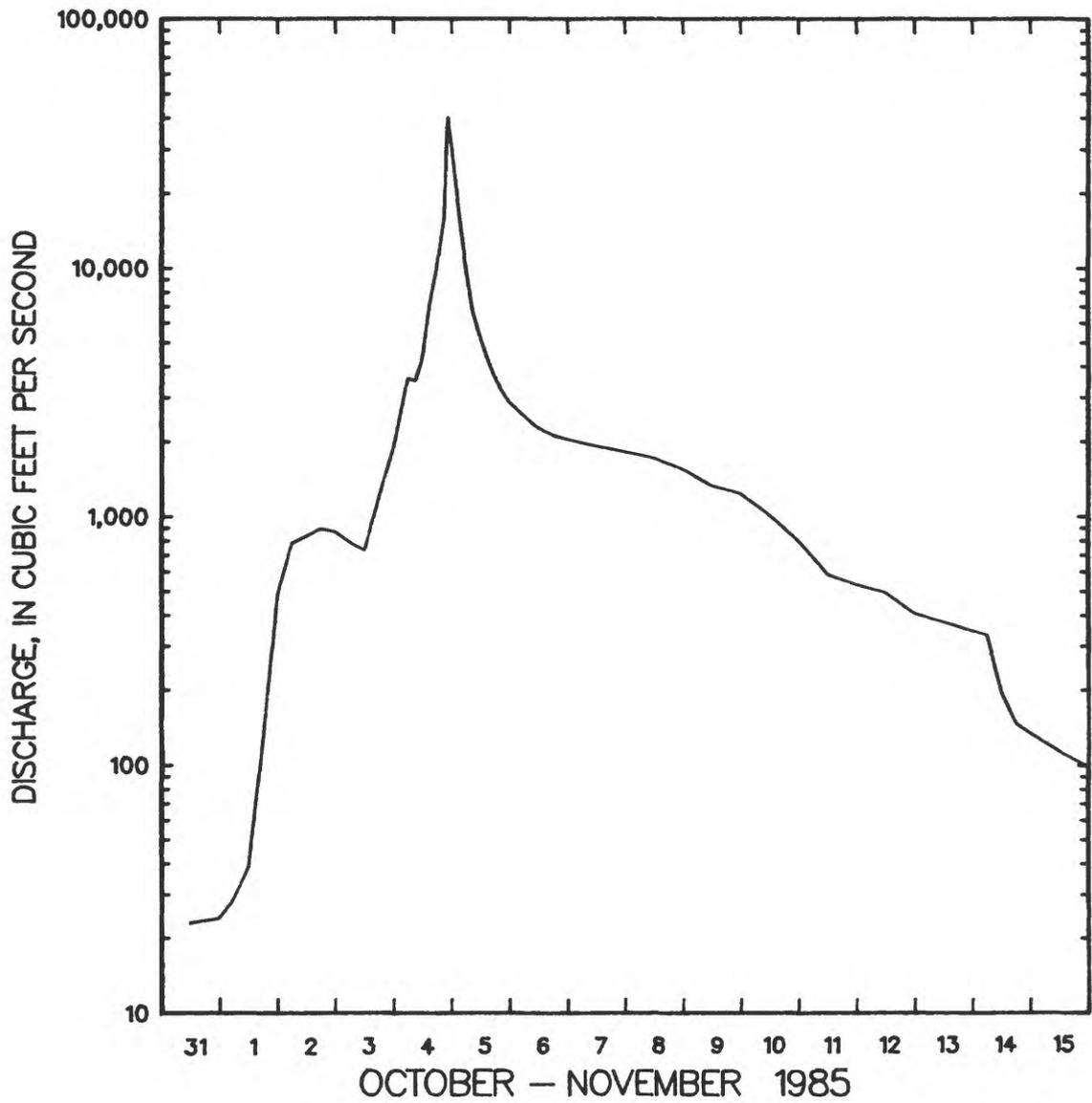


Figure 14.-- Discharge at gaging station South Fork South Branch Potomac River at Brandywine, W. Va. (Site No. 12), October 31 - November 15, 1985.

Table 2.--Gage height and discharge for flood of November 1985  
at gaging station South Fork South Branch  
Potomac River at Brandywine, W. Va. (Site No. 12)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
October 31-----	1200	1.50	23
	2400	1.51	24
November 1-----	0600	1.56	29
	1200	1.64	39
	1800	2.06	128
	2400	2.93	488
November 2-----	0600	3.38	786
	1200	3.45	835
	1800	3.53	894
	2400	3.50	870
November 3-----	0600	3.38	786
	1200	3.30	730
	1800	3.91	1,210
	2400	4.64	1,920
November 4-----	0300	5.28	2,640
	0600	6.08	3,600
	0900	6.00	3,500
	1200	6.65	4,340
	1500	8.55	7,080
	1800	10.27	10,000
	2100	13.00	16,000
	2230	18.42	40,500
November 5-----	2400	16.85	31,200
	0300	13.35	17,000
	0600	10.33	10,200
	0900	8.25	6,600
	1200	7.29	5,210
	1500	6.55	4,220
	1800	6.05	3,560
	2100	5.71	3,150
November 6-----	2400	5.47	2,860
	0600	5.18	2,520
	1200	4.95	2,260
	1800	4.82	2,120
November 7-----	2400	4.75	2,040
	1200	4.64	1,920
	2400	4.55	1,820
November 8-----	1200	4.45	1,720
	2400	4.28	1,550
November 9-----	1200	4.04	1,330
	2400	3.95	1,240
November 10-----	1200	3.68	1,010
	2400	3.40	800
November 11-----	1200	3.09	584
	2400	3.00	530
November 12-----	1200	2.94	494
	2400	2.79	405
November 13-----	1200	2.73	375
	2400	2.67	346
November 14-----	0600	2.64	333
	1200	2.28	194
	1800	2.12	146
	2400	2.08	134
November 15-----	1200	2.01	113
	2400	1.95	98

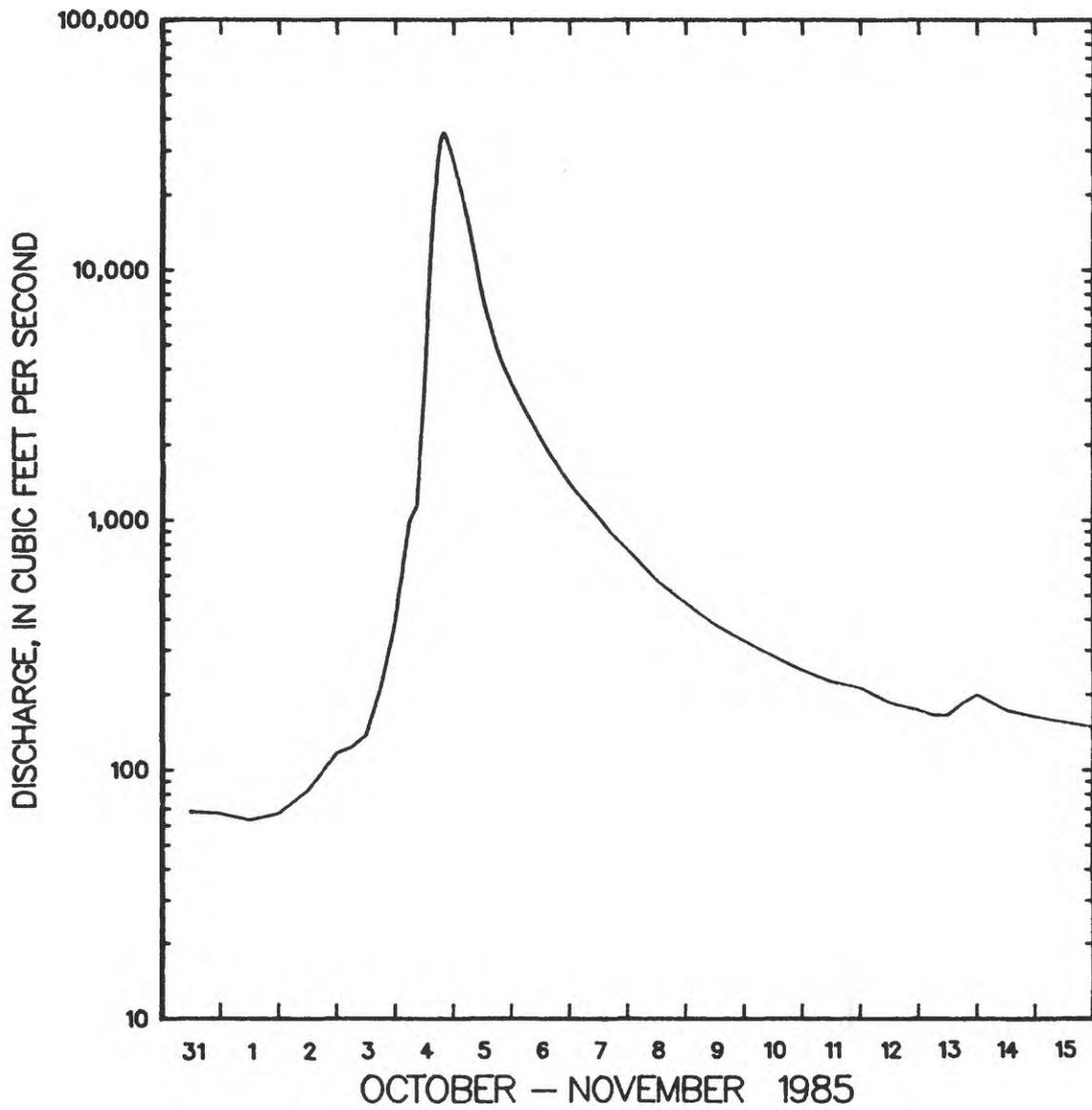


Figure 15.-- Discharge at gaging station Greenbriar River at Durbin, W. Va. (Site No. 178), October 31 - November 15, 1985.

Table 3.--Gage height and discharge for flood of November 1985  
at gaging station Greenbrier River at Durbin, W. Va.  
(Site No. 178)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
October 31-----	1200	1.35	68
	2400	1.34	67
November 1-----	1200	1.32	63
	2400	1.34	67
November 2-----	1200	1.43	83
	2400	1.61	117
November 3-----	0600	1.64	123
	1200	1.71	137
	1800	1.99	212
November 4-----	2400	2.48	392
	0300	2.91	606
	0600	3.50	1,000
	0900	3.68	1,140
	1200	5.47	3,450
	1500	9.56	13,400
	1600	11.40	19,000
	1800	14.36	30,400
	1900	15.15	33,800
	2000	<sup>a</sup> 15.50	<sup>b</sup> 35,500
November 5-----	2100	15.09	33,500
	2400	13.49	27,000
	0300	11.77	20,200
	0600	10.27	15,500
November 6-----	0900	8.85	11,300
	1200	7.54	7,900
	1500	6.69	6,020
	1800	6.11	4,740
	2100	5.76	3,980
	2400	5.47	3,450
	0600	4.99	2,680
November 7-----	1200	4.62	2,110
	1800	4.29	1,690
	2400	3.99	1,390
November 8-----	0600	3.74	1,190
	1200	3.53	1,020
	1800	3.34	872
November 9-----	2400	3.17	762
	1200	2.85	575
November 10-----	2400	2.63	465
	1200	2.45	380
November 11-----	2400	2.32	328
	1200	2.21	284
November 12-----	2400	2.11	249
	1200	2.03	224
November 13-----	2400	1.99	212
	1200	1.90	185
November 14-----	2400	1.85	173
	0600	1.82	165
	1200	1.82	165
	1800	1.90	185
November 15-----	2400	1.95	200
	1200	1.85	173
	2400	1.81	163
	1200	1.78	155
	2400	1.75	148

<sup>a</sup> Peak stage, 15.82 ft (probably between 1900 and 2000 hours); see table 16.

<sup>b</sup> Peak discharge, 37,100 ft<sup>3</sup>/s; see table 16.

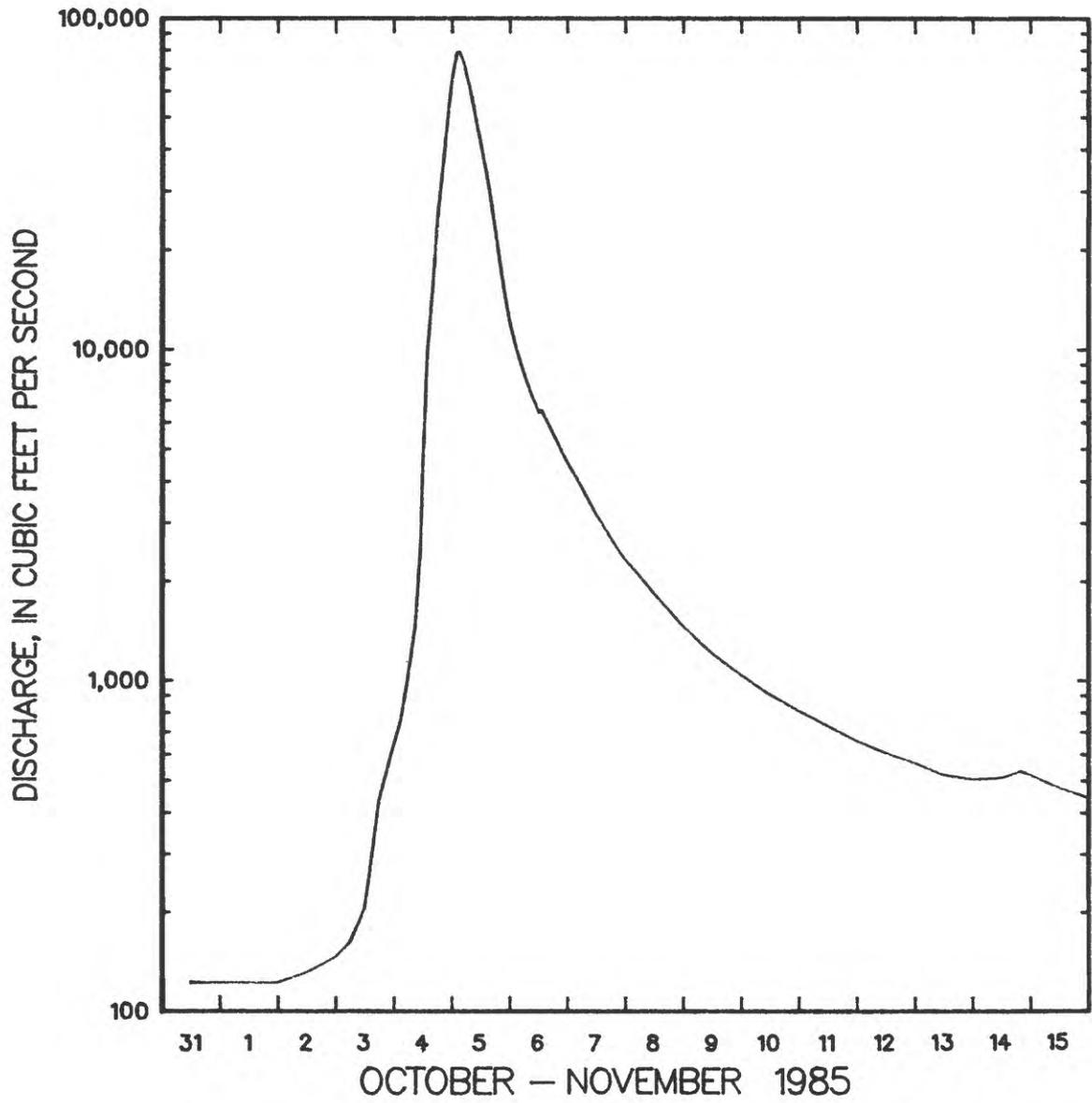


Figure 16.-- Discharge at gaging station Greenbriar River at Buckeye, W. Va. (Site No. 180), October 31 - November 15, 1985.

Table 4.--Gage height and discharge for flood of November 1985  
at gaging station Greenbrier River at Buckeye, W. Va.  
(Site No. 180)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
October 31-----	1200	2.09	122
	2400	2.09	122
November 1-----	1200	2.09	122
	2400	2.09	122
November 2-----	1200	2.12	131
	2400	2.17	146
November 3-----	0600	2.22	162
	1200	2.34	206
November 4-----	1800	2.87	445
	2400	3.26	646
	0300	3.46	766
	0600	3.87	1,040
	0900	4.46	1,490
	1100	5.51	2,540
	1200	7.05	4,790
November 5-----	1400	9.52	10,100
	1600	11.31	15,100
	1800	14.45	25,700
	2100	17.68	40,100
	2400	21.31	64,500
	0200	22.83	78,300
	0300	<sup>a</sup> 22.95	<sup>b</sup> 79,500
	0500	22.31	73,100
	0800	20.56	58,700
	1000	19.21	49,400
November 6-----	1200	17.88	41,200
	1500	15.86	31,800
	1800	13.75	23,100
	2000	12.29	18,200
	2200	11.13	14,600
	2400	10.31	12,100
	0300	9.46	9,900
	0600	8.85	8,380
	0900	8.31	7,220
	1200	7.90	6,400
November 7-----	1300	7.97	6,540
	1800	7.44	5,490
	2400	6.89	4,540
	0600	6.41	3,820
	1200	5.98	3,170
November 8-----	1800	5.63	2,700
	2400	5.32	2,320
	1200	4.84	1,840
November 9-----	2400	4.42	1,460
	1200	4.11	1,210
November 10-----	2400	3.87	1,040
	1200	3.68	907
November 11-----	2400	3.53	810
	1200	3.40	730
November 12-----	2400	3.28	658
	1200	3.19	605
November 13-----	2400	3.11	565
	1200	3.02	520
November 14-----	2400	2.99	505
	1200	3.00	510
	2000	3.05	535
November 15-----	2400	3.02	520
	1200	2.93	475
	2400	2.87	445

<sup>a</sup> Peak stage, 23.2 ft (probably between 0200 and 0300 hours);  
see table 16.

