

A satellite image of a hurricane, likely Hurricane Helene, showing a well-defined eye and spiral cloud bands over a dark blue ocean. A dark blue, semi-transparent rectangular box is overlaid on the center of the image, containing the title and subtitle in white text.

Hurricane Helene's Fury

The Devastation of I-40 in North Carolina

By: Matt Hilderbran, PE, CPM

The Hurricane/Tropical Storm

When it reached western North Carolina, it was officially classified as a tropical storm, but it still produced hurricane-force wind gusts

Why I-40 Was Vulnerable

Crosses the steep, rugged terrain of the Appalachian Mountains.

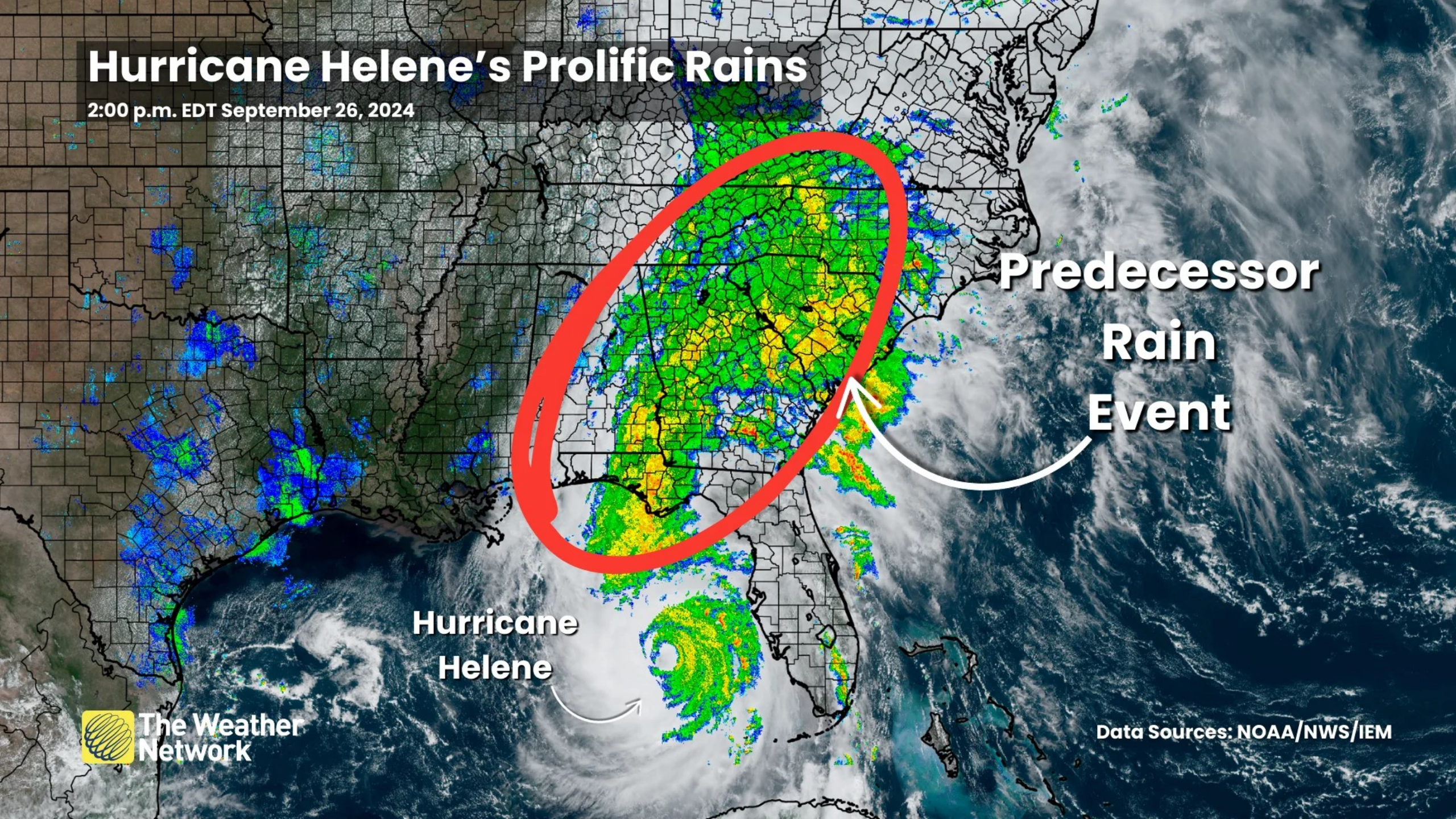
The route is carved directly through the narrow Pigeon River Gorge.

