



NORTH CAROLINA GEOLOGICAL SURVEY  
DIVISION OF LAND RESOURCES  
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

# Downslope Hazard Map of Macon County, North Carolina

## FOR SHALLOW TRANSLATIONAL SLOPE MOVEMENTS

By  
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GEOLOGIC HAZARDS MAP SERIES 1  
SLOPE MOVEMENT HAZARD MAPS OF MACON COUNTY, NORTH CAROLINA  
SHEET 3 OF 3

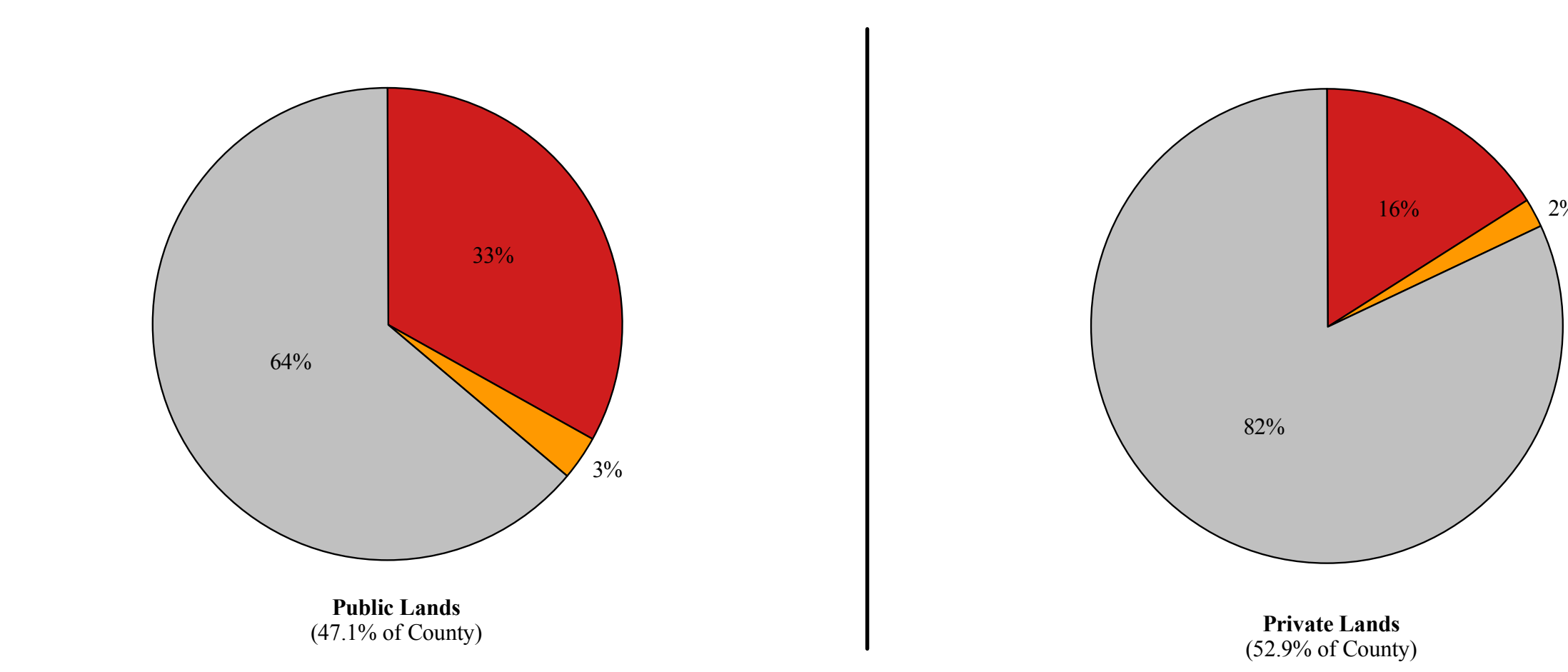
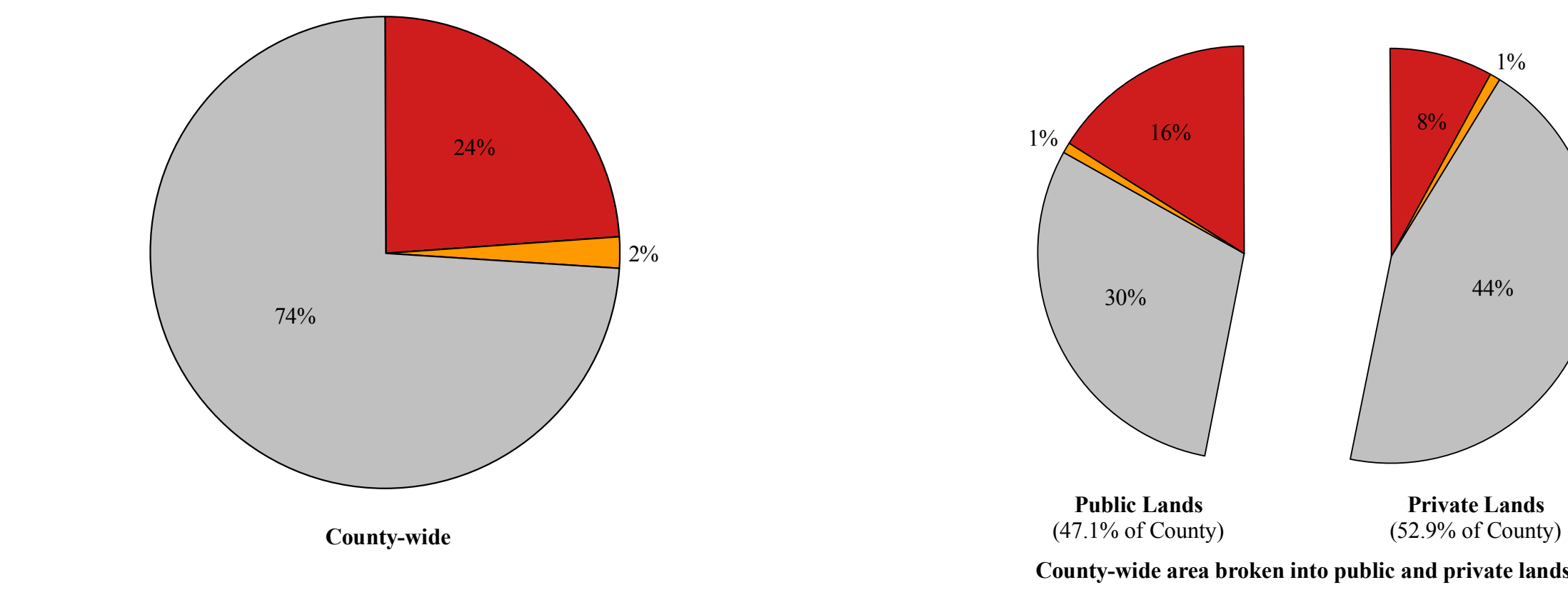
### EXPLANATION

