

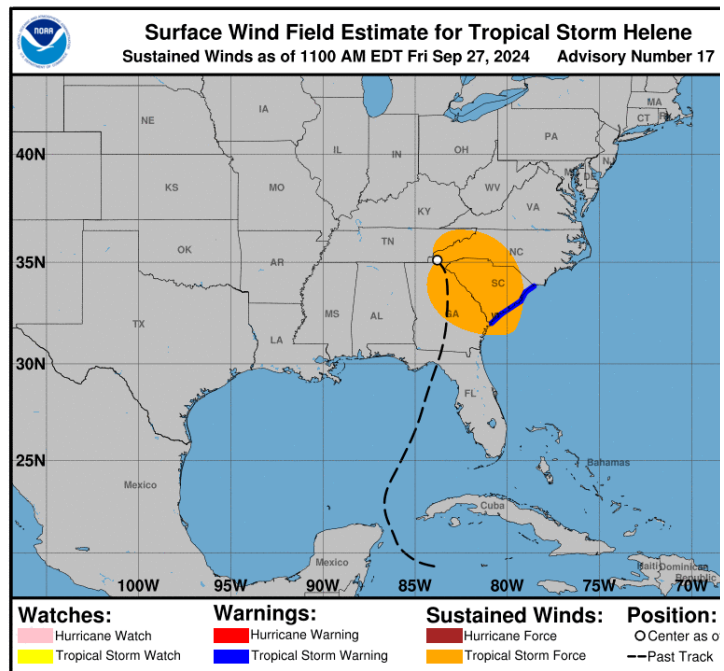


# NORTH CAROLINA FOREST DAMAGE APPRAISAL HURRICANE HELENE September 2024



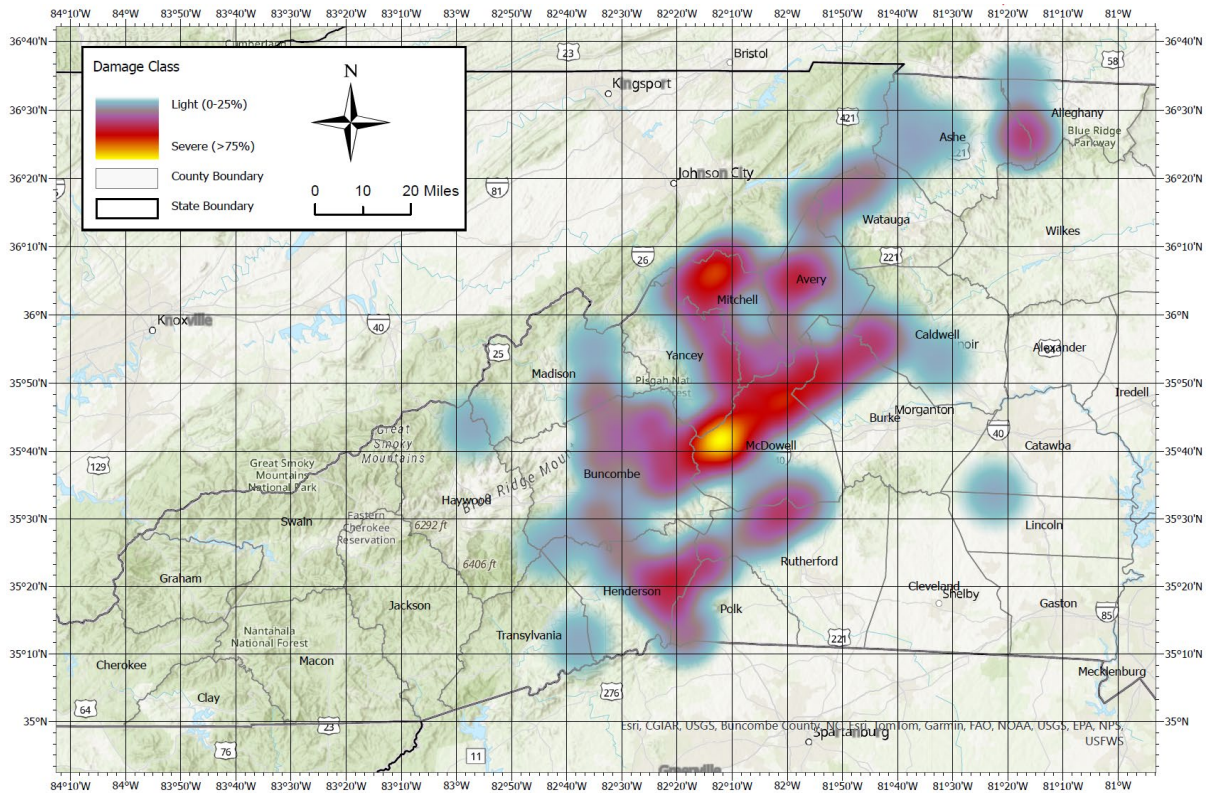
**Introduction** – On September 23 the National Weather Service posted their first advisory on a newly formed tropical system identified as Potential Tropical Cyclone 9. This system was located 350 miles south/southeast of the western tip of Cuba. This system continued to develop into what would eventually become Hurricane Helene on September 25. Hurricane Helene continued to move through the Gulf of Mexico and strengthened to a category 4 hurricane prior to landfall. Landfall occurred on September 26 just south of Perry Florida with maximum sustained winds of 140 mph.