This geography creates a natural chokepoint, highly susceptible to landslides and river flooding.



Hurricane Helene's Prolific Rains

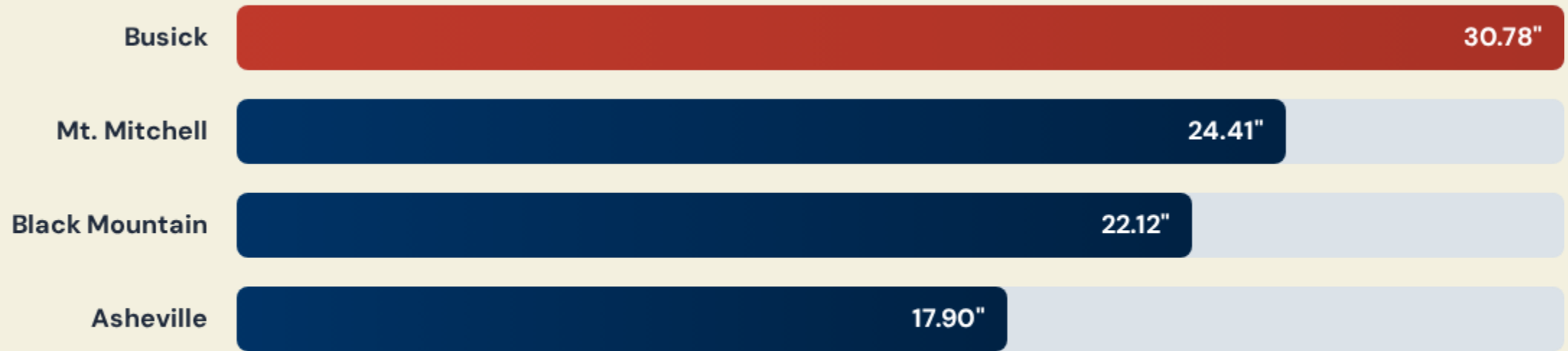
2:00 p.m. EDT September 26, 2024



**Predecessor
Rain
Event**

**Hurricane
Helene**

Historic Rainfall: Fuel for Disaster



Rainfall totals in the mountains exceeded 1,000-year event levels, saturating the ground and overwhelming river basins.

Catastrophic Failure: Landslides

The torrential rain triggered multiple, massive landslides in the Pigeon River Gorge, particularly near mile markers 0-5.

Tons of rock, mud, and trees cascaded down the steep slopes, completely burying all lanes of Interstate 40 and making the road utterly impassable.