<sup>b</sup> Peak discharge, 82,000 ft<sup>3</sup>/s; see table 16.

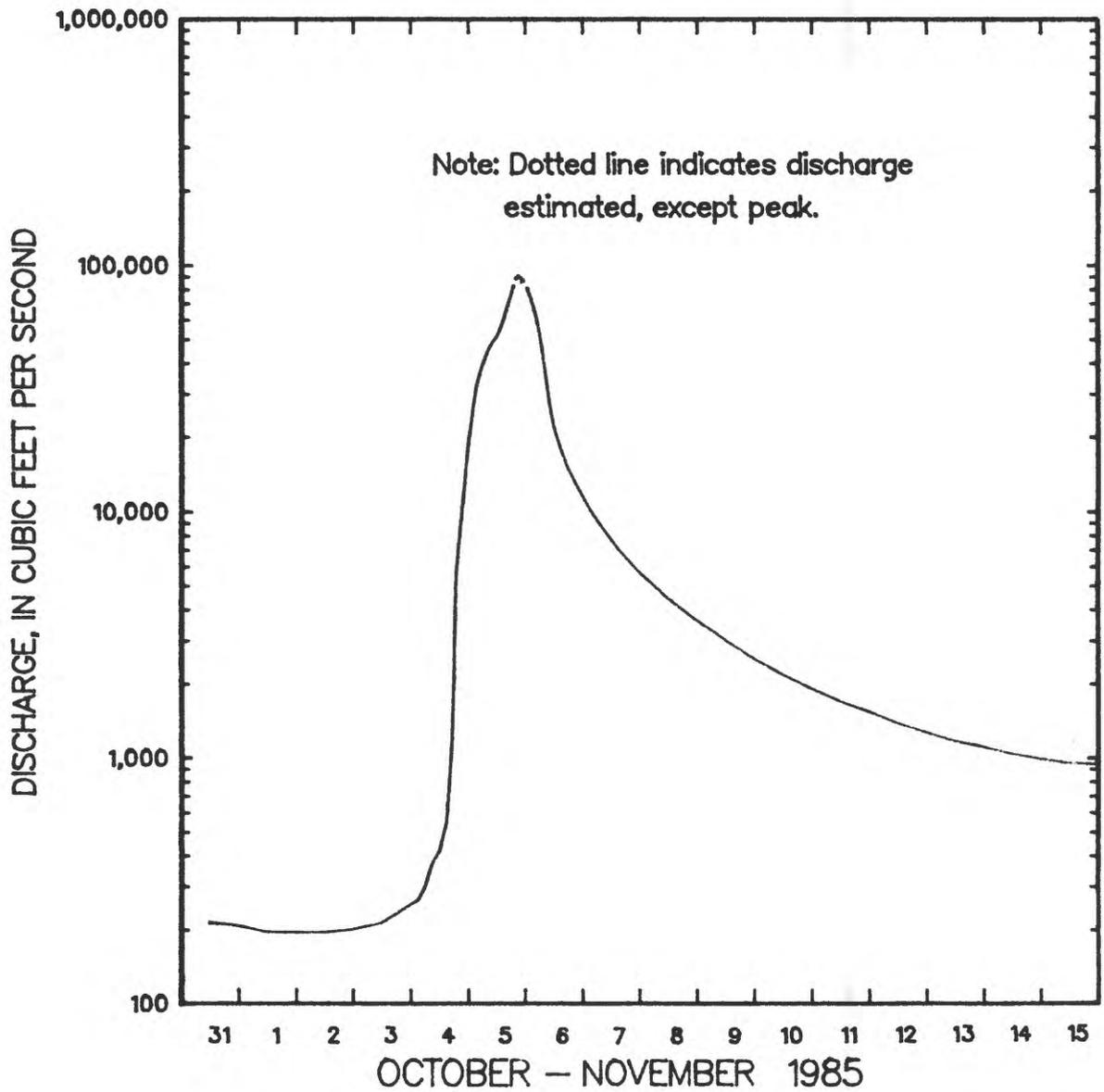


Figure 17.-- Discharge at gaging station Greenbriar River at Alderson, W. Va. (Site No. 181), October 31 - November 15, 1985.

Table 5.--Gage height and discharge for flood of November 1985  
at gaging station Greenbrier River at Alderson, W. Va.  
(Site No. 181)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second;  
dash indicates that gage height was not  
determined]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
October 31-----	1200	2.37	214
	2400	2.36	209
November 1-----	1200	2.33	196
	2400	2.33	196
November 2-----	1200	2.33	196
	2400	2.34	201
November 3-----	1200	2.37	214
	2400	2.45	254
November 4-----	0300	2.47	264
	0600	2.53	298
	0900	2.65	375
	1200	2.71	418
	1500	2.87	553
	1700	3.34	1,090
	1800	3.99	2,120
	1900	5.56	5,610
	2100	6.85	9,350
	2300	8.58	14,700
	2400	9.81	19,000
November 5-----	0300	13.01	30,200
	0400	13.98	33,600
	0600	15.47	39,100
	0900	17.16	46,600
	1200	18.30	51,500
	1300	18.67	53,400
	1500	19.91	60,500
	1800	22.41	77,300
	1900	23.09	82,800
	2000	-	<sup>a</sup> 88,500
	<sup>a</sup> 2100	23.95	90,600
	2200	-	<sup>a</sup> 89,400
	2300	-	<sup>a</sup> 87,400
	2400	-	<sup>a</sup> 84,500
November 6-----	0100	22.87	81,000
	0200	22.25	76,000
	0400	20.74	65,400
	0600	18.64	53,200
	0900	13.78	32,900
	1000	12.35	27,900
	1100	11.29	24,200
	1200	10.57	21,700
	1500	9.36	17,500
	1800	8.61	14,800
	2100	8.05	13,000
	2400	7.60	11,600
November 7-----	0300	7.18	10,300
	0600	6.83	9,290
	1200	6.30	7,700
	1800	5.90	6,530
	2400	5.59	5,690
November 8-----	1200	5.10	4,450
	2400	4.74	3,630
November 9-----	1200	4.46	3,020
	2400	4.22	2,540
November 10-----	1200	4.03	2,190
	2400	3.88	1,920
November 11-----	1200	3.75	1,690
	2400	3.66	1,540
November 12-----	1200	3.56	1,380
	2400	3.48	1,270
November 13-----	1200	3.41	1,170
	2400	3.36	1,110
November 14-----	1200	3.30	1,040
	2400	3.26	992
November 15-----	1200	3.23	956
	2400	3.22	944

<sup>a</sup> Estimated.

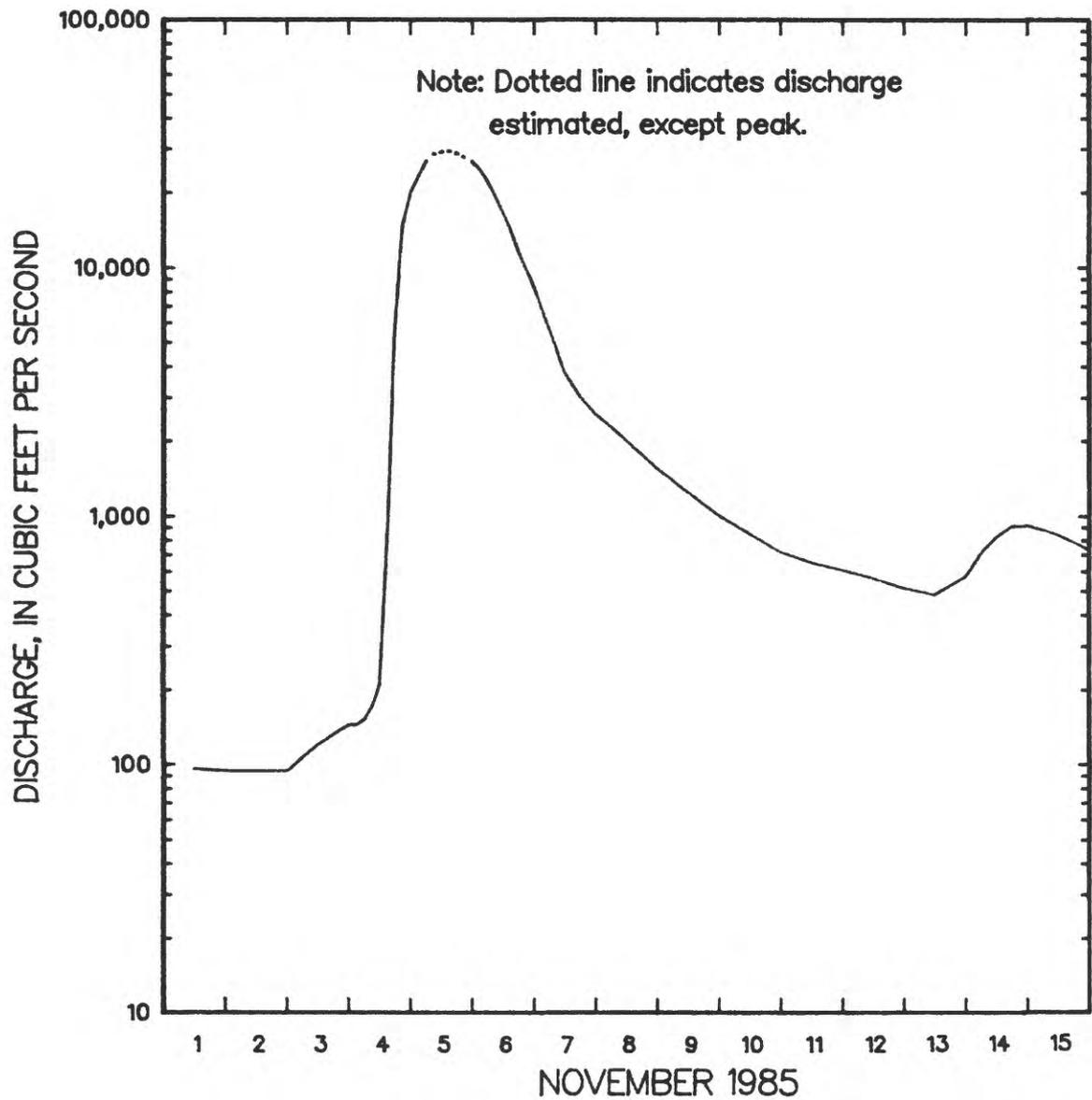


Figure 18.-- Discharge at gaging station Tygart Valley River at Belington, W. Va. (Site No. 132), November 1-15, 1985.

Table 6.--Gage height and discharge for flood of November 1985  
at gaging station Tygart Valley River at  
Belington, W. Va. (Site No. 132)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second;  
dash indicates that gage height was not  
determined]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
November 1-----	1200	2.76	96
	2400	2.75	94
November 2-----	1200	2.75	94
	2400	2.75	94
November 3-----	1200	2.84	120
	2400	2.91	144
November 4-----	0300	2.91	144
	0600	2.93	151
	0900	2.98	170
	1200	3.08	210
	1500	4.30	840
	1800	10.45	5,760
	2100	17.00	14,800
November 5-----	2400	19.63	20,000
	0300	21.08	23,300
	0600	22.50	26,700
	0900	-	<sup>a</sup> 28,600
	1200	-	<sup>a</sup> 29,200
	1500	23.65	29,500
	1800	-	<sup>a</sup> 28,900
	2100	-	<sup>a</sup> 27,800
	2400	22.52	26,700
	0300	21.78	25,000
November 6-----	0600	20.73	22,400
	0900	19.42	19,500
	1200	18.05	16,800
	1500	16.70	14,300
	1800	15.00	11,700
	2100	13.75	9,950
	2400	12.62	8,440
November 7-----	0600	10.32	5,620
	1200	8.49	3,810
	1800	7.54	3,030
	2400	6.95	2,570
November 8-----	0600	6.54	2,290
	1200	6.15	2,010
	1800	5.80	1,770
November 9-----	2400	5.49	1,550
	1200	5.00	1,250
November 10-----	2400	4.60	1,010
	1200	4.32	851
November 11-----	2400	4.08	719
	1200	3.96	653
November 12-----	2400	3.88	609
	1200	3.80	565
November 13-----	2400	3.71	515
	1200	3.65	485
November 14-----	2400	3.82	576
	0600	4.08	719
	1200	4.29	834
	1800	4.44	917
November 15-----	2400	4.45	922
	1200	4.31	845
	2400	4.11	735

<sup>a</sup> Estimated.

## Virginia

The November 1985 storm produced severe flooding over a large part of Virginia. The worst flooding was in the west-central and north-central parts of the State, but major runoff-related damage occurred as far east as Richmond. New peaks of record occurred on several streams within the Roanoke, James, and Shenandoah River basins. The most severe damage was confined to the Roanoke and James River basins, though record-breaking peaks and widespread flooding did occur in the Shenandoah River basin.

The most extensive damage in Virginia occurred in the Roanoke River basin, primarily in the Roanoke-Salem metropolitan area. Figures 19 and 20 illustrate to some extent the severity of the flooding there. New peak-discharge records were set at six gaging stations and 100-year recurrence intervals were exceeded at five of those stations (table 16). At the gaging station Roanoke River at Roanoke, the peak flow of 32,300 ft<sup>3</sup>/s exceeded the previous maximum (25,300 ft<sup>3</sup>/s) by over 25 percent, from records since 1899, and the peak stage was 3.7 ft higher. The peak flow of 52,300 ft<sup>3</sup>/s at Roanoke River at Niagara was over 75 percent greater than the previous maximum, from records since 1926, and the stage of 25.3 ft was over 6 ft higher. At another station, Tinker Creek near Daleville, a unit discharge of 890 (ft<sup>3</sup>/s)/mi<sup>2</sup> (cubic feet per second per square mile) was recorded from 11.7 mi<sup>2</sup>. At this station, the peak discharge of 10,400 ft<sup>3</sup>/s was 2.6 times the previous maximum, from records since 1956. A discharge hydrograph for the flood at Roanoke River at Niagara is shown in figure 21, and discharge data are given in table 7.

Severe flooding was widespread in the James River basin. The city of Lynchburg was particularly hard hit, with stages 7 ft higher than the previous flood of record, in 1877. New peaks of record occurred at many locations from the headwaters of the James River downstream to the main-stem station at Bent Creek. Farther downstream, the November 1985 peaks, though still extremely large, generally were smaller than those from Hurricanes Agnes and Camille. At the gaging station James River at Scottsville, the recurrence interval exceeded 100 years, but the discharge, 243,000 ft<sup>3</sup>/s, was considerably less than the 301,000 ft<sup>3</sup>/s peak from Hurricane Agnes. Flooding in Richmond was extensive, but not nearly as severe as the flooding that resulted from Agnes in June 1972, the peak stage of which was 4 ft higher than that in November 1985.

In the upper reaches of the James River basin, new records of peak discharge were set at 15 of the 24 essentially unregulated stations upstream from (and including) the gage at Bent Creek. Flood peaks exceeded 100-year recurrence intervals at 17 of those stations. At the gaging station Catawba Creek near Catawba, the discharge of 21,200 ft<sup>3</sup>/s (from 34.3 mi<sup>2</sup>) was 2.7 times the previous maximum of 7,740 ft<sup>3</sup>/s (and the stage was 8.8 ft higher), from records since 1943. The peak at Maury River at Rockbridge Baths, 87,700 ft<sup>3</sup>/s, was 2.7 times the previous peak of record and the stage was 6.1 ft higher, from records since 1928. Peak discharges on the main-stem James River gaging stations at Buchanan, Holcombs Rock, and Bent Creek all exceeded the previous maximums by at least 25 percent and stages were from 3.6 to 6.6 ft higher than the previous peak stages.

Discharge hydrographs for the James River basin gaging stations Back

Creek near Sunrise, Calfpasture River above Mill Creek at Goshen, and James River at Holcombs Rock are presented in figures 22 to 24, and corresponding discharge data are given in tables 8 to 10.

Flooding in the Shenandoah River basin was not as severe as in the James River basin. Figure 25 shows the flooding at Harpers Ferry, W. Va., at the confluence of the Shenandoah and Potomac Rivers.

Peak discharges set new records at 13 of the 24 streamflow measuring stations in the Shenandoah River basin and exceeded 100-year recurrence intervals at 9 stations. The peak discharge at the gaging station Middle River near Verona, 45,000 ft<sup>3</sup>/s, was greater than five times the previous maximum (8,650 ft<sup>3</sup>/s), from records since 1968, and the stage was 10 ft higher. The peak at South Fork Shenandoah River near Lynnwood, 95,100 ft<sup>3</sup>/s, was 19 percent greater than the previous maximum, and the stage was 2.2 ft higher, from records since 1930.

Discharge hydrographs for the flood at Middle River near Grottoes and at North Fork Shenandoah River at Mount Jackson are shown in figures 26 and 27, and corresponding discharge data are given in tables 11 and 12.

Flood damage in Virginia was extremely severe. Monetarily, Virginia's losses were the largest by far for any flood in the history of the State, including Hurricanes Camille and Agnes. Virginia's losses even exceeded those estimated for West Virginia for this flood, no doubt because more populated and otherwise developed areas were on the flood plains of the most severely flooded rivers in Virginia. The metropolitan areas of Richmond and Lynchburg along the James River, and Roanoke and Salem along the Roanoke River all sustained particularly heavy damage with flood stages being the worst ever recorded in the Roanoke, Salem, and Lynchburg areas.