Helene then moved northward through Georgia and into the Carolinas. The National Hurricane Center’s advisory for the morning of September 27 indicated damaging gusty winds and life-threatening flooding over portions of the Southern Appalachians Mountains. The 11:00 am advisory update predicted historic and catastrophic flooding in the same area. Sustained winds at this point were at 45 mph with gusts above 70 mph. In addition, 6 – 12 inches of rain were predicted with local areas receiving more than 20 inches of precipitation. This prediction proved accurate. Immediate reports from the affected area focused on the large-scale flooding events. As the system exited the area reports of blocked roads, power outages, and other damage caused by downed trees began to come in.



**Figure 1.** Hurricane Helene track and location on the morning of September 27, 2024. Tropical storm force wind (>39mph) extent is indicated. (Source: NOAA-NHC).

North Carolina Forest Service personnel began preparations for an aerial damage assessment focusing on the timber resource immediately following the passage of the system. However, the decision to conduct this assessment was delayed due to the large number of aircraft in the area conducting emergency response missions and the focus on dispatch of personnel to the area to assist with the emergency response activities.



**Figure 2.** Hurricane Helene damage assessment map.

**Results** – An estimated 822,000 acres of timberland received some level of damage during the storm resulting in an estimated \$214,000,000 of timber damage on all North Carolina forest lands. Damage distribution between land ownership was estimated to be:

- 21% public (US Forest Service and other public ownerships)
- 78% private (private individuals, corporations, and other ownerships)
- 1% reserved lands (reserved areas such as park lands)

Distribution of timber damage is further described in table 1.

Of the 333 points examined during the aerial survey, 56 points contained at least some damage (windthrown trees or ones that had tops removed by the storm). Some timber damage attributed to landslides and flooding was also observed. The timber damage overall was not consistent over the area of concern with some areas having severe damage across the landscape and others experiencing somewhat light damage overall.

It was not uncommon to see areas with severe damage with adjacent areas experiencing relatively light damage. It should be noted that slopes facing in a southerly direction received the force of the wind and therefore experienced a larger proportion of the damage overall. In some areas, the leaves were blown off the trees or damage was observed on the windward slopes while the leeward slopes received lighter effects, often retaining their leaves and appearing untouched by the effects of the wind.

Our damage estimate indicated that over 27% of the forestland in the affected counties received some level of damage. Due to the timber types prevalent in this area, a substantial proportion of this damage appears to be hardwood sawtimber. As indicated in our general observations below, softwood timber was not damaged in the same proportion as the hardwood types.