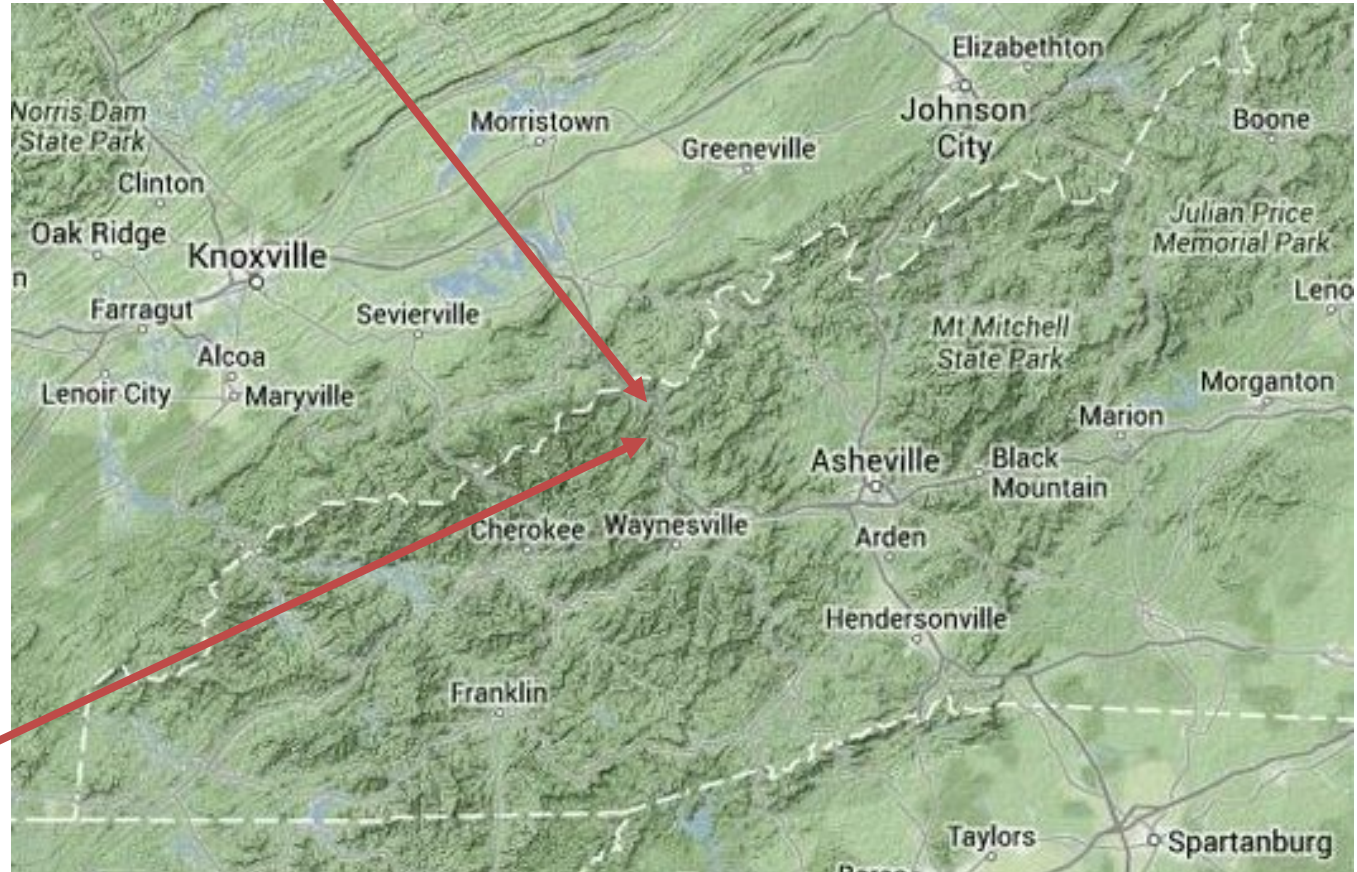
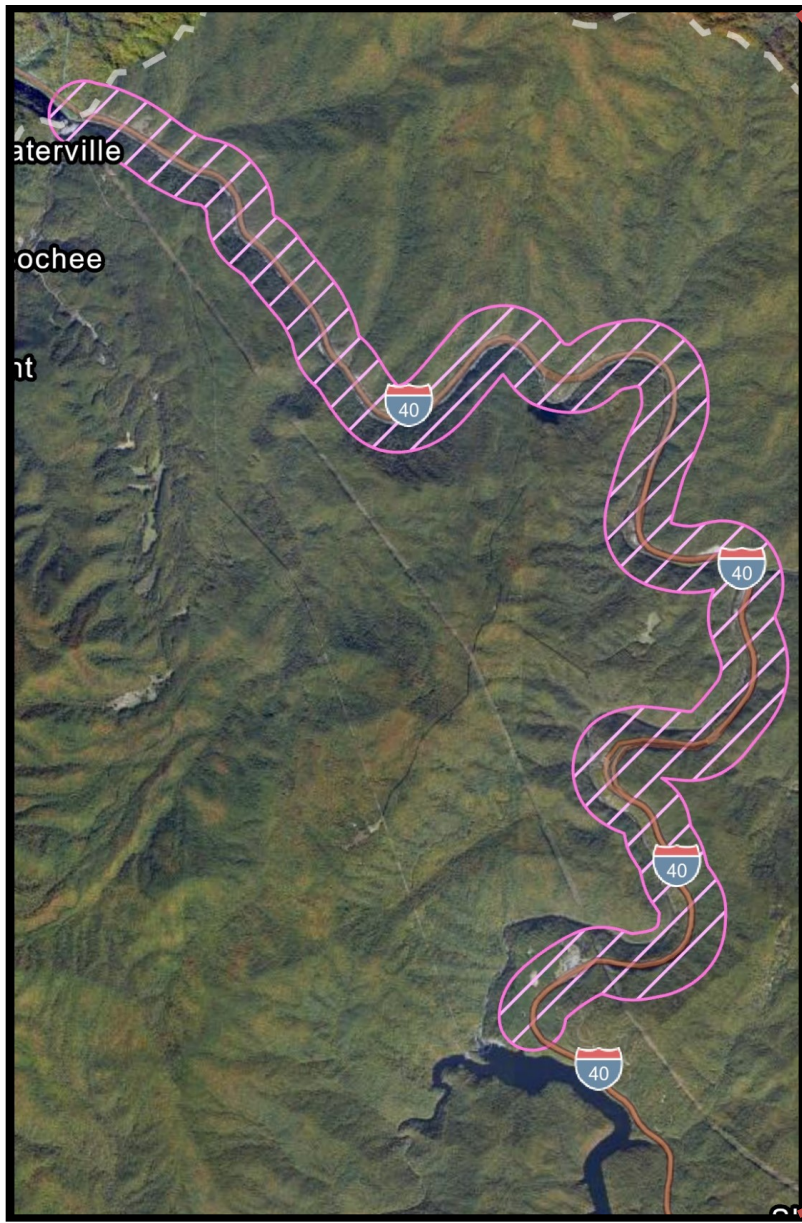
Not a Slide, A Total Washout: The Road is "Completely Gone"