A total of 22 lives were lost in Virginia and damage was estimated at \$753 million, including \$19 million tide-related damage (Federal Emergency Management Agency, 1985b). The disaster-area declaration by the Federal Government included 40 counties and 12 independent cities.

Damage to the Roanoke-Salem region alone was estimated at \$440 million. Damage to one manufacturing facility exceeded \$20 million, according to a Roanoke-based newspaper. Many people in Roanoke were rescued from rooftops by boats and helicopters. Residents of one apartment complex in Salem were rescued by boat from third-floor apartments.

In Lynchburg, where the previous maximum stage known on the James River was exceeded by approximately 7 ft, the damage also was especially severe. For example, an estimated \$8 million in tobacco stored in warehouses along the river was destroyed.

The damage in Virginia no doubt would have been even worse if not for two flood-control projects in the affected region. According to the U.S. Army Corps of Engineers (Federal Emergency Management Agency, 1985b), Lake Moomaw functioned to prevent approximately \$70 million additional flood damage in the James River basin. Also, Philpott Lake was credited with saving an estimated \$1 million in damage along the Smith River in the Roanoke River basin.



Figure 19.-- Williamson Road in Boxley Hills section, Roanoke, Va. metropolitan area. (Photograph by Bob Phillips, Roanoke Times and World News.)



Figure 20.-- Rescue operation on East Main Street, Salem, Va. (Photograph by Wayne Scarberry, Roanoke Times and World News.)

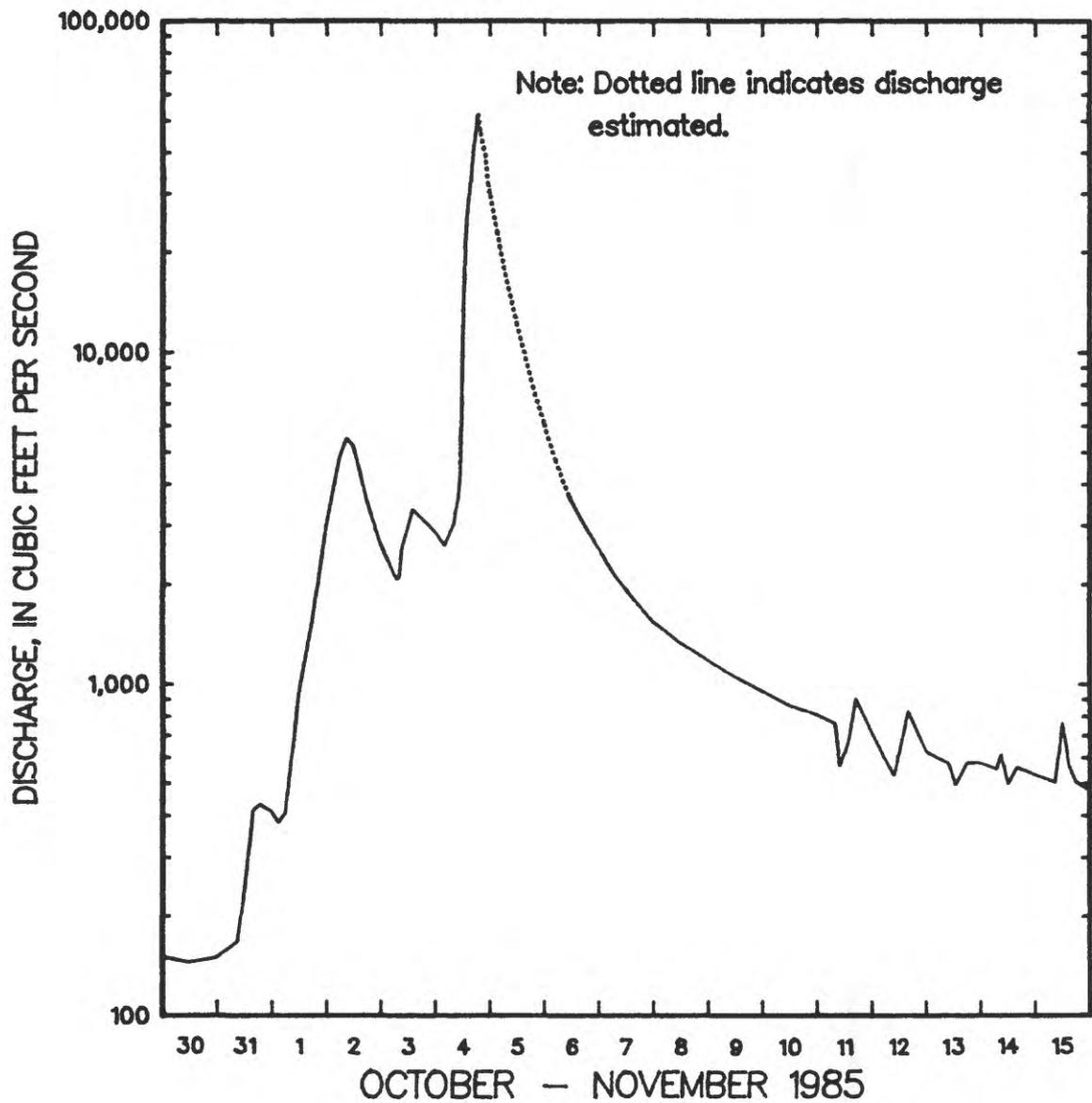


Figure 21.-- Discharge at gaging station Roanoke River at Niagara, Va. (Site No. 120), October 30 - November 15, 1985.

Table 7.--Gage height and discharge for flood of November 1985 at gaging station Roanoke River at Niagara, Va.  
(Site No. 120)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second; dash indicates that gage height was not determined]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
October 30-----	0100	1.72	150	November 5-----	0300	-	<sup>a</sup> 22,900
	1200	1.69	145		0700	-	<sup>a</sup> 17,200
	2400	1.72	150		1200	-	<sup>a</sup> 12,200
October 31-----	0900	1.82	168	1900	-	<sup>a</sup> 7,870	
	1200	2.15	237	2400	-	<sup>a</sup> 6,060	
	1600	2.81	417	November 6-----	0500	-	<sup>a</sup> 4,720
1900	2.86	433	1100		7.85	3,660	
2400	2.79	411	1700		7.28	3,060	
November 1-----	0300	2.69	381	2400	6.74	2,550	
	0600	2.78	408	November 7-----	0600	6.29	2,170
	1200	4.14	931		1200	5.97	1,920
1800	5.27	1,560	2400		5.43	1,540	
November 2-----	2400	7.21	3,040	November 8-----	1200	5.09	1,330
	0600	8.85	4,840		2400	4.83	1,180
	0900	9.36	5,510		November 9-----	1200	4.57
1200	9.14	5,210	2400	4.38		952	
1800	7.71	3,540	November 10-----	1200		4.18	859
2400	6.71	2,610		2400	4.07	810	
November 3-----	0700	6.01		2,070	November 11-----	0800	3.95
	0800	6.05	2,100	1000		3.45	564
	0900	6.68	2,580	1400		3.76	681
November 4-----	1400	7.55	3,370	1700	4.28	905	
	2400	7.01	2,860	2400	3.83	709	
	0400	6.72	2,610	November 12-----	1000	3.35	529
	0800	7.21	3,040		1600	4.12	832
	1000	7.83	3,660		2400	3.61	623
	1100	8.50	4,410	November 13-----	1000	3.48	575
	1200	11.80	9,520		1300	3.25	495
	1300	16.58	21,400		1800	3.49	578
	1400	18.36	26,800	2400	3.49	578	
	1600	20.78	34,800	November 14-----	0700	3.42	553
	1700	22.81	42,200		0900	3.59	615
	1800	23.96	46,700		1200	3.26	498
	<sup>a</sup> 1900	25.30	52,300	1600	3.44	560	
2000	-	<sup>a</sup> 45,700	2400	3.36	532		
2200	-	<sup>a</sup> 39,500	November 15-----	0900	3.28	505	
2300	-	<sup>a</sup> 32,100		1200	3.97	767	
2400	-	<sup>a</sup> 29,500		1500	3.45	564	
				1800	3.28	505	
				2400	3.20	478	

<sup>a</sup> Estimated.

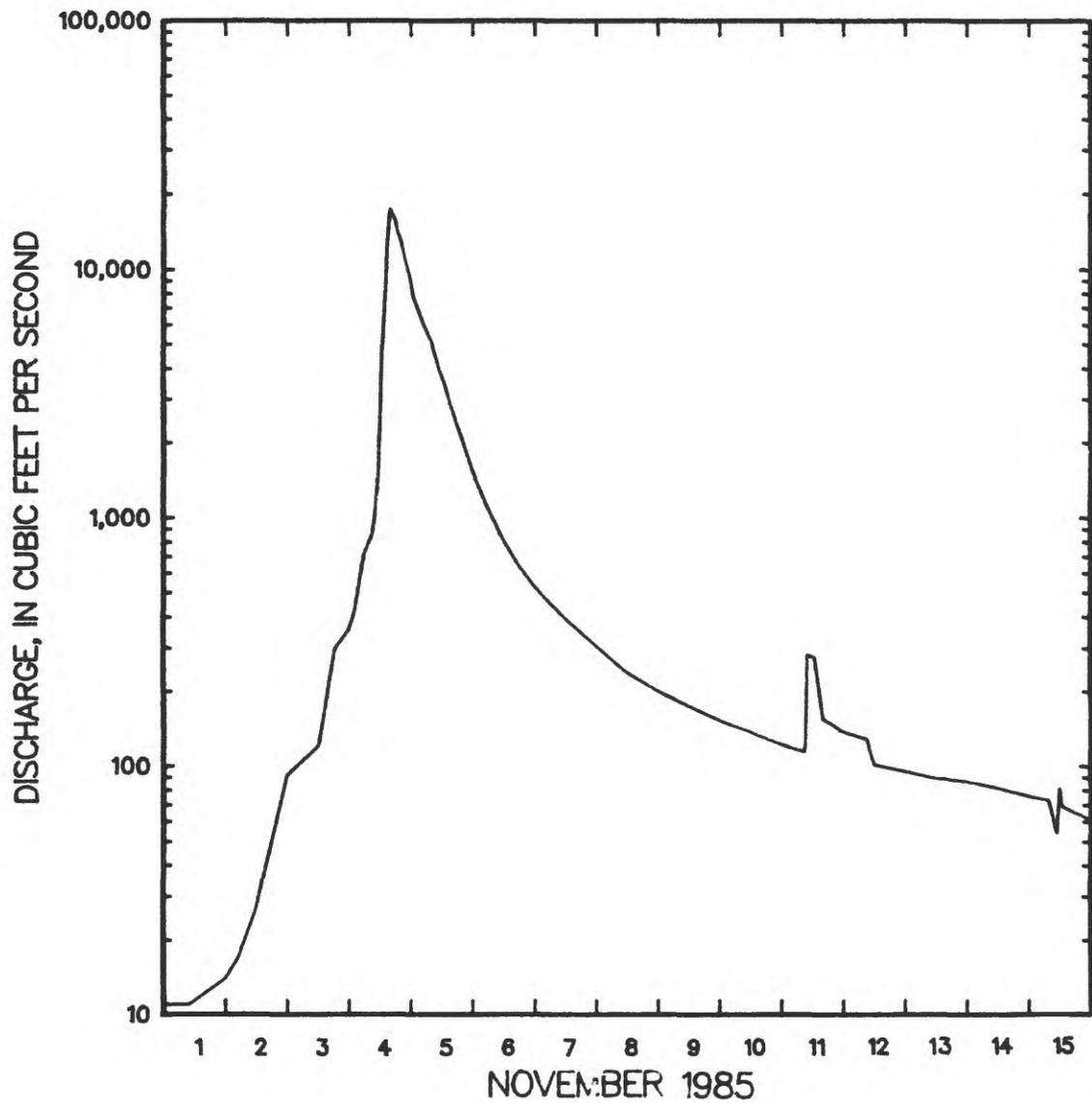


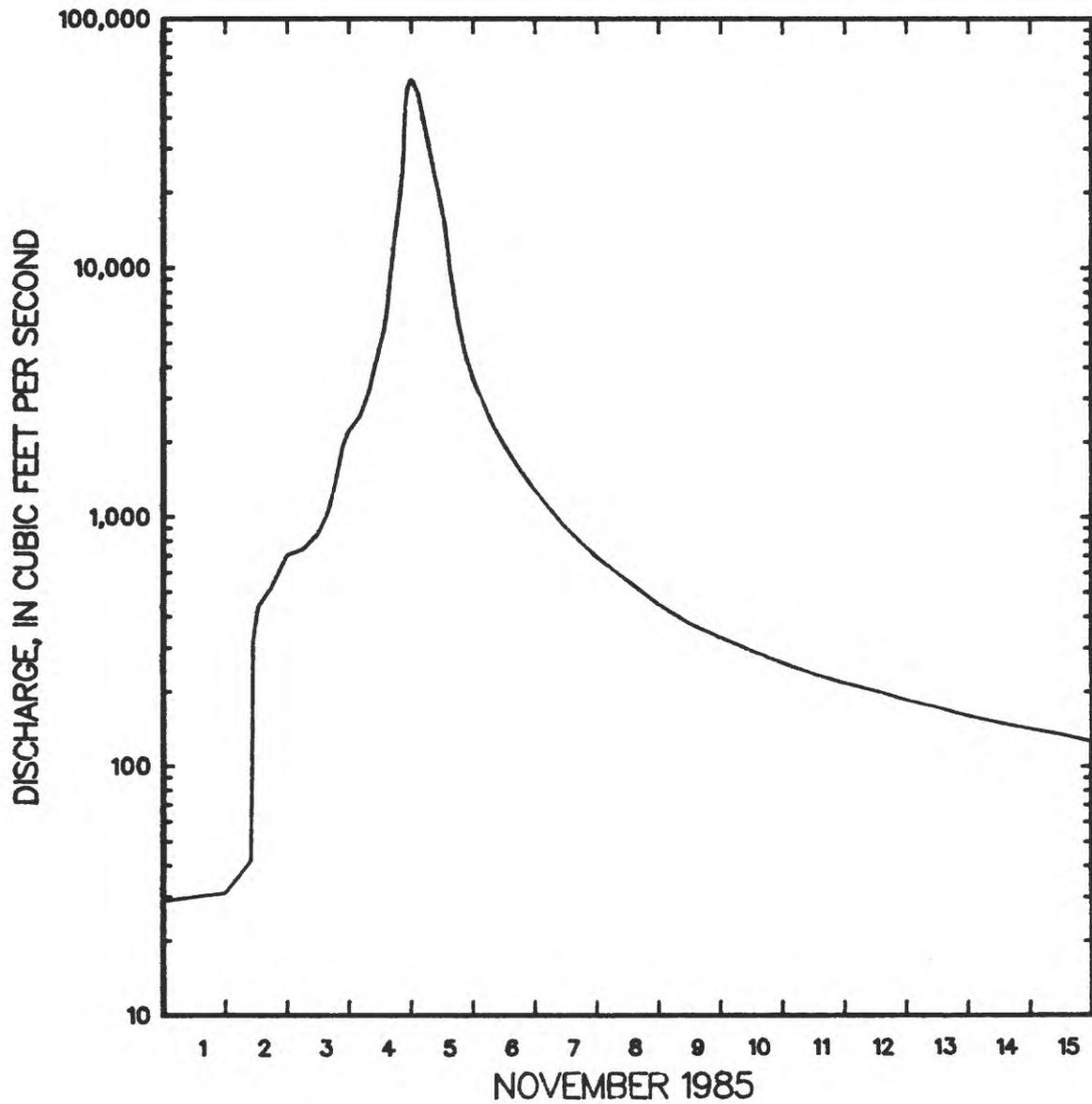
Figure 22.-- Discharge at gaging station Back Creek near Sunrise, Va.  
 (Site No. 60), November 1-15, 1985.

Table 8.--Gage height and discharge for flood of November 1985  
at gaging station Back Creek near Sunrise, Va.  
(Site No. 60)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
November 1-----	0100	0.50	11
	1000	0.50	11
	2400	0.58	14
November 2-----	0500	0.62	17
	1200	0.78	27
	2400	1.31	92
November 3-----	1200	1.46	120
	1900	2.20	301
	2400	2.39	355
November 4-----	0200	2.56	407
	0600	3.32	731
	0900	3.56	857
	1000	3.77	977
	1100	4.26	1,310
	1200	5.30	2,470
	1300	6.66	5,050
	1400	7.73	7,970
	1500	9.15	13,300
	1600	<sup>a</sup> 10.00	17,500
	1700	9.79	16,400
November 5-----	1800	9.67	15,800
	1900	9.28	13,900
	2000	9.14	13,300
	2200	8.51	10,700
	2400	8.01	8,880
	0100	7.64	7,690
	0500	7.02	5,950
	0800	6.67	5,070
	1100	6.15	3,900
	1300	5.93	3,470
	1600	5.49	2,740
November 6-----	2000	4.98	2,040
	2400	4.58	1,520
	0600	4.08	1,090
	1200	3.66	814
November 7-----	1800	3.35	639
	2400	3.10	529
	1200	2.74	395
November 8-----	2400	2.44	307
	1200	2.18	239
November 9-----	2400	2.03	201
	1200	1.92	175
November 10-----	2400	1.83	153
	1200	1.76	137
	2400	1.69	122
November 11-----	0900	1.65	114
	1000	3.20	283
	1300	3.18	275
	1600	2.80	155
	2400	2.72	137
November 12-----	0900	2.68	128
	1200	2.54	101
	2400	2.51	95
November 13-----	1200	2.47	89
	2400	2.46	87
November 14-----	1200	2.43	82
	2400	2.39	76
November 15-----	0800	2.37	73
	1100	2.23	54
	1200	2.50	82
	1300	2.41	69
	2400	2.35	61

<sup>a</sup> Peak stage, 10.01 ft; see table 16.