#### MAP FEATURES

Map Color Code	Relative Downslope Hazard	Description	Comments
Red	High	Areas in the predicted flow paths of possible debris or earth slides and flows that initiate in the unstable and upper threshold stability zones of the Stability Index Map (Sheet 2).	Slope movements that initiate on modified slopes within these high hazard zones may also follow similar flow paths.
Orange	Moderate	Areas within the boundaries of mapped slope movement deposits that are not included in the high hazard zones.	Unconsolidated slope movement deposits can be unstable when over-steepened by excavations or stream erosion.
Yellow	Low	Areas outside of the predicted flow paths of debris or earth slides and flows or mapped slope movement deposits.	The hazard in these areas is considered low for unmodified slopes, however slope movements may result from slope modification.

Table 1. Definitions and explanation of relative downslope hazard zones.

#### RELATIVE PERCENTAGES OF PUBLIC AND PRIVATE LANDS WITHIN EACH DOWNSLOPE HAZARD ZONE



### OVERVIEW OF THE DOWNSLOPE HAZARD MAP

**Introduction**  
In response to the number of slope movements (landslides) and the destruction caused by the remnants of Hurricanes Frances and Juan in western North Carolina in September 2004, the North Carolina General Assembly authorized the North Carolina Geological Survey (NCGS) to produce landslide hazard maps for 19 western counties. Macon County was selected as the first county to be mapped because of the fatalities caused by a debris flow and the fast-growing population potentially at risk from other slope movements. The intent of the landslide hazard mapping program is to provide the public, local government, and local state emergency agencies with a description and location of areas where slope movements have occurred, or are likely to occur, and the general areas at risk from these slope movements. The locations of previous slope movements are important because they often reoccur in the same general areas. This predictive mapping is not intended to be a substitute for a detailed, onsite analysis by a qualified geologist or engineer.

**Low Hazard Zones.** Low hazard downslope zones are those areas outside of the predicted flow paths of potential debris/earth slides and flows, and mapped slope movement deposits. There is a low likelihood of damage in this area from slope movements that originate from outside of this area. Slope movements may result from the modification of slopes in low hazard zones.

**Map Production**  
The Downslope Hazard Map is derived from two sources:  
1. outlines of slope movements (debris flow tracks) and slope movement deposits from the Slope Movement and Slope Movement Deposit Map (GHMS-1, Sheet 1); and  
2. high hazard areas of the Stability Index Map (GHMS-1, Sheet 2).  
The following sequential steps outline the method used to produce the Downslope Hazard Map on a 20-ft (6-m) LIDAR (Light Detecting And Ranging)-derived elevation model grid.  
1. All high hazard areas from the Stability Index Map (GHMS-1, Sheet 2) were designated as the most likely slope movement source areas for the downslope hazard zones.  
2. These high hazard zones were reduced to include only those with contiguous areas  $\geq 25$  acres (10,893 ft<sup>2</sup> or 1,012 m<sup>2</sup>). This reduction was needed to make the following step in the process computationally feasible.  
3. Hydrologic flow paths based on topographic gradients were then created in ArcGIS<sup>®</sup> from points placed on a 39.4-ft (12-m) grid constructed from these high hazard areas (using a 20-ft or 6-m grid was not computationally feasible).  
4. Flow paths were terminated once they encountered slope gradients less than three degrees. Three degrees was selected as a nominal gradient consistent with the lowestmost downslope extent of most slope movement deposits and tracks delineated in the accompanying Slope Movement and Slope Movement Deposit Map (GHMS-1, Sheet 1).  
5. These flow path widths were then buffered to 33 ft (10 m) on each side to delineate the downslope hazard zones. This buffer approximates the average track width of mapped debris flows in Macon County.  
6. Known slope movement outlines (e.g., recent debris flow tracks) were added to these downslope hazard zones to produce the high downslope hazard class.

Extensive manual map editing was required to adjust the downstream extents of the high hazard zones in order to preserve flow path continuity and terminate unrealistic flow paths where warranted. These adjustment procedures are outlined as follows:  
1. Flow paths with gaps occurring within the areal extent of mapped slope movement deposits were connected.  
2. Flow paths with gaps of 98 ft (30 m) or less were connected.  
3. Flow paths that traveled along a floodplain or along a road were terminated.  
4. Flow paths were arbitrarily terminated at lake boundaries (where LIDAR elevation data are absent).  
5. Flow paths that originated at the toes of slopes were limited in their downstream extent.

### ACKNOWLEDGEMENTS

The North Carolina Geological Survey would like to thank Macon County Emergency Services, the Sheriff's Department, Planning Department, and Department of Projects and Development. Special thanks go to the residents of Macon County for their willingness to provide information and property access. The North Carolina Department of Transportation - Geotechnical Engineering Unit, the North Carolina Floodplain Mapping Program, and the U.S.D.A. Forest Service provided much useful data and assistance.