The greater shock came when NCDOT engineers assessed the damage. This was not just a landslide.

The sheer force of the flooded Pigeon River had completely scoured the roadbed, washing the eastbound lanes of I-40 away.

During Hurricane Helene, the Pigeon River's flow rate reached a peak of approximately 1.3 million gallons per second at the Nolichucky Dam, more than double the previous record. At this point, the water level at the dam was 1,266 feet, which was more than nine feet higher than the previous record.





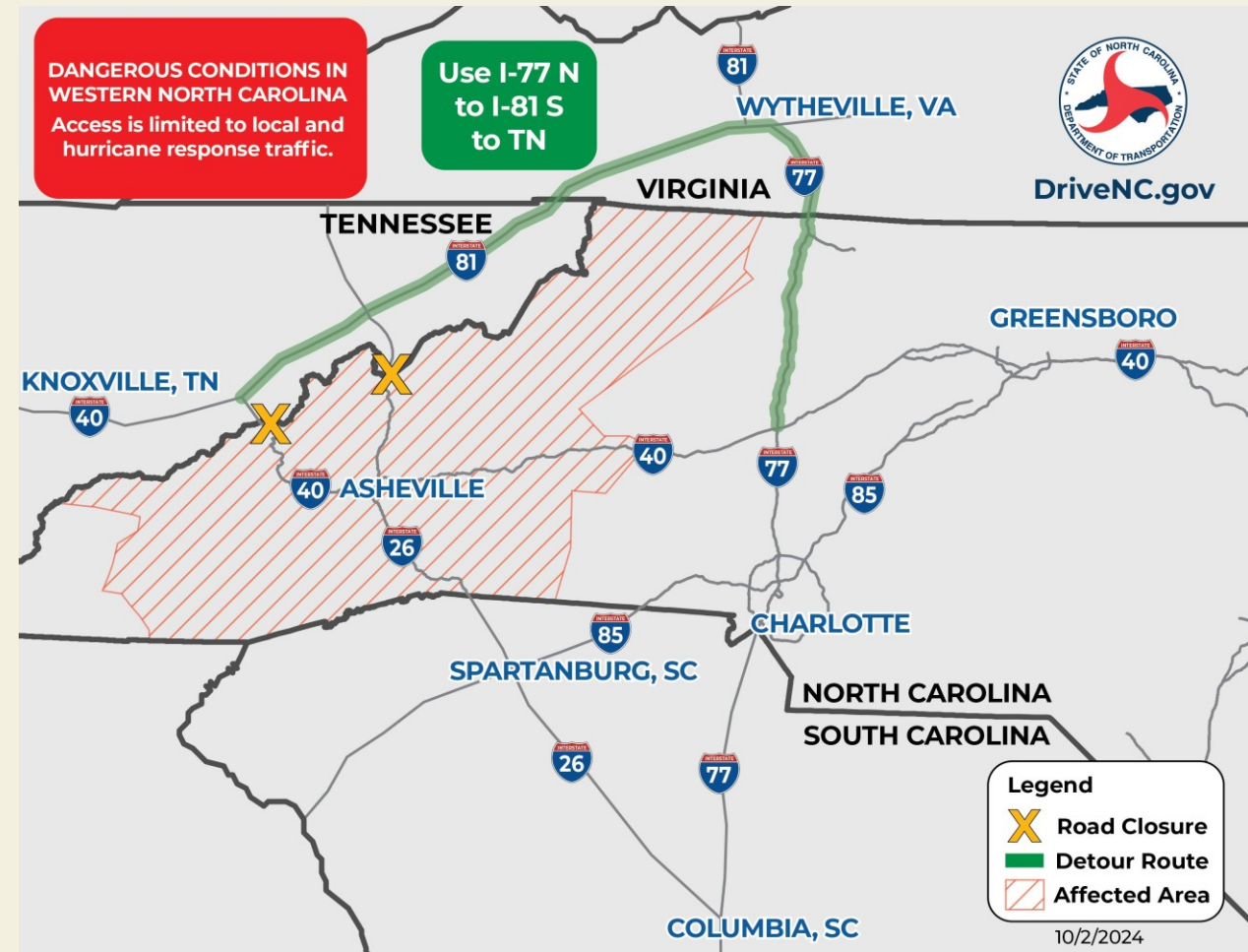
A Region Severed: Immediate Aftermath

I-40 was closed indefinitely, cutting off WNC from Tennessee.

An estimated 27,000 vehicles per day were forced onto long detours.

Heroic NCDOT IMAP crews worked during the storm to turn vehicles around, preventing certain fatalities.

Other sections near Asheville were inundated by the French Broad and Swannanoa Rivers.



The Economic Toll of a Severed Artery



Statewide Impact

Hurricane Helene is one of the costliest in state history, with total damage estimates exceeding \$59 billion.



Supply Chains Broken

Goods were rerouted over 100 miles via I-81 and I-77, costing millions per day and delaying deliveries.



Tourism Halted

The closure struck at the beginning of the peak fall leaf season, a critical time for the mountain economy.

The Response: NCDOT Mobilizes - A 24/7 Operation

A massive, round-the-clock operation began immediately with no cell service or internet access.

Over 2,000 NCDOT employees and 354 contracting firm employees were mobilized.

Multiple State DOT forces deployed to western NC.

Countless Disaster Recovery Organizations, NC National Guard, National Forestry Service, etc. deployed people and goods to western NC.

Geotechnical engineers began anchoring the mountainside.