**Figure 23.-- Discharge at gaging station Calfpasture River above Mill Creek at Goshen, Va. (Site No. 80), November 1-15, 1985.**

Table 9.--Gage height and discharge for flood of November 1985  
 at gaging station Calfpasture River above Mill Creek  
 at Goshen, Va. (Site No. 80)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
November 1-----	0100	1.93	29
	1200	1.94	30
	2400	1.95	31
November 2-----	1000	2.02	42
	1100	3.01	325
	1300	3.22	442
	1800	3.35	523
November 3-----	2400	3.63	706
	0600	3.68	741
	1200	3.84	855
	1600	4.09	1,050
	1800	4.35	1,270
November 4-----	2200	5.16	1,980
	2400	5.43	2,230
	0400	5.72	2,520
	0800	6.44	3,240
	1400	8.20	5,790
	1500	8.85	7,030
	1600	9.88	9,160
	1800	11.54	14,200
	2000	13.10	20,200
	2100	14.58	26,900
November 5-----	2200	18.36	46,000
	2300	19.82	54,000
	2400	20.23	56,300
	0100	20.09	55,500
	0300	18.92	49,100
	0600	16.01	33,900
	0800	14.48	26,500
	1300	11.77	15,000
	1500	10.27	10,100
	1700	9.04	7,390
	1900	8.14	5,680
November 6-----	2100	7.49	4,530
	2400	6.78	3,620
	0300	6.22	3,020
	0600	5.77	2,570
	0900	5.41	2,210
	1200	5.12	1,950
	1800	4.68	1,550
November 7-----	2400	4.35	1,270
	1200	3.90	900
	2400	3.61	692
November 8-----	1200	3.40	555
	2400	3.23	448
November 9-----	1200	3.11	376
	2400	3.02	330
November 10-----	1200	2.94	293
	2400	2.87	262
November 11-----	1200	2.81	236
	2400	2.76	217
November 12-----	1200	2.72	202
	2400	2.67	185
November 13-----	1200	2.63	173
	2400	2.59	160
November 14-----	1200	2.55	150
	2400	2.52	142
November 15-----	1200	2.49	135
	2400	2.45	126

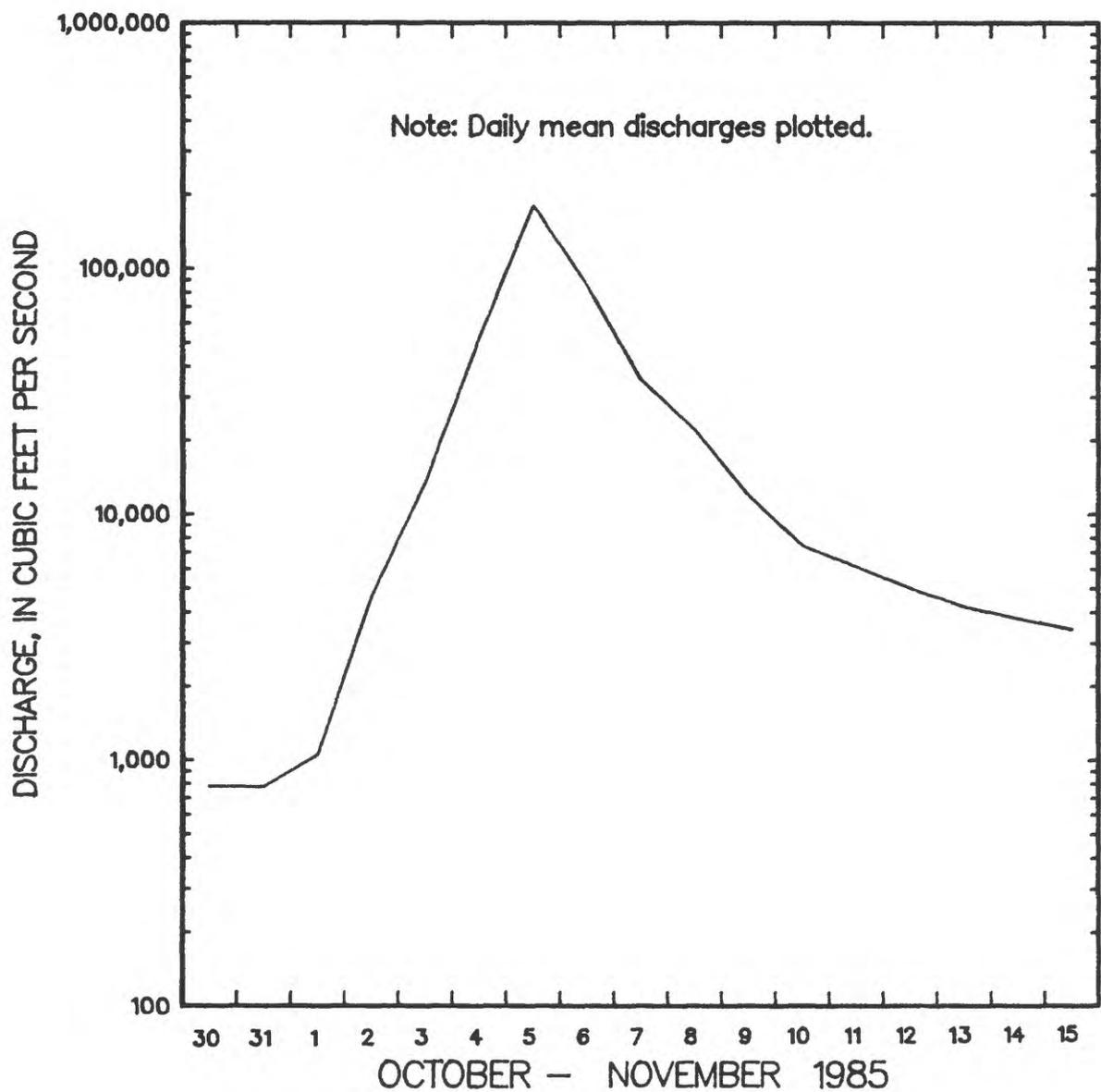


Figure 24.-- Discharge at gaging station James River at Holcombs Rock, Va. (Site No. 86), October 30 - November 15, 1985.

Table 10.--Daily mean discharge for flood of November 1985 at gaging station James River at Holcombs Rock, Va. (Site No. 86)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Equivalent gage height (ft)	Mean Discharge (ft <sup>3</sup> /s)
October 30-----	4.17	708
31-----	4.16	776
November 1-----	4.45	1,050
2-----	6.99	4,590
3-----	10.79	13,500
4-----	20.72	51,600
November 5-----	<sup>a</sup> 39.17	<sup>a</sup> 180,000
6-----	26.55	86,000
7-----	17.21	35,800
8-----	13.65	22,300
9-----	10.27	12,000
November 10-----	8.48	7,510
11-----	7.83	6,160
12-----	7.24	5,040
13-----	6.78	4,240
14-----	6.50	3,790
November 15-----	6.27	3,430

<sup>a</sup> Peak discharge (instantaneous maximum) occurred November 5, 207,000 ft<sup>3</sup>/s; gage height = 42.15 ft.



Figure 25... Confluence of Shenandoah and Potomac Rivers at Harpers Ferry, W. Va. (Photograph by Larry Morris, the Washington Post, Washington, D.C.)

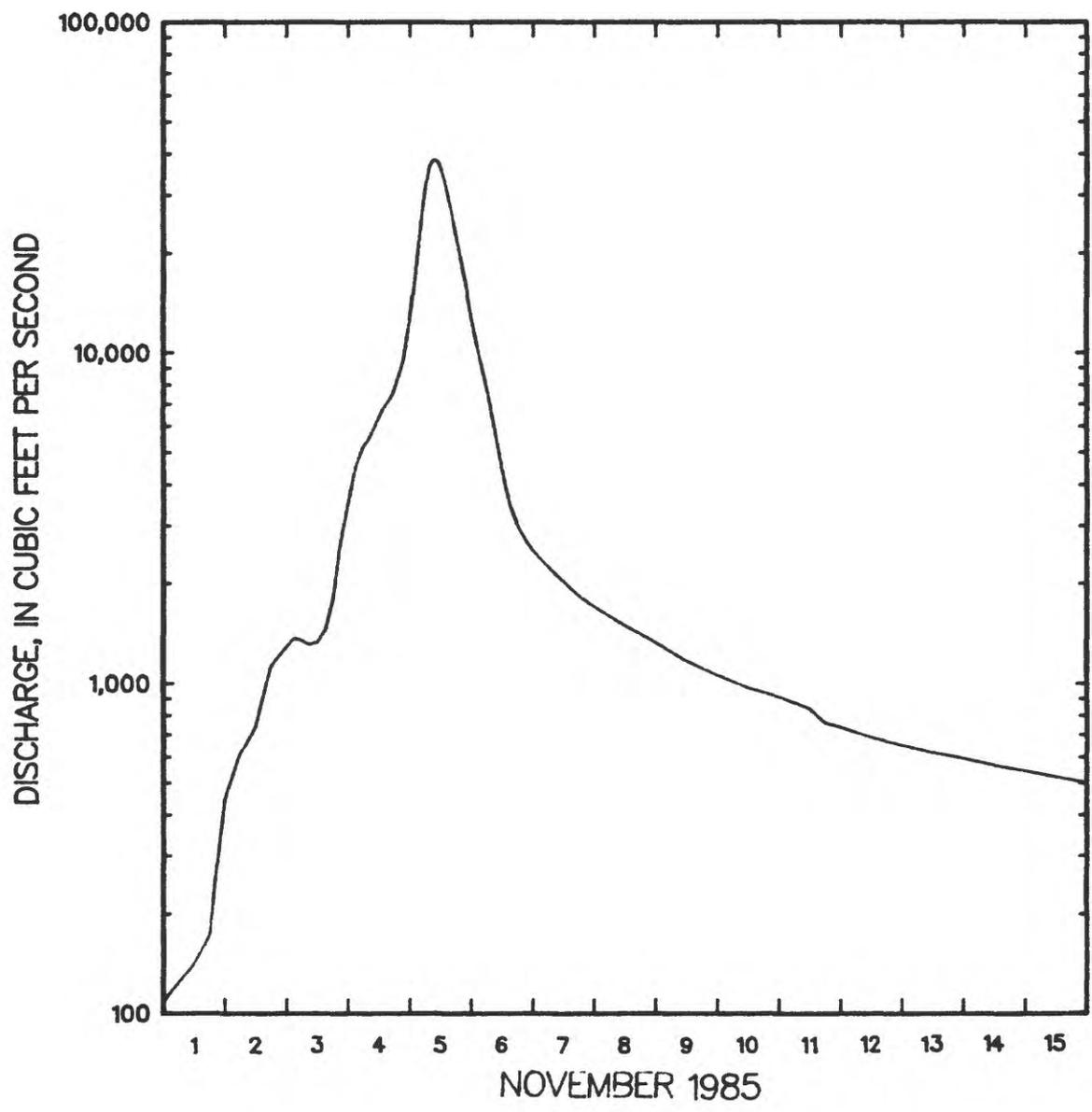


Figure 26.-- Discharge at gaging station Middle River near Grottoes, Va. (Site No. 30), November 1-15, 1985.

Table 11.--Gage height and discharge for flood of November 1985  
at gaging station Middle River near Grottoes, Va.  
(Site No. 30)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
November 1-----	0100	3.53	111
	1200	3.69	142
	1800	3.82	173
	2400	4.85	450
November 2-----	0600	5.38	617
	1200	5.72	739
	1800	6.72	1,130
November 3-----	2400	7.10	1,290
	0300	7.28	1,370
	0600	7.23	1,350
	0900	7.16	1,310
November 4-----	1200	7.20	1,330
	1500	7.43	1,450
	1800	8.05	1,780
	2100	9.41	2,620
	2400	10.76	3,540
	0300	12.05	4,570
	0600	12.77	5,210
	0900	13.22	5,630
	1200	13.94	6,350
	1400	14.45	6,870
November 5-----	1700	14.94	7,400
	1800	15.26	7,760
	2100	16.46	9,160
	2200	17.09	9,950
	2400	19.14	12,700
	0200	21.90	16,800
	0400	25.74	23,300
	0600	29.93	31,500
	0700	31.51	34,900
	0800	32.58	37,300
	0900	33.01	38,300
	1000	<sup>a</sup> 33.03	<sup>b</sup> 38,400
	1100	32.77	37,700
	1200	32.07	36,100
1400	30.17	32,000	
1600	27.78	27,200	
1800	25.28	22,500	
2100	21.86	16,800	
2400	19.15	12,700	
November 6-----	0300	17.07	9,920
	0600	15.28	7,780
	0900	13.54	5,950
	1200	11.82	4,410
	1500	10.54	3,450
	1800	9.84	3,000
	2100	9.39	2,730
November 7-----	2400	9.03	2,520
	0600	8.53	2,240
	1200	8.15	2,030
November 8-----	1800	7.79	1,830
	2400	7.55	1,700
	1200	7.15	1,490
November 9-----	2400	6.83	1,330
	1200	6.51	1,170
November 10-----	2400	6.29	1,060
	1200	6.10	971
November 11-----	2400	5.97	912
	1200	5.81	840
	1800	5.62	759
November 12-----	2400	5.57	739
	1200	5.44	687
	2400	5.35	651
November 13-----	1200	5.27	619
	2400	5.21	595
November 14-----	1200	5.13	566
	2400	5.07	545
November 15-----	1200	5.00	522
	2400	4.93	501

<sup>a</sup> Peak stage, 33.09 ft (probably between 0900 and 1000 hours); see table 16.

<sup>b</sup> Peak discharge, 38,500 ft<sup>3</sup>/s; see table 16.

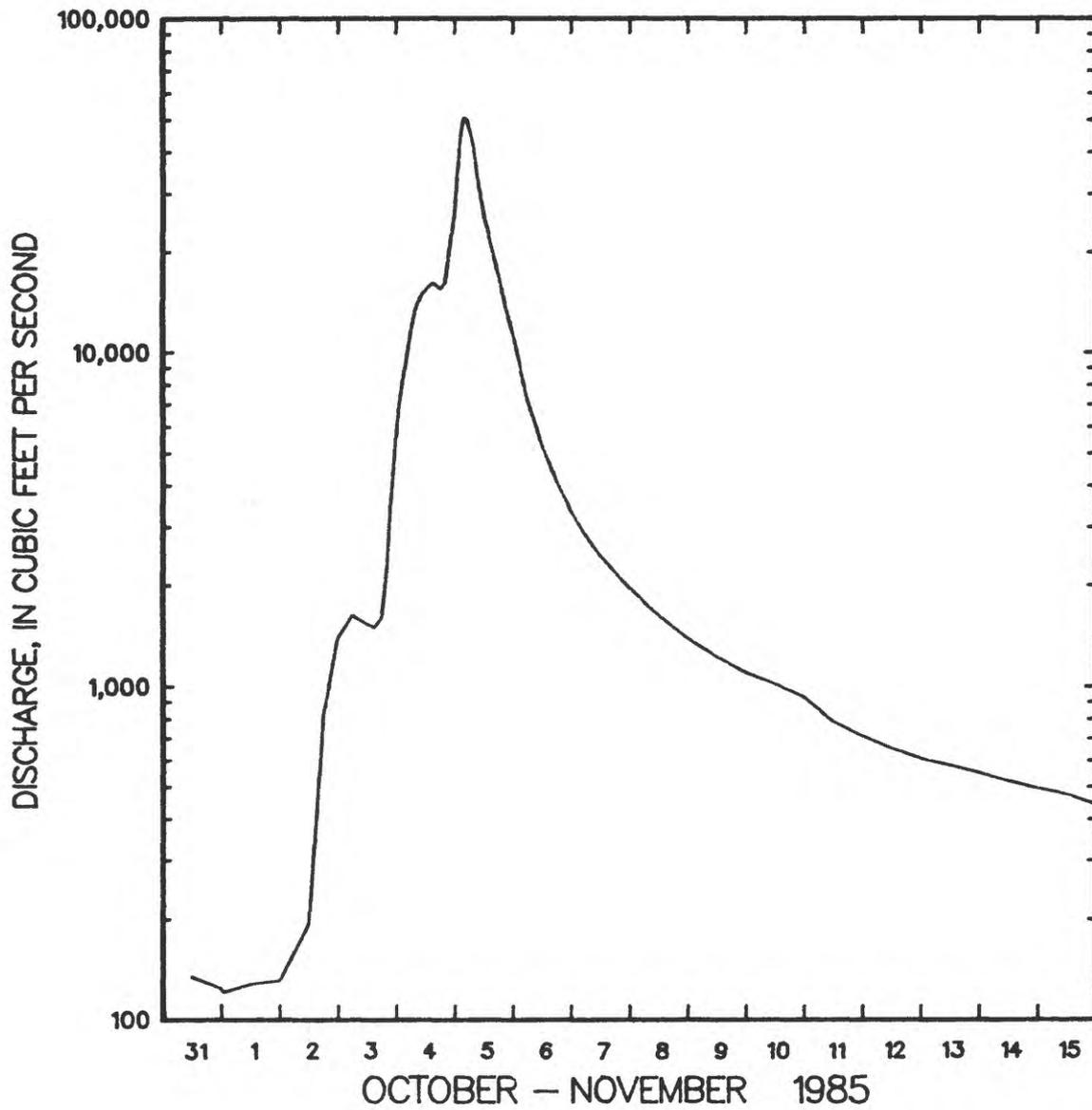


Figure 27.-- Discharge at gaging station North Fork Shenandoah River at Mount Jackson, Va. (Site No. 42), October 31 - November 15, 1985.

