U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

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FEDERAL EMERGENCY MANAGEMENT AGENCY

GEOLOGIC INVESTIGATIONS SERIES
I–2623–B

78° 30' 00"
78° 22' 30"
78° 15' 00"
38° 32' 30"
38° 30' 30"
38° 22' 30"
38° 20' 00"

SHENANDOAH NATIONAL PARK
Old Rag Mountain
Skyline Drive
Etlan
Syria
Whiteoak Run
Rivers
Doubletop Mountain
Jones Mountain
Bluff Mountain
Sag Top
Robinson River
Criglersville
Graves Mill
Brassey Ridge
Gaar Mountain
Kirtley Mountain
German Ridge
Ruth
Camp Shiloh
Kinderhook
Conway River
Rapidan River
Madison
Wolftown
NAT PARK
SHENANDOAH NATIONAL PARK

Base from U.S. Geological Survey Digital Line Graph (DLG) file
Big Meadows, 1994; Fletcher, 1965, photorevised 1979; Madison, 1964, photorevised 1972; Old Rag, 1994; Rochelle, 1964, photorevised 1987; and Stanardsville, 1964, photorevised 1987
Road classifications may differ from those shown on printed editions of topographic quadrangle maps

APPROXIMATE MEAN DECLINATION, 1999

SCALE 1:24 000
1 1/2 0 1 MILE
1 .5 0 1 KILOMETER

Debris flows and flood effects from field work from August 1995 to September 1996 by William C. Burton, Giovanni Mandrone (Polytechnic Institute of Turin), Benjamin A. Morgan, Randall C. Orndorff, C. Scott Southworth and Gerald F. Wieczorek. Slope value and potential debris-flow paths by R.H. Campbell. Photographic, topographic, and field identification of older fan of debris-flow deposits and flood plains by Benjamin A. Morgan and L. Scott Eaton (University of Virginia).
Digital compilation by Russell H. Campbell and Peter Chirico
Edited by Elizabeth D. Koozmin
Digital cartography by D. Paul Mathieux and Jordyn N. Mitchell

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1999

## EXPLANATION OF MAP SYMBOLS

- Flood erosion or deposition
- Flood plain and terraces not affected by 1995 storm
- Debris-flow track
- Potential debris-flow path—Channel or other area that, during a storm event, could fill with debris to a height of 10 ft
- Older debris-flow fans
- Boundary of study area

Slope angle

- Greater than 45 degrees
- 34 to 45 degrees
- 26 to 34 degrees
- 14 to 26 degrees
- Less than 14 degrees
- Boundary of Shenandoah National Park

## DISCUSSION

On June 27, 1995, an unusually severe storm wreaked havoc on a small area of about 50 square miles in Madison County, Virginia. During a period of about 16 hours, as much as 30 inches of rain fell in the area of maximum storm intensity; probably about 25 inches fell within a five-hour period over small areas. The results of this extreme rainfall event were 1) mass wasting of steep hillslopes in the form of soil slides and slumps, rock slides, and numerous debris flows; 2) downstream flooding; and 3) consequent destruction of houses, roads, utilities, livestock, and crops. A general description of landslides and debris flows caused by the storm was reported by Wieczorek and others (1995). A preliminary inventory of the effects and the extent of debris flows and floods in the area was reported by Wieczorek and others (1996). A more complete discussion of the debris flows resulting from the storm was reported by Morgan and others (1997).

This map depicts hazards associated with the June 27, 1995, storm and shows debris-flow paths in the area. Debris flows and flood erosion and deposition resulting from the storm are projected onto a slope map. Analyses of field measurements reported in Morgan and others (1997) show that most failures occurred on colluvium-mantled slopes with an average slope steepness of 30 degrees with a standard deviation of only 3.5 degrees. Active and intermittent stream channels draining slopes steeper than 26 degrees constitute the principal pathways for debris flows and provide a guide for predicting the sites of future ground failures and channels for debris flows. Prehistoric accumulations of debris-flow fans and the extent of the modern flood plains of the Conway, Rapidan, and Robinson Rivers also provide guides for areas of potential hazards. Accordingly, the areas having the potential for ground failure and flood hazards are based on the following criteria: (1) areas traversed by the debris flows from the June 1995 event; (2) areas flooded by the June 1995 event; (3) areas identified by the distribution of terraces and alluvial sediments deposited by earlier floods; (4) areas underlain by prehistoric debris-flow deposits; (5) areas underlain by slopes greater than 26 degrees; and (6) topographic channels having an origin on slopes greater than 26 degrees that could fill with a hypothetical debris flow 10 feet in elevation above the channel floor.

## REFERENCES CITED

Morgan, B.A., Wieczorek, G.F., Campbell, R.H., and Gori, P.L., 1998, Debris-flow hazards in areas affected by the June 27, 1995, storm in Madison County, Virginia: U.S. Geological Survey Open-File Report 97–438, 15 p., 2 maps.
Wieczorek, G.F., Gori, P.L., Campbell, R.H., and Morgan, B.A., 1995, Landslide and debris-flow hazards caused by the June 27, 1995, storm in Madison County, Virginia: U.S. Geological Survey Open-File Report 95–822, 14 p.
Wieczorek, G.F., Morgan, B.A., Campbell, R.H., Orndorff, R.C., Burton, W.C., Southworth, C.S., and Smith, J.A., 1996, Preliminary inventory of debris-flow and flooding effects of the June 27, 1995, storm in Madison County Virginia, showing time sequence of positions of storm cell center: U.S. Geological Survey Open-File Report 96–13, 8 p., 1 map.


Index map showing location of U.S. Geological Survey 7.5-minute quadrangle coverage of the study area

# HISTORICAL AND POTENTIAL DEBRIS-FLOW AND FLOOD HAZARD MAP OF THE AREA AFFECTED BY THE JUNE 27, 1995, STORM IN MADISON COUNTY, VIRGINIA

By

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1999

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