Road to Recovery – 5 Months



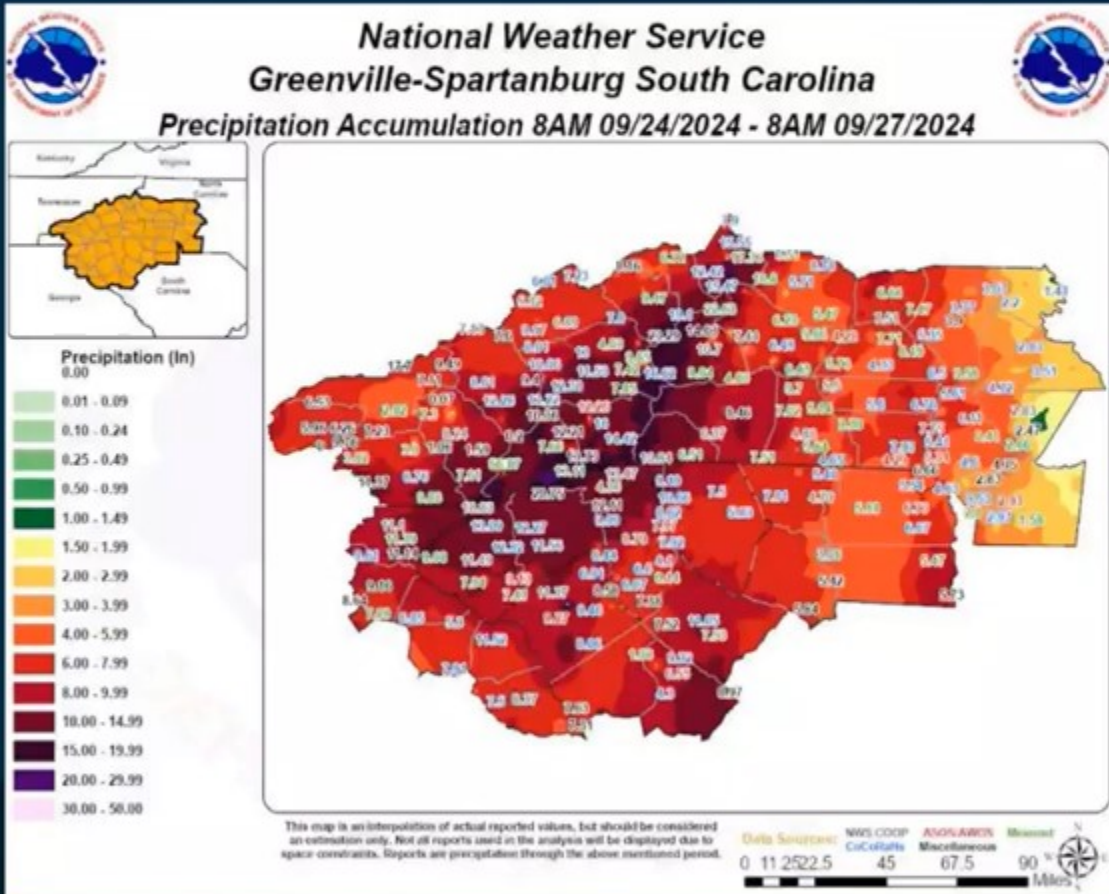


Entering
Cherokee
National Forest

Cherokee
National Forest



Rainfall Totals During Helene



City	County	Rain (in)
Busick	Yancey	29.58
Mt Mitchell St. Park	Yancey	24.2
Spruce Pine	Mitchell	18.23
Davidson River	Transylvania	17.7
Foscoe	Watauga	16.42
Old Fort	McDowell	15.6
Whitehead	Alleghany	15.59
Hendersonville	Henderson	15.11
Swannanoa	Buncombe	14.81
North Cove Pinnacle	McDowell	14.75
Guion Farm	Henderson	14.73
Saluda	Polk	14.58
Highlands	Macon	14.52
Grandfather	Watauga	14.47
Watauga Medical Center	Watagua	10.98
Boone Precip 2 S	Watagua	9.21

CD

Chad Dew

Thorne...

Partin, J...

Skeens, ...

Fine, Lo...

N

NCDOT ~...

Edwards,...

Biggerst...

CM

McLamb,...

LC

Carpente...

JG

Garner, J...

MG

Gibbs, M...

M

Middleto...

JS

Simmon...

Goldston...

JC

Chastain...

Hill, Dwi...

+83

Road to Recovery – Building Resiliency for the Future:

June 18 2025

Heavy rains caused rockslides and flooding on I-40 WB near TN/NC border causing weeks of additional lane closures

Present Day 2025

Progress continues at a steady pace on I-40 in the Pigeon River Gorge: All modular bridge parts are on-site, and the two temporary bridges are currently being pieced together.

Crews built a "borrow site" upstream to quarry rock and create fill material, saving crucial time and money (Pisgah National Forest).

Nov 2025

The repair is not just a replacement. NCDOT is drilling deep into the mountains, anchoring rock, and building new retaining walls to withstand future events and prevent a repeat failure.