Table 12.--Gage height and discharge for flood of November 1985  
at gaging station North Fork Shenandoah River at  
Mount Jackson, Va. (Site No. 42)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
October 31-----	1200	2.67	134
	2400	2.64	124
November 1-----	0100	2.63	121
	1200	2.65	128
November 2-----	2400	2.66	131
	1200	2.85	194
November 3-----	1800	4.14	824
	2400	5.06	1,410
	0600	5.35	1,630
	1200	5.22	1,530
November 4-----	1500	5.18	1,500
	1800	5.31	1,600
	2000	6.00	2,150
	2200	7.55	3,740
	2400	9.03	5,680
	0100	9.79	6,780
	0300	10.81	8,520
	0600	12.35	11,600
November 5-----	0800	13.24	13,600
	1000	13.77	14,800
	1200	14.07	15,500
	1500	14.30	16,200
	1800	14.06	15,500
	2000	14.30	16,200
	2400	16.13	26,700
	0200	17.39	41,600
	0300	17.66	47,500
	0400	17.79	50,800
	0500	17.76	50,000
	0700	17.50	44,000
November 6-----	0900	16.95	34,500
	1200	15.98	25,500
	1400	15.54	22,400
	1600	15.07	19,600
	2000	13.71	14,600
	2400	12.22	11,300
	0300	11.08	9,060
	0600	10.11	7,300
November 7-----	1200	8.76	5,300
	1800	7.86	4,110
	2400	7.21	3,350
November 8-----	0600	6.72	2,830
	1200	6.33	2,450
November 9-----	2400	5.76	1,960
	1200	5.35	1,630
November 10-----	2400	5.03	1,390
	1200	4.80	1,230
November 11-----	2400	4.60	1,100
	1200	4.46	1,020
November 12-----	2400	4.32	932
	1200	4.07	784
November 13-----	2400	3.94	712
	1200	3.83	652
November 14-----	2400	3.75	608
	1200	3.70	580
November 15-----	2400	3.64	550
	1200	3.58	520
	2400	3.53	495
	1200	3.49	475
	2400	3.42	442

## Pennsylvania

The November 1985 storm caused severe flooding in Pennsylvania, but flooding was much more localized than in West Virginia and Virginia. Record-breaking floods in Pennsylvania occurred only in the Monongahela River basin and only on the main stem above the confluence with the Youghiogheny River. However, the flooding along the Monongahela River was severe and the damage was very extensive. Many towns along the main stem were flooded from Point Marion (fig. 28), located just downstream from the West Virginia State line, to Pittsburgh (fig. 29).

At two gaging stations, the peak discharges set new records for magnitude: the peak flow of 220,000 ft<sup>3</sup>/s at the Monongahela River at Greensboro was more than 60 percent greater than the previous maximum (134,000 ft<sup>3</sup>/s) from records since 1938, and the peak stage was more than 9 ft higher. The peak discharge farther downstream on the Monongahela River at Elizabeth, 178,000 ft<sup>3</sup>/s, obviously was attenuated but was still 12 percent greater than the previous maximum (158,000 ft<sup>3</sup>/s), from records since 1933. The recurrence interval of the flood peak at the downstream station was 85 years, and at the upstream station (at Greensboro) it was over 100 years. At a third station, Monongahela River at Braddock, still farther downstream (below the confluence with the Youghiogheny River), the peak discharge was 190,000 ft<sup>3</sup>/s (not a record) with a recurrence interval of 25 years. Flooding on the Youghiogheny River in Pennsylvania was minimal, largely because of flood-control storage provided by Youghiogheny River Lake which crosses the Pennsylvania-Maryland State line. Discharge hydrographs of the flood on the Monongahela River at Greensboro (daily-discharge) and at Elizabeth (instantaneous-discharge) are shown in figures 30 and 31, respectively, and discharge values are given in tables 13 and 14.

Flood damage in Pennsylvania was extremely heavy along the Monongahela River, but was essentially limited to that river basin. There was one flood-related fatality in the State and damage was estimated at \$83 million (Federal Emergency Management Agency, 1985a). A total of six counties in Pennsylvania were declared disaster areas by the Federal Government.

Nearly 3,000 homes in the disaster-declared counties were damaged, with major damage to over 900 of them. Damage to the facilities of one of the steel companies along the river was estimated to be \$3 million.

Along the Monongahela River there is a network of nine locks and dams that normally make it navigable throughout its length. Commercial barge traffic is extensive and important to the economy. During the flood, 62 barges broke loose from their moorings. They smashed into bridges, got caught in dams and locks, and some sank, causing extremely hazardous conditions. Repairs to damaged facilities, clearing the channel, and the loss of commerce were estimated to be as much as \$15 million.

Flood-control projects at three locations upstream in the Monongahela River basin, two in West Virginia and one crossing the Maryland-Pennsylvania State line, no doubt materially reduced the flooding on the



**Figure 28.-- Monongahela River at bridge on State highway 88, Point Marion, Pa. (Photograph by Ron Rittenhouse, Dominion Post, Morgantown, W. Va.)**



**Figure 29.-- Pittsburgh's Three River Stadium on Ohio River at confluence of Monongahela and Allegheny Rivers, Pa. (Photograph by Dale Gleason, The Pittsburgh Press).**

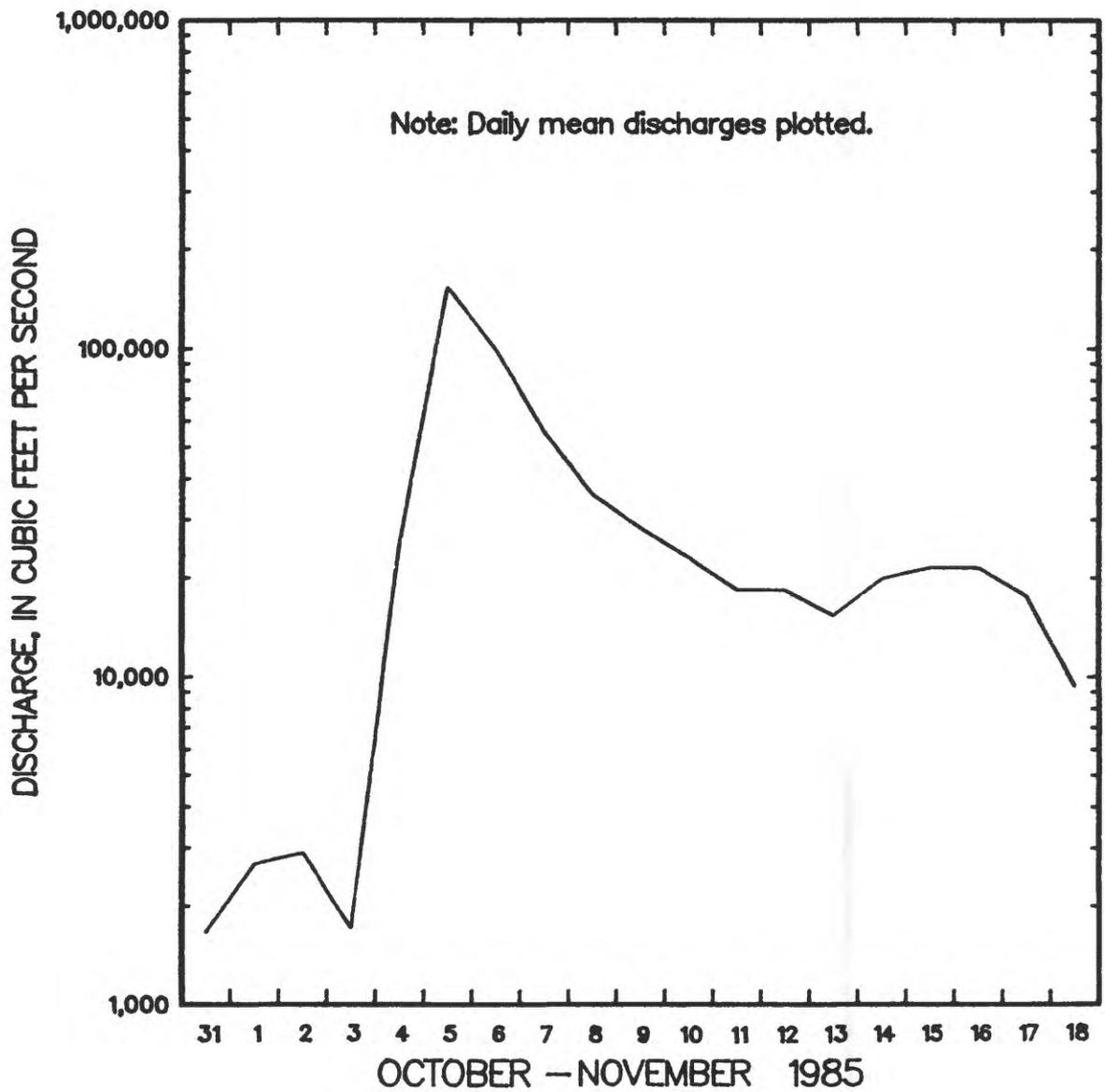


Figure 30.-- Discharge at gaging station Monongahela River at Greensboro, Pa. (Site No. 150), October 31 - November 18, 1985.

Table 13.--Daily mean discharge for flood of November 1985  
at gaging station Monongahela River at  
Greensboro, Pa. (Site No. 150)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Equivalent gage height (ft)	Mean Discharge (ft <sup>3</sup> /s)
October 31-----	11.36	1,660
November 1-----	11.76	2,680
2-----	11.83	2,900
3-----	11.38	1,710
4-----	15.42	25,500
November 5-----	<sup>a</sup> 33.16	<sup>a</sup> 154,000
6-----	23.14	100,000
7-----	18.24	55,600
8-----	16.54	35,900
9-----	15.74	28,300
November 10-----	15.14	23,100
11-----	14.55	18,400
12-----	14.55	18,400
13-----	14.14	15,400
14-----	14.74	19,900
November 15-----	14.94	21,500
16-----	14.94	21,500
17-----	14.44	17,600
18-----	13.24	9,440

<sup>a</sup> Peak discharge (instantaneous maximum) occurred November 5,  
220,000 ft<sup>3</sup>/s; gage height = 39.39 ft.

main stem in Pennsylvania. Tygart Lake on the Tygart Valley River and Stonewall Jackson Lake on the West Fork River both functioned to prevent even more extensive damage in the upper Monongahela River valley. Youghioghenny River Lake on the Youghioghenny River effectively reduced the flooding on the lower Youghioghenny and lower Monongahela River valleys.

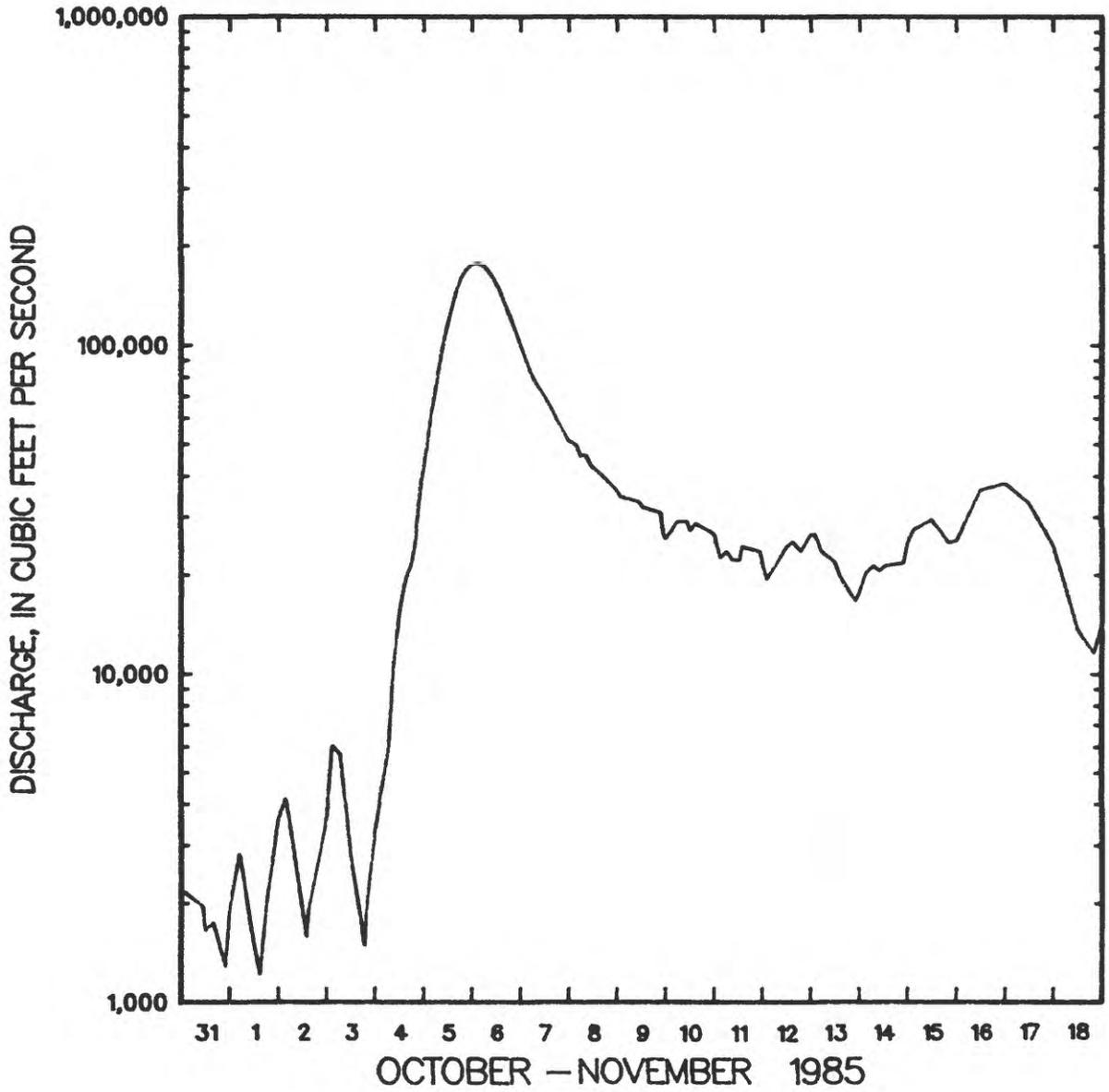


Figure 31.-- Discharge at gaging station Monongahela River at Elizabeth, Pa. (Site No. 153), October 31 - November 18, 1985.

Table 14.--Gage height and discharge for flood of November 1985  
at gaging station Monongahela River at Elizabeth, Pa.  
(Site No. 153)

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
October 31-----	0200	1.98	2,160
	1100	1.90	1,950
	1200	1.78	1,650
	1600	1.82	1,750
	2200	1.63	1,280
	2400	1.90	1,950
November 1-----	0500	2.21	2,830
	1200	1.72	1,505
	1500	1.60	1,210
	1800	1.92	2,010
November 2-----	2400	2.46	3,610
	0400	2.62	4,170
	1400	1.75	1,580
	1500	1.89	1,930
November 3-----	2400	2.46	3,610
	0300	3.10	6,070
	0700	3.02	5,690
	1200	2.18	2,740
	1900	1.71	1,480
	2000	1.91	1,980
November 4-----	2400	2.37	3,320
	0700	3.08	5,980
	0900	3.90	10,400
	1200	4.67	15,400
	1500	5.22	19,400
	1800	5.54	21,700
	2000	5.95	25,300
	2300	7.40	38,400
November 5-----	2400	7.75	41,800
	0200	8.60	49,900
	0400	10.00	63,000
	0500	10.50	67,500
	0800	12.90	89,100
	1100	15.20	110,000
	1300	16.70	123,000
	1400	17.73	131,000
	1600	19.52	145,300
	1800	21.07	158,000
	2000	22.15	166,000
	2200	22.89	172,000
	November 6-----	2400	23.39
0100		23.52	177,000
0200		23.60	178,000
0300		23.59	178,000
0400		23.53	177,000
0500		23.34	176,000
0700		22.81	172,000
1000		21.61	162,000
1200		20.56	154,000
1400		19.42	146,000
1600		18.24	135,000
1800		17.06	126,000
2000		15.96	117,000
2200		14.97	108,000
November 7-----	2400	14.06	99,700
	0400	12.48	85,300
	0700	11.69	78,200
	1200	10.78	70,000
	1600	10.08	63,700
	2000	9.28	56,300
November 8-----	2400	8.75	51,300
	0400	8.57	49,600
	0600	8.17	45,800
	0700	8.24	46,500
	0900	8.20	46,100
	1100	7.90	43,200
	1800	7.53	39,600
	2400	7.17	36,200

Table 14.--Gage height and discharge for flood of November 1985  
at gaging station Monongahela River at Elizabeth, Pa.  
(Site No. 153)--Continued

[ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Time	Gage height (ft)	Discharge (ft <sup>3</sup> /s)
November 9-----	0200	6.98	34,600
	1100	6.86	33,400
	1300	6.71	32,100
	2200	6.59	31,000
	2300	6.07	26,400
November 10-----	2400	5.99	25,700
	0600	6.38	29,100
	1100	6.38	29,100
November 11-----	1200	6.17	27,200
	1500	6.34	28,700
	2400	6.10	26,600
	0300	5.63	22,500
	0600	5.76	23,600
November 12-----	0900	5.60	22,200
	1300	5.60	22,200
	1400	5.84	24,400
	2300	5.74	23,500
	2400	5.55	21,800
	0200	5.22	19,400
November 13-----	1200	5.86	24,500
	1500	5.95	25,300
	1900	5.76	23,600
	2400	6.10	26,600
	0200	6.10	26,600
November 14-----	0500	5.76	23,600
	1200	5.55	21,800
	1400	5.30	20,000
	2200	4.85	16,600
	2400	5.01	17,800
	0300	5.34	20,300
	0700	5.49	21,400
November 15-----	1000	5.39	20,600
	1300	5.50	21,400
	2200	5.55	21,800
	2400	5.95	25,300
	0300	6.20	27,500
November 16-----	1200	6.42	29,500
	2000	5.91	25,000
	2400	5.96	25,400
November 17-----	1200	7.19	36,400
	2400	7.37	38,100
November 18-----	1200	6.84	33,200
	2400	5.86	24,500
	1200	4.43	13,700
	2000	4.10	11,600
	2400	4.51	14,300

## Maryland

Flooding in Maryland was more widespread than in Pennsylvania, but generally less severe. Except for some incidental flooding caused by high tides in the coastal regions, flooding in Maryland was confined mainly to the Potomac River basin. This flooding, however, created some serious problems all the way from the headwaters of the Potomac, on the North Branch, to Washington, D.C. The most serious flooding occurred in the headwaters of the North Branch and on the mainstem Potomac River downstream from confluences with major tributaries from the south which drained the severely flooded regions of West Virginia and Virginia. The major flooding in the headwaters occurred upstream from Bloomington Lake, which was very effective in preventing more severe flooding downstream. Significant flooding did occur in the Youghiogheny River basin in Maryland, but it did not cause widespread damage.