The heaviest damage was confined to a six-county area with Buncombe and McDowell counties being at the center of this area. Counties affected are:

Alleghany, Ashe, Avery, Buncombe, Burke, Caldwell, Haywood, Henderson, Lincoln, Madison, McDowell, Mitchell, Polk, Rutherford, Swain, Transylvania, Watauga, and Yancey. The most heavily impacted counties are Avery, Buncombe, McDowell, Mitchell, Henderson, and Yancey. This was based on percentage of points within the county showing damage. The timber value loss estimates and general observations on timber type losses on North Carolina’s forest lands are listed below.

**Table 1.** Hurricane Helene timber damage estimation by ownership.

County	Public Ac.	Private Ac.	Reserve Ac	Total Ac.	Public Land \$	Private Land \$	Reserve \$	Total Value
Alleghany	0	11,843	1,048	12,892	\$14,158.79	\$325,652.10	\$14,158.79	\$353,969.67
Ashe	2,174	48,397	0	50,571	\$381,872.72	\$9,164,945.33	\$0.00	\$9,546,818.06
Avery	17,486	56,951	0	74,437	\$3,755,495.64	\$12,572,746.26	\$0.00	\$16,328,241.90
Buncombe	24,805	64,635	0	89,440	\$5,402,468.16	\$13,892,060.98	\$0.00	\$19,294,529.14
Burke	12,071	32,557	1,127	45,755	\$2,857,454.60	\$7,514,047.27	\$211,663.30	\$10,583,165.18
Caldwell	14,589	38,143	0	52,732	\$3,170,057.89	\$8,151,577.43	\$0.00	\$11,321,635.32
Haywood	2,785	9,505	4,447	16,737	\$471,355.26	\$1,221,238.64	\$449,930.03	\$2,142,523.93
Henderson	13,481	43,562	0	57,043	\$3,994,292.04	\$12,648,591.47	\$0.00	\$16,642,883.52
Lincoln	0	28,925	0	28,925	\$0.00	\$4,742,073.77	\$0.00	\$4,742,073.77
Madison	24,526	13,683	1,556	39,764	\$4,723,735.12	\$2,590,435.39	\$304,757.10	\$7,618,927.62
McDowell	14,541	116,265	0	130,805	\$1,857,992.01	\$15,032,844.45	\$0.00	\$16,890,836.46
Mitchell	12,337	46,908	0	59,244	\$8,623,351.80	\$32,440,228.21	\$0.00	\$41,063,580.01
Polk	2,157	21,490	0	23,647	\$1,498,164.36	\$15,148,106.29	\$0.00	\$16,646,270.65
Rutherford	3,332	39,255	0	42,587	\$472,952.39	\$5,438,952.47	\$0.00	\$5,911,904.86
Transylvania	11,346	10,029	0	21,376	\$1,732,402.31	\$1,536,281.30	\$0.00	\$3,268,683.61
Watauga	973	12,066	0	13,039	\$271,587.49	\$3,608,233.77	\$0.00	\$3,879,821.26
Yancey	11,930	48,519	2,463	62,912	\$5,499,842.02	\$21,174,391.77	\$824,976.30	\$27,499,210.08
	168,532	642,733	10,641	821,906	\$44,727,182.60	\$167,202,406.91	\$1,805,485.52	\$213,735,075.04

\*Reserved lands are those lands, such as park lands, reserved from timber harvesting.