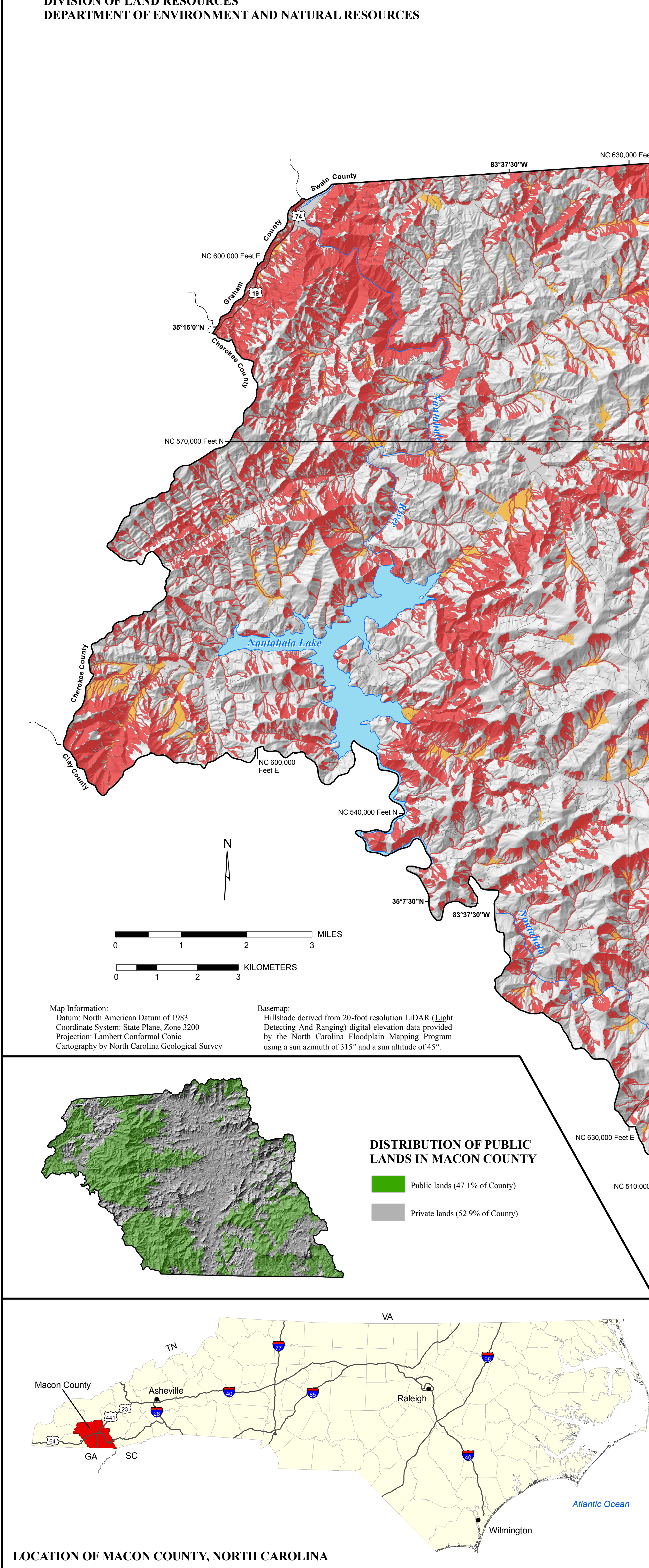
Reviews and comments by Bart Cattanach, Timothy Clark, Michael Medina, Carl Mersbach, and John Nickerson greatly improved the map. This project was completed in cooperation with the North Carolina Center for Geographic Information and Analysis, DNR.

### DISCLAIMER OF LIABILITY

The Hurricane Recovery Act of 2005 (Section 6) directs the Department of Environment and Natural Resources (DENR) to ensure that maps indicating areas vulnerable to landslides be made available for the 19 counties included in the Major Disaster Declarations for Hurricanes Frances and Ivan.

The North Carolina Geological Survey was tasked to prepare those maps and is committed to providing users with accurate, useful and current information. All electronic and/or hardcopy products (maps, data, text, etc.) produced by this landslide hazard mapping program are considered public information and may be redistributed and/or copied. These products, however, are intended to serve for general planning purposes only, and are provided on an "as is" basis. These maps and products do not substitute for an on-the-ground site assessment by a qualified geologist or engineer.

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