At three gaging stations in the Potomac River basin in Maryland, the peak discharges exceeded 100-year recurrence intervals, and at two of those stations the peaks set new records of magnitude. At the gaging station North Branch Potomac River at Steyer, the peak flow, 11,500 ft<sup>3</sup>/s, exceeded the previous maximum of 11,300 ft<sup>3</sup>/s, though barely, from records available since 1956. The peak flow farther downstream at North Branch Potomac River at Kitzmiller, 50,400 ft<sup>3</sup>/s, exceeded the previous maximum, 33,400 ft<sup>3</sup>/s (from records since 1949), by 51 percent. The peaks at both of these sites exceeded 100-year recurrence intervals. The peak discharge at Potomac River at Paw Paw also exceeded the 100-year recurrence interval with a discharge of 235,000 ft<sup>3</sup>/s, which approached the previous maximum of 240,000 ft<sup>3</sup>/s recorded in 1936. The gaging station at Paw Paw is downstream from the confluence of the North Branch and South Branch Potomac River. The flood peak at Paw Paw came primarily from the extreme flooding on the South Branch, in West Virginia, with relatively little contribution from the North Branch. The North Branch peak was effectively attenuated by Savage River Dam and Bloomington Lake downstream from the gaging station at Kitzmiller. A discharge hydrograph for the flood at Potomac River at Paw Paw is shown in figure 32, and daily discharge data are given in table 15.

Only one extraordinary peak was recorded in Maryland in the Youghiogheny River basin. That peak, 11,700 ft<sup>3</sup>/s, at Youghiogheny River near Oakland, had a recurrence interval of 50 years and was exceeded, but only slightly, by the previous maximum, 11,800 ft<sup>3</sup>/s, from records since 1941.

Considerable damage occurred in Maryland as a result of the flood of November 1985, particularly along the main stem Potomac River. However, the damage was relatively minor compared to that inflicted on the other three States. One fatality was attributed to the flooding in Maryland, and damage was estimated at \$5 million, plus another \$16 million from tide-related coastal flooding (Maryland Emergency Management and Civil Defense Agency, written commun., 1986).

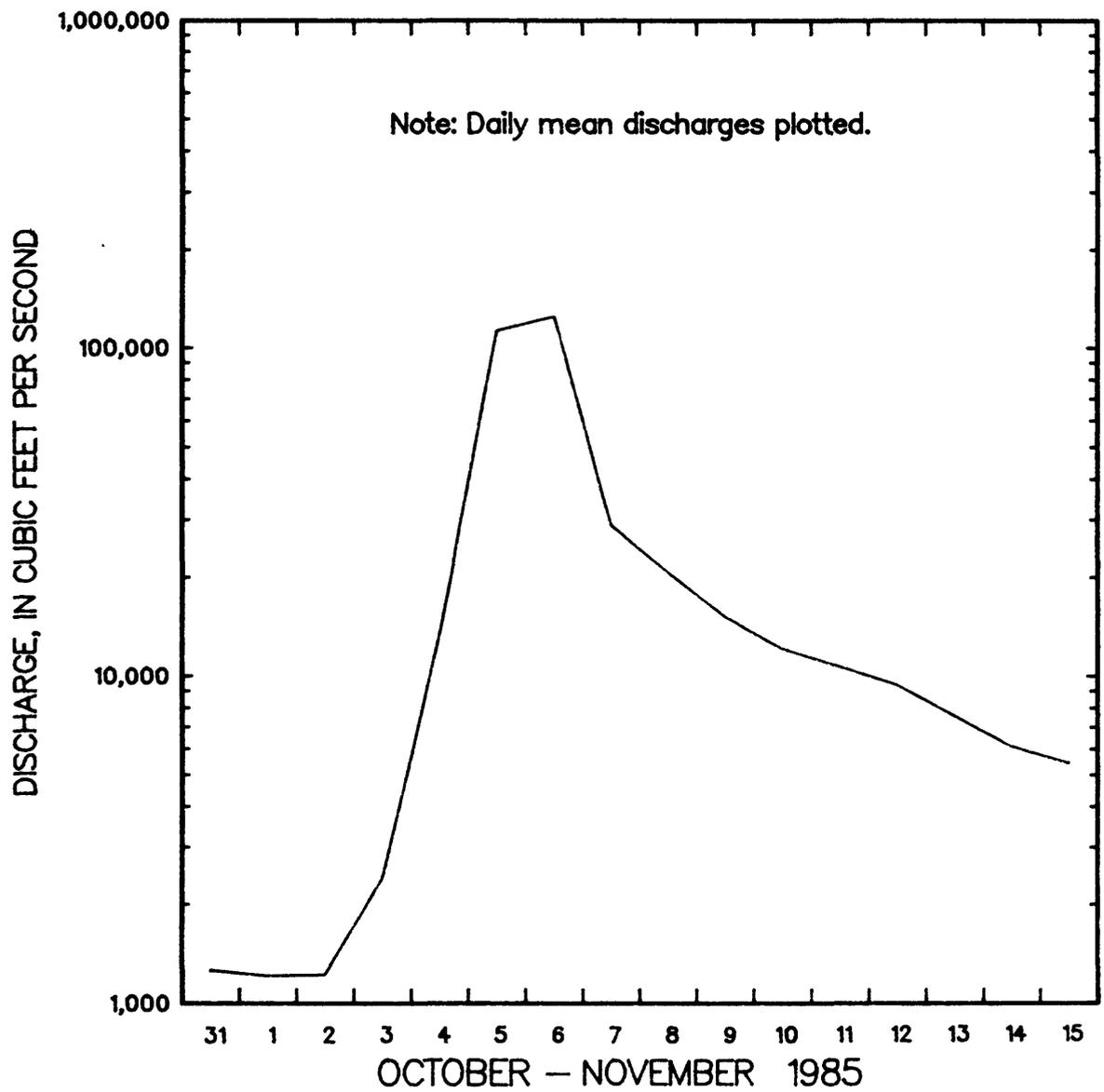


Figure 32.-- Discharge at gaging station Potomac River at Paw Paw, W. Va.  
 (Site No. 15), October 31 - November 15, 1985.

Table 15.--Daily mean discharge for flood of November 1985 at gaging station Potomac River at Paw Paw, W. Va. (Site No. 15)

[Equivalent gage heights not given; stage affected by backwater; ft = feet; ft<sup>3</sup>/s = cubic feet per second]

Date	Mean discharge (ft <sup>3</sup> /s)
October 31-----	1,260
November 1-----	1,210
2-----	1,220
3-----	2,400
4-----	13,400
November 5-----	<sup>a</sup> 113,000
6-----	125,000
7-----	28,900
8-----	20,700
9-----	15,100
November 10-----	12,100
11-----	10,700
12-----	9,400
13-----	7,570
14-----	6,100
November 15-----	5,440

<sup>a</sup> Peak discharge (instantaneous maximum) occurred November 5, 235,000 ft<sup>3</sup>/s; gage height = 53.6 ft.

The towns of Hancock and Point of Rocks were partially inundated by the flooding along the Potomac River. Smaller communities along the North Branch in the headwaters, such as Gorman, experienced significant damage. A public school building in the town of Oldtown, near the confluence of the North and South branches, was severely damaged, with losses estimated at \$1.5 million.

In the upper reaches of the North Branch Potomac River, two reservoirs effectively reduced the flooding and related damage downstream, particularly in the vicinity of Cumberland. Bloomington Lake on the main stem North Branch and Savage River Dam on Savage River functioned to prevent damage to Maryland and West Virginia estimated at \$142 million (combined) by the U.S. Army Corps of Engineers (Federal Emergency Management Agency, 1985c).

## SUMMARY

Heavy rains over the period October 31-November 6, 1985 (related to Hurricane Juan), caused major flooding over a large region of West Virginia, Virginia, Pennsylvania, and Maryland. Totals in excess of 10 in. of rain were recorded over much of the region.

As a result, the greatest floods on record occurred at many locations in each of the following major river basins: Potomac, James, Roanoke, Monongahela, and Kanawha. A summary of flood-peak data from 190 sites, including previous maximums and recurrence intervals, is given in table 16. At 40 streamflow-gaging stations in the region, recorded peak discharges were more than 50 percent greater than the previous maximums. At 63 gaging stations, the peaks equaled or exceeded 100-year recurrence intervals.

Extremely damaging floods occurred along the Cheat and South Branch Potomac Rivers. Some towns, such as Albright and Parsons, W. Va., were practically destroyed. The cities of Roanoke and Lynchburg, Va., on the Roanoke and James Rivers, respectively, were also extremely hard hit; property damage in the Roanoke-Salem area alone was estimated at \$440 million. Property damage over the four-State affected region was estimated at \$1,400 million, excluding tide-related coastal damage. There were 62 fatalities caused by the flooding. Countless homes, bridges, and other facilities were destroyed or badly damaged.

The operation of flood-control projects in several river basins resulted in significant reductions in the damage that occurred. Reservoirs in the Potomac, James, Monongahela, and Kanawha River basins functioned to attenuate the downstream flood peaks materially. Damage was reported to have been reduced by \$135 million in West Virginia alone.

Regardless of how thorough a documentation is made of a disaster such as this flood, the impact cannot be adequately described in terms of deaths, monetary cost, and inconvenience. It needs also to be described in terms of the incredible power of nature and in terms of human endurance and damaged lives. To address these issues adequately is beyond the scope of this report. Nonetheless, there remains a valid need to document this flood disaster for posterity in hopes that the information will be used somehow to lessen the destruction more significantly the next time the forces of nature coalesce with such energy.

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## GLOSSARY

- Acre-foot (acre-ft).** The volume of water required to cover 1 acre to a depth of 1 foot. It equals 43,560 ft<sup>3</sup> (cubic feet), 325,851 gal (gallons), or 1,233 m<sup>3</sup> (cubic meters).
- Contents.** The volume of water in a reservoir or lake. Content is computed on the basis of a level pool or reservoir backwater profile and does not include bank storage.
- Convection cloud.** A cloud which owes its vertical development, and possibly its origin, to convection.
- Cubic feet per second (ft<sup>3</sup>/s).** A rate of discharge. One cubic foot per second is equal to the discharge of a stream of rectangular cross section 1 foot wide and 1 foot deep, flowing at an average velocity of 1 ft/s (foot per second). It equals 28.32 L/s (liters per second) or 0.02832 m<sup>3</sup>/s (cubic meters per second).
- Cubic feet per second per square mile [(ft<sup>3</sup>/s)/mi<sup>2</sup>].** The average number of cubic feet per second flowing from each square mile of area drained by a stream, assuming that the runoff is distributed uniformly in time and area. One (ft<sup>3</sup>/s)/mi<sup>2</sup> is equivalent to 0.0733 (m<sup>3</sup>/s)/km<sup>2</sup> (cubic meters per second per square kilometer).
- Drainage area of a stream at a specific location.** The area, measured in a horizontal plane, bounded by topographic divides. Drainage area is given in square miles (mi<sup>2</sup>). One square mile is equivalent to 2.590 km<sup>2</sup> (square kilometers).
- Equivalent gage height.** The water-surface elevation corresponding to a discharge given as a mean (as in daily mean discharge). Equivalent gage height is given in feet (ft), see gage height.
- Flood.** Any high streamflow that overtops natural or artificial banks of a stream and overflows onto land not usually underwater, or ponding caused by precipitation at or near the point where it fell.
- Flood peak.** The highest value of the stage or discharge attained by a flood.
- Flood profile.** A graph of the elevation of water surface of a river in a flood--plotted as ordinate, against distance--plotted as abscissa.
- Flood stage.** The approximate elevation of the stream when overbank-flooding begins.
- Front.** The interface or transition zone between two airmasses of different density.
- Gage height.** The water-surface elevation referred to some arbitrary gage datum. Gage height commonly is used interchangeably with the more general term "stage." Gage height is given in feet (ft).

## GLOSSARY--Continued

**Gaging station.** A particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are made.

**Isohyet.** A line drawn on a map connecting points receiving equal rainfall.

**Jet stream.** High-velocity strong winds concentrated within a narrow stream high in the atmosphere.

**Miscellaneous site.** A site where data pertaining only to a specific hydrologic event are obtained.

**National Geodetic Vertical Datum of 1929 (NGVD of 1929).** A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

**Recurrence interval.** As applied to flood events, recurrence interval is the average number of years within which a given flood peak will be exceeded once.

**Runoff.** That part of the precipitation that appears in surface streams.

**Stage.** Water-surface elevation referred to some arbitrary datum, see gage height.

**Time of day is expressed in 24-hour time.** For example, 12:30 a.m. is 0030 hours; 1:00 p.m. is 1300 hours.

**Water year.** The period beginning October 1 and ending September 30 of the following calendar year, designated by the calendar year in which it ends. For example, the water year 1986 begins October 1, 1985, and ends September 30, 1986.

Table 16.--Summary of flood stages and discharges

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second;  
 - = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence Interval (years)
POTOMAC RIVER BASIN												
1	01595000	North Branch Potomac River at Steyer, Md.	73.0	2,276.01	1956-86	10/15/54	13.0	11,300	Nov. 5	13.14	11,500	>100
2	01595200	Stony River near Mt. Storm, W. Va.	48.8	2,554.54	1961-86	5/31/85	11.85	7,300	Nov. 5	16.41	14,000	b
3	01595500	North Branch Potomac River at Kitzmiller, Md.	225	1,572.26	1949-86	10/15/54	13.73	33,400	Nov. 5	14.85	50,400	>100
4	01596500	Savage River near Barton, Md.	49.1	1,603.88	1948-86	10/15/54	8.45	7,510	Nov. 5	6.57	4,320	25
5	01599000	Georges Creek at Franklin, Md.	72.4	958.96	1905-06, 1929-86	3/17/36	9.60	8,500	Nov. 4	10.78	4,300	15
6	01601500	Wills Creek near Cumberland, Md.	247	640.89	1905-06, 1929-86	3/17/36	20.2	38,100	Nov. 5	9.10	8,970	5
7	01603000	North Branch Potomac River near Cumberland, Md.	875	585.22	1929-86	6/1/1889	29.2	89,000	Nov. 5	18.85	25,500	5
8	01604500	Patterson Creek near Headsville, W. Va.	219	624.90	1938-86	8/18/55	12.20	16,000	Nov. 5	11.17	8,220	5
9	01605500	South Branch Potomac River at Franklin, W. Va.	182	1,692.5	1940-69, 1976-86	6/17/49, 3/36	11.40, 13	15,000	Nov. 4	22.58	44,000	>100
10	01606000	North Fork South Branch Potomac River at Cabins, W. Va.	314	1,051.13	1940-61	6/17/49	18.0	50,000	Nov. 5	Unknown	90,000	>100

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second; - = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known		Maximum during flood November 1985				
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
POTOMAC RIVER BASIN--Continued												
11	01606500	South Branch Potomac River near Petersburg, W. Va.	642	962.00	1928-86	6/17/49 1877	22.83 a21.2	62,000	Nov. 5	-	130,000	>100
12	01607500	South Fork Potomac River at Brandywine, W. Va.	102	1,558.35	1943-86	6/17/49	d18	41,200	Nov. 4	a18.42	40,500	b
13	01608000	South Fork Potomac River near Moorefield, W. Va.	283	861.51	1928-35, 1938-86	6/18/49	16.1	39,000	Nov. 5	19.99	110,000	>100
14	01608500	South Branch Potomac River near Springfield, W. Va.	1,471	562.02	1894-96, 1899-06, 1928-86	3/18/36 1877	34.2 34	143,000 140,000	Nov. 5	a44.22	240,000	>100
15	01610000	Potomac River at Paw Paw, W. Va.	3,109	487.88	1938-86	3/18/36	54.0	240,000	Nov. 5	53.58	235,000	>100
16	01611500	Cacapon River near Great Cacapon, W. Va.	677	456.78	1922-86	3/18/36 1889	30.1 24.7	87,600 57,500	Nov. 5	21.95	44,500	20
17	01613000	Potomac River at Hancock, Md.	4,073	383.68	1932-86	3/18/36	47.6	340,000	Nov. 6	41.20	207,000	50
18	01613900	Hogue Creek near Hayfield, Va.	15.0	668.60	1960-86	6/22/72	8.85	2,760	Nov. 4	4.88	709	<2
19	01614500	Conococheague Creek at Fairview, Md.	494	391.85	1928-86	6/23/72	a24.5	32,400	Nov. 5	7.92	4,760	<2
20	01615000	Opequon Creek near Berryville, Va.	57.4	503.24	1943-86	10/42 11/13/70	18.4 12.82	- 10,600	Nov. 4	6.46	1,420	<2