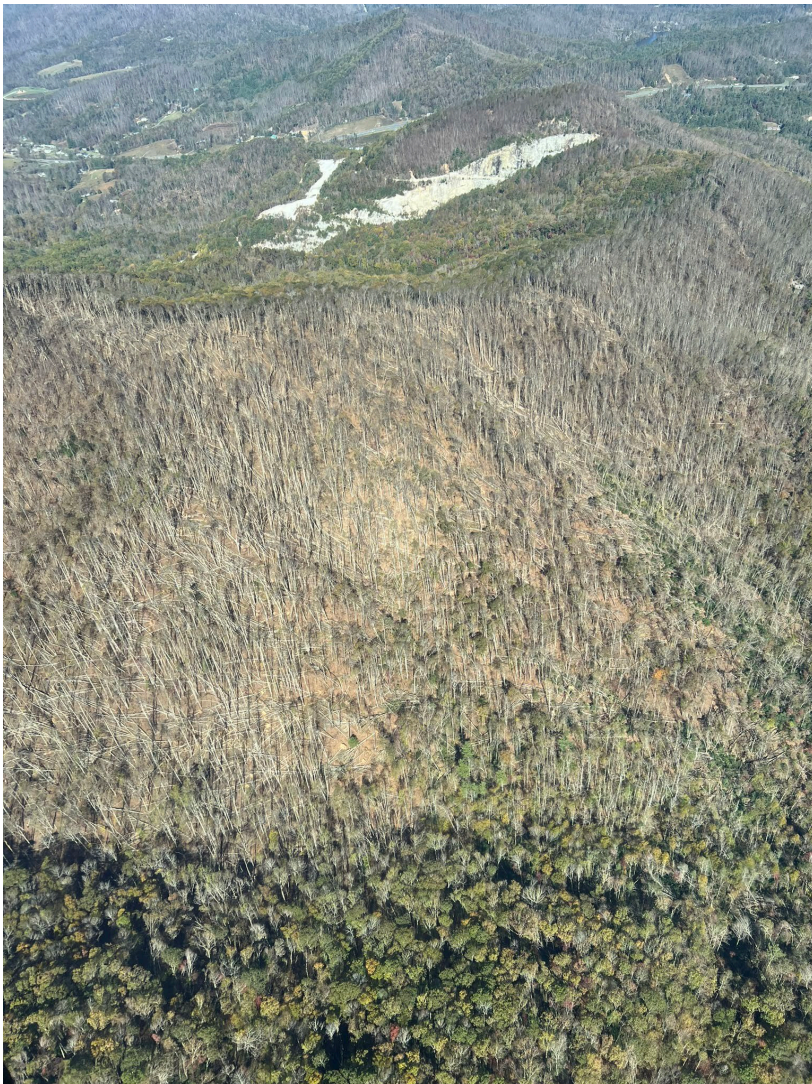
**Additional Observations** – During the assessment, aerial surveyors made general observations including:

- Damage was not consistent overall
- Windward (southerly slopes) received a larger share of the damage.
- Apparent microburst or downburst areas were evident throughout the area.



- Areas of heavy damage were interspersed throughout areas with much lighter damage.
- Hardwood stands were affected to a larger extent than conifer stands
- Most damage was blowdown with top/stem breakage being lighter
- Mudslides and flooding were a small proportion of the overall timber damage.
- Single, scattered tree damage is difficult to quantify from the air.

While we have seen some other damaging wind events affecting our timber resource in recent decades, this may be the most damaging wind event we have seen in North Carolina since Hurricane Fran in 1996 (Eastern North Carolina) and Hurricane Hugo in 1989 (Western North Carolina). Ground observations by personnel within the damaged areas and pictures coming out of these areas reinforce the observations made.



**Figure 2:** Typical damage on a windward (southerly) slope in the Helene damage area.

**Survey Design and Analysis** - To arrive at a quantitative forest damage estimate, a systematic aerial survey of the area was conducted using flight lines located 10 miles apart, running from the southwest to the northeast over all of NC Forest Service Region 3. This survey

served as both a delimiting survey and a damage assessment survey. This decision was made due to lack of focused information on the extent of the damage. At 5-mile intervals along the flight lines, the forest closest to the aircraft was observed and tree damage data was recorded. The damage observed from the air was georeferenced and classified in damage classes as either no damage, light damage (1-25%), moderate damage (26 -50%), heavy damage (51 - 75%), or severe damage (>75%). Aerial observers also recorded information related to broad forest type (softwood, hardwood, mixed, and spruce/fir) and damage type (windthrow, top breakage, flood/landslide damage). Data was collected using ESRI's Field Maps program.