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second; - = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
POTOMAC RIVER BASIN--Continued												
21	01616000	Abrams Creek near Winchester, Va.	16.5	526.46	1949-60, 1977-86	12/14/50, 2/14/84	6.16, 5.34	962, 982	Nov. 4	3.73	520	5
22	01616500	Opequon Creek near Martinsburg, W. Va.	272	354.89	1905-06, 1947-86	6/22/72, 1936	17.45, 17.5	19,000	Nov. 4	9.82	2,570	-
23	01618000	Potomac River at Shepherdstown, W. Va.	5,936	281.00	1928-86	3/19/36	842.1	335,000	Nov. 7	31.44	187,000	25
24	01620500	North River near Stokesville, Va.	17.2	2,054.57	1946-86	10/42, 6/17/49	8.4, 10.9	-, 9,530	Nov. 5	19.8	7,600	>100
25	01621000	Dry River at Rawley Springs, Va.	72.6	1,606.42	1947-76	10/42	10.5	13,000	Nov. 4	12.3	20,000	>100
26	01622000	North River near Burkettown, Va.	379	1,103.49	1925-72, 1979-86	6/18/49	36.3	62,600	Nov. 5	35.85	65,000	>100
27	01622400	Buffalo Branch tributary near Christian, Va.	0.49	1,622.53	1967-86	3/19/75	5.18	122	Nov. 4	6.96	240	>100
28	01624300	Middle River near Verona, Va.	178	1,260.78	1968-86	9/06/79	14.17	8,650	Nov. 5	24.29	45,000	>100
29	01624800	Christians Creek near Fishersville, Va.	70.1	91,230	1968-86	10/05/72	12.91	3,850	Nov. 4	13.58	4,520	>100
30	01625000	Middle River near Grottoes, Va.	375	1,061.51	1927-86	3/18/36	28.57	24,500	Nov. 5	33.09	38,500	>100
31	01626000	South River near Waynesboro, Va.	127	1,296.20	1952-86	10/42, 8/20/69	14.3, 15.27	14,500, 17,400	Nov. 4	15.30	17,500	30
32	01626850	South River near Dooms, Va.	149	1,247.04	1974-86	3/19/75	12.02	8,000	Nov. 4	14.03	19,100	25

Table 16.--Summary of flood stages and discharges--Continued

(mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second; - = information was not determined; footnotes found at end of table)

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
POTOMAC RIVER BASIN--Continued												
33	01627500	South River at Harrison, Va.	212	1,129.87	1925-51, 1960-86	1870	18.8	-	Nov. 4	15.47	28,100	40
						1877	18.8	-				
						10/15/42	17.2	23,100				
34	01628060	White Oak Run near Grottoes, Va.	1.94	91,480	1979-86	6/13/82	-	255	Nov. 4	6.17	515	-
						3/18/83	3.90	200				
35	01628500	South Fork Shenandoah River near Lynnwood, Va.	1,084	1,013.17	1930-86	10/15/42	27.2	80,000	Nov. 5	29.46	95,100	>100
36	01629500	South Fork Shenandoah River near Luray, Va.	1,377	721.76	1925-30, 1938-51, 1979-86	3/18/36	23.6	81,600	Nov. 5	26.72	110,000	60
						10/16/42	25.7	100,000				
37	01629945	Chub Run near Stanley, Va.	3.16	1,023.05	1959-86	11/07/77	6.26	752	Nov. 4	9.66	1,260	35
38	01631000	South Fork Shenandoah River at Front Royal, Va.	1,642	469.38	1899-06, 1930-86	10/16/42	34.8	130,000	Nov. 6	32.43	120,000	60
39	01632000	North Fork Shenandoah River at Cootes Store, Va.	210	1,051.8	1925-86	10/15/42	25.3	50,000	Nov. 4	25.13	49,200	>100
40	01632900	Smith Creek near New Market, Va.	93.2	881.50	1960-86	10/06/72	16.38	10,600	Nov. 5	13.01	6,050	10
41	01632970	Crooked Run near Mt. Jackson, Va.	6.49	962.84	1972-86	8/07/78	8.90	2,600	Nov. 4	7.24	1,630	5
42	01633000	North Fork Shenandoah River at Mt. Jackson, Va.	506	838.55	1943-86	10/42	20.2	80,000	Nov. 5	17.79	50,800	70
						10/06/72	18.10	40,000				
43	01633650	Pughs Run near Woodstock, Va.	3.66	1,027.27	1972-86	6/22/72	9.30	543	Nov. 4	5.08	133	2

Table 16.--Summary of flood stages and discharges--Continued

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Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
POTOMAC RIVER BASIN--Continued												
44	01634000	North Fork Shenandoah River near Strasburg, Va.	768	494.03	1925-86	10/16/42	31.2	100,000	Nov. 5	27.37	62,600	70
45	01634500	Cedar Creek near Winchester, Va.	103	647.09	1937-86	10/15/42 3/17/36	27.0 25.0	22,000 18,000	Nov. 5	16.05	8,980	15
46	01635500	Passage Creek near Buckton, Va.	87.8	525.14	1905-06, 1932-86	10/15/42	15.5	21,000	Nov. 5	10.45	4,640	5
47	01636500	Shenandoah River at Millville, W. Va.	3,040	293.00	1895-09, 1928-86	10/16/42 3/18/36 1870	32.4 26.36 26.36	230,000 151,000 151,000	Nov. 6	25.60	142,000	40
48	01638500	Potomac River at Point of Rocks, Md.	9,651	200.63	1895-86	3/19/36	41.03	480,000	Nov. 7	36.28	309,000	25
49	01646500	Potomac River near Washington, D.C.	11,560	37.95	1930-86	3/19/36	h28.1	484,000	Nov. 7	17.99	317,000	25
RAPPAHANNOCK RIVER BASIN												
50	01662000	Rappahannock River near Warrenton, Va.	195	312.57	1942-86	10/15/42	23.5	32,000	Nov. 4	14.47	5,600	5
51	01662800	Battle Run near Laurel Mills, Va.	27.6	374.62	1958-86	10/09/76	13.90	9,120	Nov. 4	12.46	5,060	20
52	01663500	Hazel River at Rixeyville, Va.	287	288.30	1942-86	4/26/37 10/15/42	28.4 31.8	43,500 60,000	Nov. 4	24.79	29,500	20
53	01664000	Rappahannock River at Remington, Va.	620	252.53	1942-86	10/16/42	30.0	90,000	Nov. 4	19.73	26,400	15
54	01665000	Mountain Run near Culppeper, Va.	15.9	389.46	1949-86	8/18/55 12/04/50	11.00 11.20	5,440 5,940	Nov. 3	6.04	548	<2

Table 16.--Summary of flood stages and discharges--Continued

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Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
RAPPAHANNOCK RIVER BASIN--Continued												
55	01665500	Rapidan River near Ruckersville, Va.	114	439.44	1942-86	10/15/42	20.8	30,700	Nov. 5	14.72	12,600	10
56	01666500	Robinson River near Locust Dale, Va.	179	283.70	1943-86	10/15/42 6/22/72	23.9 20.92	44,000 24,500	Nov. 5	20.17	17,200	15
57	01667500	Rapidan River near Culpeper, Va.	472	241.36	1930-86	10/16/42	30.3	58,100	Nov. 5	22.52	28,500	10
58	01668000	Rappahannock River near Fredericksburg, Va.	1,596	55.18	1907-86	10/16/42	26.9	140,000	Nov. 6	14.33	50,200	10
JAMES RIVER BASIN												
59	02011400	Jackson River near Bacova, Va.	158	1,639.20	1974-86	12/26/73	13.88	7,560	Nov. 4	22.25	30,000	>100
60	02011460	Back Creek near Sunrise, Va.	60.1	2,200.02	1974-86	1/26/78	6.80	5,400	Nov. 4	10.01	17,500	>100
61	02011500	Back Creek near Mountain Grove, Va.	134	1,701.45	1951-86	3/07/67	10.77	12,700	Nov. 4	11.24	14,200	b
62	02011800	Jackson River below Gathright Dam near Hot Springs, Va.	345	1,400.00	1973-86	12/26/73	18.77	29,000	Nov. 6 Nov. 7	14.78 15.29	8,750 10,400	b b
63	02012500	Jackson River at Falling Spring, Va.	411	1,333.49	1925-86	3/13 3/17/36	20 14.74	50,000 24,700	Nov. 7	12.62	15,600	b
64	02012950	Sweet Springs Creek tributary near Sweet Chalybeate, Va.	0.66	1,926.94	1966-86	7/05/74	10.50	375	Nov. 4	8.24	267	10

Table 16.---Summary of flood stages and discharges--Continued

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Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (Years)
65	02013000	Dunlap Creek near Covington, Va.	164	1,294.70	1928-86	3/13 6/21/72	18.0 15.65	27,400	Nov. 4	13.42	17,400	>100
66	02013100	Jackson River below Dunlap Creek at Covington, Va.	614	1,206.53	1974-86	6/21/72 4/05/77	24.36 19.85	34,000 23,200	Nov. 4	23.31	31,300	b
67	02014000	Potts Creek near Covington, Va.	153	1,273.93	1928-56, 1965-86	11/18/77 3/13 6/21/72	12.0 12.50 12.33	- - 12,400	Nov. 4	13.46	15,400	>100
68	02015600	Compasture River near Head Waters, Va.	11.3	1,985.65	1949-86	6/17/49	6.50	5,650	Nov. 4	6.45	5,380	>100
69	02015700	Bullpasture River at Williamsville, Va.	110	1,610.14	1960-86	4/05/77	9.25	9,430	Nov. 4	14.39	22,900	>100
70	02016000	Compasture River near Clifton Forge, Va.	461	1,006.93	1925-86	3/13 3/18/36	20.8 18.62	45,000 34,200	Nov. 5	19.15	40,900	>100
71	02016500	James River at Lick Run, Va.	1,373	978.30	1925-86	11/18/77 3/13 3/18/36	33.0 30.4 27.01	120,000 98,000 66,600	Nov. 5	30.22	87,500	b
72	02017300	Craig Creek at New Castle, Va.	112	1,245.69	1967-86	6/21/72	17.09	16,500	Nov. 4	19.55	24,400	>100
73	02017500	Johns Creek at New Castle, Va.	104	1,254.30	1926-86	1/23/35 6/21/72	10.80 12.48	8,000 7,960	Nov. 4	11.96	7,010	25
74	02017700	Craig Creek tributary near New Castle, Va.	2.05	-	1968-86	9/21/79	9.99	579	Nov. 4	13.45	1,100	70
75	02018000	Craig Creek at Parr, Va.	329	992.50	1925-86	6/21/72	19.29	20,200	Nov. 4	24.76	58,500	>100

JAMES RIVER BASIN--Continued

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second; - = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
JAMES RIVER BASIN--Continued												
76	02018500	Catawba Creek near Catawba, Va.	34.3	1,299.96	1943-86	8/40 6/21/72	13.26 10.35	7,740	Nov. 4	19.19	21,200	>100
77	02018800	North Fork near Fincastle, Va.	4.17	1,248.65	1968-86	9/21/79	9.88	1,230	Nov. 4	10.39	3,470	>100
78	02019500	James River at Buchanan, Va.	2,075	802.90	1898-86	11/18/77 3/27/13	34.9 31	142,000 115,000	Nov. 5	38.84	179,000	>100
79	02020100	Renick Run near Buchanan, Va.	2.06	1,261.85	1967-86	8/20/69	9.90	1,210	Nov. 4	5.88	472	4
80	02020500	Calpasture River above Mill Creek at Goshen, Va.	144	1,384.84	1938-86	10/06/72	12.78	20,900	Nov. 4	20.23	56,300	>100
81	02021500	Maury River at Rockbridge Baths, Va.	329	1,100.33	1928-86	3/17/36	13.07	33,000	Nov. 5	19.19	87,700	>100
82	02021700	Cedar Grove Branch near Rockbridge Baths, Va.	12.3	1,041.22	1967-86	8/20/69	31.20	7,300	Nov. 4	10.87	830	2
83	02022500	Kerrs Creek near Lexington, Va.	35.0	980.32	1926-86	9/10/50	13.8	23,000	Nov. 4	11.37	9,450	20
84	02023300	South River near Steeles Tavern, Va.	15.7	91,600	1936-86	8/20/69	8.70	4,700	Nov. 4	6.53	2,680	20
85	02024000	Maury River near Buena Vista, Va.	646	846.58	1938-86	3/18/36 8/20/69	22 31.23	105,000	Nov. 5	26.30	72,100	>100
86	02025500	James River at Holcombs Rock, Va.	3,259	548.53	1900-15, 1926-86	3/28/13 8/20/69	31.3 35.50	118,000 150,000	Nov. 5	42.15	207,000	>100

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second; - = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
JAMES RIVER BASIN--Continued												
87	02026000	James River at Bent Creek, Va.	3,683	381.39	1924-86	9/30/1870 8/20/69 6/21/72	27.0 24.77 27.13	150,000 144,000 176,000	Nov. 5	30.76	226,000	>100
88	02027000	Tye River near Lovingston, Va.	92.8	578.39	1938-86	8/20/69	29.0	80,000	Nov. 4	14.46	12,700	10
89	02027500	Piney River at Piney River, Va.	47.6	633.58	1949-86	6/49 8/20/69	9.9 13.8	- 38,000	Nov. 4	12.63	25,200	90
90	02027800	Buffalo River near Tye River, Va.	147	444.39	1960-86	8/20/69	27.95	45,000	Nov. 5	15.26	13,500	10
91	02028500	Rockfish River near Greenfield, Va.	94.6	530.29	1943-86	10/15/42 8/20/69	23.4 31.2	30,000 70,000	Nov. 4	13.24	9,970	5
92	02029000	James River at Scottsville, Va.	4,584	253.18	1924-86	10/1870 8/20/69 6/22/72	30.7 30.00 34.02	215,000 188,000 301,000	Nov. 6	31.77	243,000	>100
93	02030500	Slate River near Arvonnia, Va.	226	238.78	1926-86	6/22/72	25.10	42,200	Nov. 5	14.10	6,930	5
94	02030800	Stockton Creek near Afton, Va.	2.80	835.27	1967-86	6/21/72	9.68	678	Nov. 4	8.18	520	20
95	02031000	Mechums River near White Hall, Va.	95.4	429.75	1942-51, 1979-86	10/15/42 9/06/79	30.3 24.5	20,000 15,500	Nov. 5	21.11	9,960	7
96	02032200	Doyles River near White Hall, Va.	6.70	928.08	1967-86	9/22/79	13.73	-	Nov. 4	13.06	1,780	-
97	02032250	Moormans River near Free Union, Va.	74.6	403.11	1979-86	6/21/72 9/06/79	20.2 21.55	15,100 16,500	Nov. 4	20.41	15,500	-
98	02032300	Muddy Run near Stanardsville, Va.	3.36	756.79	1967-86	5/13/78 8/28/79	8.33 8.33	5,650 5,650	Nov. 4	7.22	3,190	5

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second;  
- = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
99	02032515	South Fork Rivanna River near Charlottesville, Va.	260	9330	1979-86	9/06/79	23.50	15,200	Nov. 5	22.70	14,300	-
100	02032540	Haneytown Creek near Stanardsville, Va.	4.45	616.34	1967-86	3/19/75	13.85	1,220	Nov. 4	13.34	854	5
101	02032550	Lynch River at Nortonville, Va.	13.6	591.70	1967-86	6/21/72 10/05/72	16.50 16.46	18,000 18,000	Nov. 4	15.60	13,000	5
102	02032680	North Fork Rivanna River near Proffit, Va.	176	323.43	1970-86	6/21/72	30.4	31,800	Nov. 5	18.64	10,900	2
103	02034000	Rivanna River at Palmyra, Va.	664	210.39	1933-86	8/20/69 6/22/72	39.85 37.34	86,000 75,400	Nov. 5	26.53	31,800	5
104	02034500	Willis River at Lakeside Village, Va.	262	178.98	1926-86	6/22/72	29.8	24,000	Nov. 6	22.97	9,470	15
105	02035000	James River at Cartersville, Va.	6,257	163.90	1898-86	11/1877 3/19/36 10/16/42 8/21/69 6/22/72	30.4 28.77 27.14 33.75 37.87	- 166,000 135,000 250,000 362,000	Nov. 6	32.60	225,000	60
106	02037500	James River near Richmond, Va.	6,758	98.82	1934-86	3/19/36 8/21/69 6/23/72	23.42 24.95 28.62	175,000 222,000 313,000	Nov. 7	24.77	218,000	30
107	02038000	Falling Creek near Chesterfield, Va.	32.8	126.39	1955-86	10/01/79	15.32	5,930	Nov. 4	11.63	1,820	10
108	02038850	Holiday Creek near Andersonville, Va.	8.53	472.97	1966-86	6/21/72	14.64	9,640	Nov. 4	6.80	1,220	5
109	02039500	Appomattox River at Farmville, Va.	303	281.93	1926-86	6/22/72	29.70	33,100	Nov. 5	20.03	9,400	5

JAMES RIVER BASIN--Continued

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second; - = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Datum of 1929 (ft)	Period of flood record	Maximum previously known		Maximum during flood November 1985				
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
CHOMAN RIVER BASIN												
110	02044000	Mottoway River near Burkeville, Va.	38.7	354.58	1946-86	8/40 10/23/71	27.4 22.33	13,400	Nov. 4	13.62	1,620	<2
111	02044500	Mottoway River near Rawlings, Va.	309	184.88	1950-86	8/40 10/06/72	20.8 23.25	19,000 29,900	Nov. 4	16.43	12,200	10
112	02045500	Mottoway River near Stony Creek, Va.	579	58.42	1929-86	8/17/40	23.66	25,200	Nov. 6	20.22	14,800	20
113	02051000	North Meherrin River near Lunenburg, Va.	55.6	333.7	1946-80, 1981-86	8/40 10/23/71	48 28.30	14,400	Nov. 4	15.42	2,690	2
114	02051500	Meherrin River near Lawrenceville, Va.	552	136.56	1928-86	8/17/40	42.0	38,000	Nov. 5	28.98	15,000	15
115	02052000	Meherrin River at Emporia, Va.	747	67.17	1951-86	8/17/40 10/08/72	31.5 27.38	40,000 21,100	Nov. 6	25.74	17,500	15
ROANOKE RIVER BASIN												
116	02053800	South Fork Roanoke River near Shawsville, Va.	110	1,361.87	1960-86	6/21/72	11.12	14,200	Nov. 4	8.81	7,070	20
117	02054500	Roanoke River at Lafayette, Va.	257	1,174.47	1943-86	8/40 6/21/72	12.2 15.60	19,000 24,500	Nov. 4	13.34	17,100	40
118	02055000	Roanoke River at Roanoke, Va.	395	906.84	1899-86	8/14/40 6/21/72	18.25 19.61	22,800 25,300	Nov. 4	23.35	32,300	>100
119	02055100	Tinker Creek near Daleville, Va.	11.7	1,217.47	1956-86	8/40 6/21/72	9.0 9.82	4,000	Nov. 4	13.36	10,400	>100
120	02056000	Roanoke River at Niagara, Va.	512	820.15	1926-86	8/14/40 6/21/72 4/27/78	17.50 18.90 19.12	24,400 28,800 29,300	Nov. 4	25.30	52,300	>100

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second;  
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Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
ROANOKE RIVER BASIN--Continued												
121	02056650	Back Creek near Dundee, Va.	56.8	822.67	1974-86	6/21/72 5/29/76	20.0 15.00	7,500	Nov. 4	25.1	20,000	>100
122	02056900	Blackwater River near Rocky Mount, Va.	115	876.45	1976-86	9/22/79	16.38	8,130	Nov. 5	21.92	20,800	>100
123	02058400	Pigg River near Sandy Level, Va.	350	617.00	1963-86	4/27/78	25.56	25,400	Nov. 4	19.50	13,800	5
124	02059500	Goose Creek near Huddleston, Va.	188	592.91	1925-28, 1930-86	10/19/37	25.75	20,300	Nov. 4	22.05	14,600	10
125	02060500	Roanoke River at Altavista, Va.	1,789	503.10	1930-86	8/15/40	40.08	105,000	Nov. 5	27.38	35,700	b
126	02061500	Big Otter River near Evington, Va.	320	544.02	1936-86	10/19/37	23.14	27,500	Nov. 5	22.69	27,100	35
127	02065500	Cub Creek at Phenix, Va.	98.0	370.19	1946-86	6/22/72	20.37	7,380	Nov. 4	12.74	4,240	25
128	02066000	Roanoke River at Randolph, Va.	2,977	307.59	1900-06, 1927-30, 1950-86	12/31/01 8/16/40	41.6	97,000 150,000	Nov. 6	29.58	51,200	b
129	02076200	Bearskin Creek near Chatham, Va.	4.06	9630	1967-86	6/21/72	13.12	1,920	Nov. 4	16.00	2,300	30
130	02076500	Georges Creek near Gretna, Va.	9.24	629.54	1949-86	9/22/79	8.50	1,480	Nov. 4	7.33	1,160	10
MONONGAHELA RIVER BASIN												
131	03050500	Tygart Valley River near Elkins, W. Va.	272	<sup>i</sup> 1,893.95	1944-86	12/31/69	15.65	13,100	Nov. 5	<sup>8</sup> 22.81	23,500	>100

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second; - = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
132	03051000	Tygart Valley River at Belington, W. Va.	408	i 1,679.49	1907-86	7/25/12	j 20.3	18,400	Nov. 5	23.65	29,500	>100
133	03052500	Sand Run near Buckhannon, W. Va.	14.5	91,530	1946-86	6/25/50	6.29	2,000	Nov. 4	8.34	3,200	50
134	03053500	Buckhannon River at Hall, W. Va.	277	-	1907-09, 1915-86	3/07/67	15.07	13,000	Nov. 5	16.88	15,000	>100
135	03054500	Tygart Valley River at Philippi, W. Va.	916	1,280.55	1940-86	3/07/67 7/25/12	d 25.93 e 26	43,000 37,000	Nov. 5	g 31.83	61,000	>100
136	03056250	Three Forks Creek near Grafton, W. Va.	97.4	91,000	1984-86	-	-	-	Nov. 5	20.13	12,000	k >100
137	03057000	Tygart Valley River at Colfax, W. Va.	1,366	856.27	1939-86	2/14/48 1888	m 16.86 n 39.6	22,500	Nov. 5	f 18.89	-	b
138	03057300	West Fork River at Walkersville, W. Va.	28.9	1,070.64	1984-86	-	-	-	Nov. 4	17.87	3,390	k 25
139	03058500	West Fork River at Butcherville, W. Va.	181	-	1915-86	6/25/50 1888	n 17	18,000	Nov. 5	15.20	14,400	b
140	03061000	West Fork River at Enterprise, W. Va.	759	i 869.45	1907-18, 1932-86	3/07/67 1888	o 28.05 p 33	36,500	Nov. 5	30.37	41,100	b
141	03061500	Buffalo Creek at Barrackville, W. Va.	115	884.4	1907-08, 1915-24, 1932-86	1/22/17 7/12	q 16.2 r 18.0	9,490	Nov. 5	14.73	8,000	10
142	03062400	Coburn Creek at Morgantown, W. Va.	10.9	9890	1965-86	8/18/80	19.94	3,100	Nov. 5	7.76	684	-
143	03065000	Dry Fork at Hendricks, W. Va.	345	i 1,698.76	1940-86	10/15/54	15.23	47,000	Nov. 5	g 20.74	100,000	>100

MONONGAHELA RIVER BASIN--Continued

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second;  
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Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known		Maximum during flood November 1985				
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
MONONGAHELA RIVER BASIN--Continued												
144	03066000	Blackwater River at Davis, W. Va.	86.2	3,058.87	1921-86	3/29/24	13.20	7,170	Nov. 5	17.67	12,500	>100
145	03069000	Shavers Fork at Parsons, W. Va.	214	1,634.87	1910-26, 1940-86	3/20/82 7/10/1888 7/17/07	12.02 h12.5 h12.5	16,800 25,000 25,000	Nov. 5	19.86	43,000	>100
146	03069500	Cheat River near Parsons, W. Va.	718	i 1,589.66	1913-86	10/15/54 7/10/1888	19.08 q20.5	82,000	Nov. 5	24.3	P170,000	>100
147	03070000	Cheat River at Rowlesburg, W. Va.	972	1,370.24	1912-86	10/16/54 7/06/1844 7/10/1888	15.67 r16.7 r16.2	- 125,000 118,000	Nov. 5	-	P190,000	>100
148	03070500	Big Sandy Creek at Rockville, W. Va.	200	91,310	1909-18, 1921-86	7/24/12 7/10/1888	18.0 20	21,300 50,000	Nov. 5	11.76	7,140	-
149	03072000	Dunkard Creek at Shannopin, Pa.	229	806.25	1940-86	8/18/80	14.27	17,600	Nov. 5	10.34	7,600	2
150	03072500	Monongahela River at Greensboro, Pa.	4,407	767.55	1938-86	3/07/67	29.61	134,000	Nov. 5	39.39	220,000	>100
151	03073000	South Fork Tenmile Creek at Jefferson, Pa.	180	852.54	1931-86	6/04/41	18.45	13,800	Nov. 5	11.32	6,440	2
152	03074500	Redstone Creek at Waltersburg, Pa.	73.7	883.28	1942-86	6/23/72	14.83	8,660	Nov. 5	5.50	1,760	<2
153	03075070	Monongahela River at Elizabeth, Pa.	5,340	725.50 s735.33	1933-86	3/07/67	a, s41.63	s158,000	Nov. 6	23.60	178,000	t85
154	03075500	Youghiogheny River near Oakland, Md.	134	2,353.61	1941-86	10/16/54	12.16	11,800	Nov. 5	12.07	11,700	50
155	03076500	Youghiogheny River at Friendsville, Md.	295	1,487.33	1898-1904, 1940-86	3/29/24	a10.2	15,600	Nov. 5	8.59	13,000	25

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second;  
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Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
MONONGAHELA RIVER BASIN--Continued												
156	03076600	Bear Creek at Friendsville, Md.	48.9	1,551.34	1964-86	9/14/71	9.6	4,650	Nov. 5	5.43	1,910	10
157	03077500	Youghiogheny River at Youghiogheny River Dam, Pa.	436	1,310.17	1939-86	3/05/48	11.28	13,700	Nov. 5	8.58	-	-
158	03078000	Casselman River at Grantsville, Md.	62.5	2,088.97	1947-86	10/15/54	10.70	8,400	Nov. 5	7.04	4,030	10
159	03079000	Casselman River at Markleton, Pa.	382	1,655.29	1920-86	10/15/54	14.06	50,000	Nov. 5	9.58	17,900	5
160	03080000	Laurel Hill Creek at Ursina, Pa.	121	1,335.26	1918-86	10/15/54	10.63	10,900	Nov. 5	3.41	1,930	<2
161	03081000	Youghiogheny River below Confluence, Pa.	1,029	1,302.77	1940-86	3/18/36	21.6	85,000	Nov. 5	10.56	18,400	5
162	03082500	Youghiogheny River at Connettsville, Pa.	1,326	860.13	1908-86	10/16/54	21.96	103,000	Nov. 5	10.74	22,000	<2
163	03083500	Youghiogheny River at Sutersville, Pa.	1,715	733.36	1920-86	10/16/54	23.5	108,000	Nov. 5	14.78	22,000	<2
164	03085000	Monongahela River at Braddock, Pa.	7,337	707.16	1938-86	3/18/36	23.8	210,000	Nov. 6	29.07	190,000	25
WHEELING CREEK BASIN												
165	03112000	Wheeling Creek at Elm Grove, W. Va.	282	667.59	1940-86	12/30/42	13.67	22,100	Nov. 5	6.56	6,840	-

Table 16.--Summary of flood stages and discharges--Continued

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Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
MIDDLE ISLAND CREEK BASIN												
166	03114500	Middle Island Creek at Little, W. Va.	458	<sup>i</sup> 631.32	1915-22, 1928-86	6/26/50 1875	28.0 33.5	25,000	Nov. 5	25.12	24,200	50
167	03151400	Little Kanawha River near Wildcat, W. Va.	112	850.00	1973-86	1/26/78	12.62	7,090	Nov. 5	14.81	10,500	50
168	Miscellaneous site	Oil Creek at Burnsville, W. Va.	23.9	-	-	-	-	-	Nov. 5	-	10,500	k >100
169	Miscellaneous site	Sand Fork near Sand Fork, W. Va.	34.4	-	-	-	-	-	Nov. 5	-	9,000	k >100
170	03152000	Little Kanawha River at Glenville, W. Va.	386	697.79	1915-22, 1928-86	3/07/67 11/16/26	<sup>f</sup> 34.50 33.6	21,500	Nov. 5	<sup>e</sup> 36.46	26,900	b
171	03153500	Little Kanawha River at Grantsville, W. Va.	913	<sup>i</sup> 652.83	1928-86	3/07/67	43.9	35,100	Nov. 5	42.87	33,700	b
172	03154000	West Fork Little Kanawha River at Rocksedale, W. Va.	205	<sup>i</sup> 657.85	1928-31, 1937-86	4/16/39	30.3	20,200	Nov. 5	22.03	7,420	-
173	03155000	Little Kanawha River at Palestine, W. Va.	1,515	585.51	1915-22, 1939-86	3/07/67 4/17/39	<sup>j</sup> 39.14 <sup>u</sup> 32.25	50,700 53,000	Nov. 6	34.43	39,800	b
174	03155500	Hughes River at Cisco, W. Va.	452	<sup>i</sup> 607.92	1915-22, 1928-31, 1938-86	6/26/50	32.69	31,700	Nov. 5	30.87	24,800	20
175	03168000	New River at Allisonia, Va.	2,202	1,848.36	1929-86	8/14/40	23.42	185,000	Nov. 5	7.82	32,100	2
176	03170000	Little River at Grayson, Va.	300	1,816.04	1928-86	6/21/72	13.40	22,800	Nov. 5	11.67	18,200	40

Table 16.--Summary of flood stages and discharges--Continued

(mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second; - = information was not determined; footnotes found at end of table)

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Vertical Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
177	03179000	Bluestone River at Pipestem, W. Va.	394	1,527.35	1950-86	4/05/77	15.82	19,300	Nov. 5	6.80	1,940	-
178	03180500	Greenbrier River at Durbin, W. Va.	133	2,699.71	1943-86	3/07/67	9.15	12,200	Nov. 4	15.82	37,100	>100
179	03182000	Knapp Creek at Marlinton, W. Va.	108	-	1946-58, 1980	7/15/54, 7/21/80	13.86, 24.50	7,710	Nov. 5	-	15,600	>100
180	03182500	Greenbrier River at Buckeye, W. Va.	540	2,085.89	1929-86	2/05/32	17.5	41,500	Nov. 5	<sup>a</sup> 23.2	82,000	>100
181	03183500	Greenbrier River at Alderson, W. Va.	1,364	1,529.42	1895-86	3/14/18	22.0	77,500	Nov. 5	23.95	90,600	>100
182	03184000	Greenbrier River at Hilldale, W. Va.	1,619	1,388.66	1936-86	12/27/73, 3/18/36	23.13, 21.85	58,100, 60,800	Nov. 6	<sup>a</sup> 25.68	83,800	>100
183	03184500	New River at Hinton, W. Va.	6,256	1,355.18	1936-86	8/15/40	18.97	246,000	Nov. 6	9.91	78,200	b
184	03186500	Williams River at Dyer, W. Va.	128	<sup>i</sup> 2,193.46	1929-86	7/04/32	18.45	22,000	Nov. 4	16.69	19,400	100
185	03187500	Cranberry River near Richwood, W. Va.	80.4	92,100	1944-51, 1954, 1964-82, 1984-86	7/19/54, 8/31/84	12.22, 11.0	18,000, 9,900	Nov. 4	11.41	10,500	100
186	03189100	Gauley River near Craigsville, W. Va.	529	1,870.00	1964-86	3/07/67	22.73	40,700	Nov. 4	25.72	61,800	100
187	03190400	Meadow River near Mt. Lookout, W. Va.	365	91,200	1966-86	3/07/67	13.44	18,500	Nov. 6	10.04	8,100	-
188	03194000	Elk River at Webster Springs, W. Va.	171	91,500	1908-16	1/29/11	11.00	17,300	Nov. 4	-	27,000	>100

KANAWHA RIVER BASIN

Table 16.--Summary of flood stages and discharges--Continued

[mi<sup>2</sup> = square miles; ft = feet; ft<sup>3</sup>/s = cubic feet per second;  
 - = information was not determined; footnotes found at end of table]

Site No.	Permanent station No.	Stream and place of determination	Drainage area (mi <sup>2</sup> )	Datum of gage above National Geodetic Datum of 1929 (ft)	Period of flood record	Maximum previously known			Maximum during flood November 1985			
						Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Date	Gage height (ft)	Discharge (ft <sup>3</sup> /s)	Recurrence interval (years)
KANAWHA RIVER BASIN--Continued												
189	Miscellaneous site	Back Fork at Webster Springs, W. Va.	69	-	-	-	-	-	Nov. 4	-	7,700	k >50
190	03194700	Elk River below Webster Springs, W. Va.	266	V1,020.1	1959-83, 1985	6/02/74 9/1861	13.97 26.34	23,900	Nov. 4	817.2	38,000	>100

- a From floodmark.
- b Significant regulation by reservoir(s) upstream.
- c At site 95 feet downstream.
- d At present site.
- e At site 575 feet downstream at different datum.
- f Affected by backwater.
- g Altitude from topographic map.
- h At previous site and datum.
- i Datum of gage above National Geodetic Vertical Datum, adjustment of 1912.
- j At previous site.
- k Based on regional flood-frequency relationship.
- m At site 1,100 feet downstream.
- n At site 3,500 feet downstream.
- p Estimated.
- q At site and datum in use prior to August 17, 1944.
- r Referred to present gage by curve of relationship.
- s At site 17.5 miles upstream.
- t From U.S. Army Corps of Engineers, Pittsburgh District, 1973.
- u From floodmark at old Lock 4.
- v Elevation from altimeters.