Damage data was analyzed in ArcGIS using an interpolation method known as kriging. Kriging assumes a spatial relationship between known data points and produces a raster layer that estimates values between sample points based on values around the given area. Polygons were then projected over the kriging output to produce a map depicting the damage.

Forestland volumes by county and species class were obtained for each county from the FIA eValidator program. This data was organized by species group which entailed a great deal of analysis to obtain volumes by broad species group. This data was available in net total volume and sawtimber volume (Doyle Rule). Again, a great deal of work was needed to convert the data to a common format (in this case tons). Standard conversions were used to arrive at tonnage of forest products. Tonnage by product was then applied to stumpage values from Timber Mart South (2024, 2<sup>nd</sup> Quarter) and local sources to arrive at value estimates for timber lost. NC State University Forestry Extension Economic Contribution Data, by county, was used as the source of county timberland acreage figures used in these calculations. All assumptions and data are contained as an appendix to this document (Appendix A).

### **Disclaimers**

- Based on the methods for determining acreage impacted by Hurricane Helene, calculations related to acreage—and thus volumes and values—are estimates of maximum values.
- The timber damage map (Figure 2) was generated from aerial survey using GIS technology. The map is a modeled representation of the damage observed. Not all timber within the damage polygon is assumed to be damaged. In addition, damaged timber may be found in areas that appear to be non-affected.
- Wind damage (windthrow and main trunk breakage) and flooding/landslide damage are represented in the acres, volumes, and values estimations. Landowners are urged to monitor their forests and contact forestry professionals, including their local NC Forest Service County Ranger for guidance on managing affected forests.
- No attempt was made to assess urban or landscape trees during this survey. Storm impacts related to urban trees are difficult to quantify by aerial survey and determining values of urban trees involves a complex process. Homeowners are urged to contact a qualified arborist to assess and provide guidance with urban and landscape trees.

### **Literature Cited**

U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis. (2022). EVALIDator Program.  
Timber Mart South, 2024 2<sup>nd</sup> Quarter Price Report (statewide). Retrieved from <https://forestry.ces.ncsu.edu/forestry-price-data/>  
National Oceanic and Atmospheric Administration – National Hurricane Center. (2024). Hurricane Helene Advisories 1-60A. Retrieved from [www.nhc.noaa.gov](http://www.nhc.noaa.gov)

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## **Appendix A: Hurricane Helene Stumpage Prices and Assumptions**

See Timber Mart South 2<sup>nd</sup> Quarter statewide report (see conversions and prices on sheet unless otherwise identified in this summary)

White pine: \$100/MBF (local info)

Used 6.5 tons/MBF Scribner for white pine, hemlock, red spruce, Fraser Fir, cedar due to weight instead of 7 tons/MBF Scribner as with hard pine.

Used 85 cu. ft. solid wood per standard cord

Other softwood sawtimber priced the same as white pine.

Forest tree species groups that are mixed species were divided evenly between species ( for example, yellow poplar/white oak/northern red oak volumes were proportioned evenly between each species).

Red oak and white oak volumes were combined due to oak stumpage prices being reported as a blended price.

Log Rule Conversions: Doyle to Scribner=1.462 (based on a conversion from the Pennsylvania Stumpage Price Report).

### **Method**

After assumptions above were considered, all volumes were converted to tons. Total tonnage – sawtimber tonnage yielded pulpwood/chipwood. Damage % by county was distributed evenly across all classes to arrive at the damage assessment for the county. The midpoint of each damage class was used for these calculations except for the severe damage category. This category was reported as 100% based on the assumption that stands damaged to this level could be considered completely removed either by salvage or for natural regeneration purposes.