Rock removal should begin by Thanksgiving transferring material from the borrow site and across the bridges.

A USGS stream gauge is being installed at the low-water bridge near Exit 7 that will provide real-time stream information to local residents.

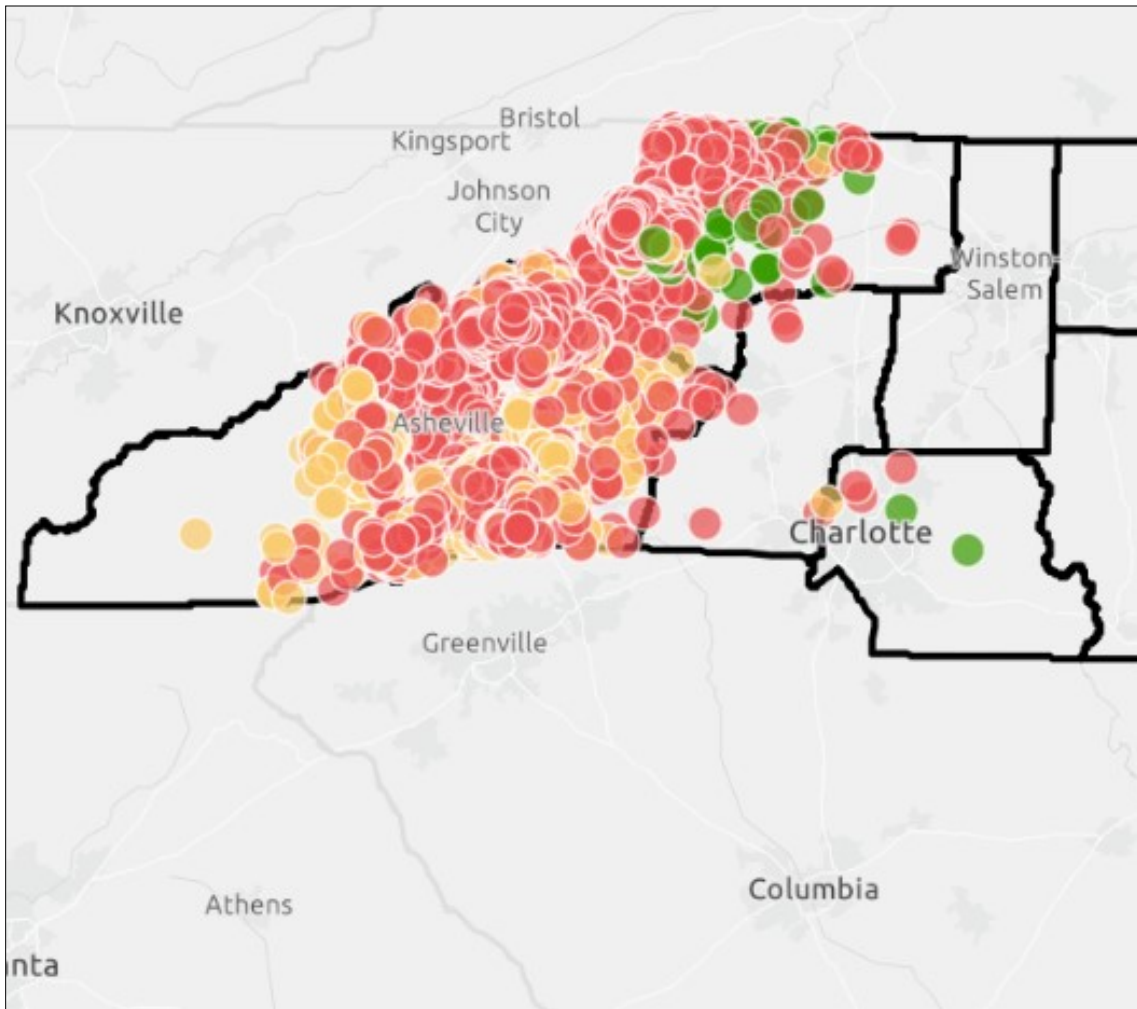
Design and project cost estimates are concurrently being refined.

The Numbers:

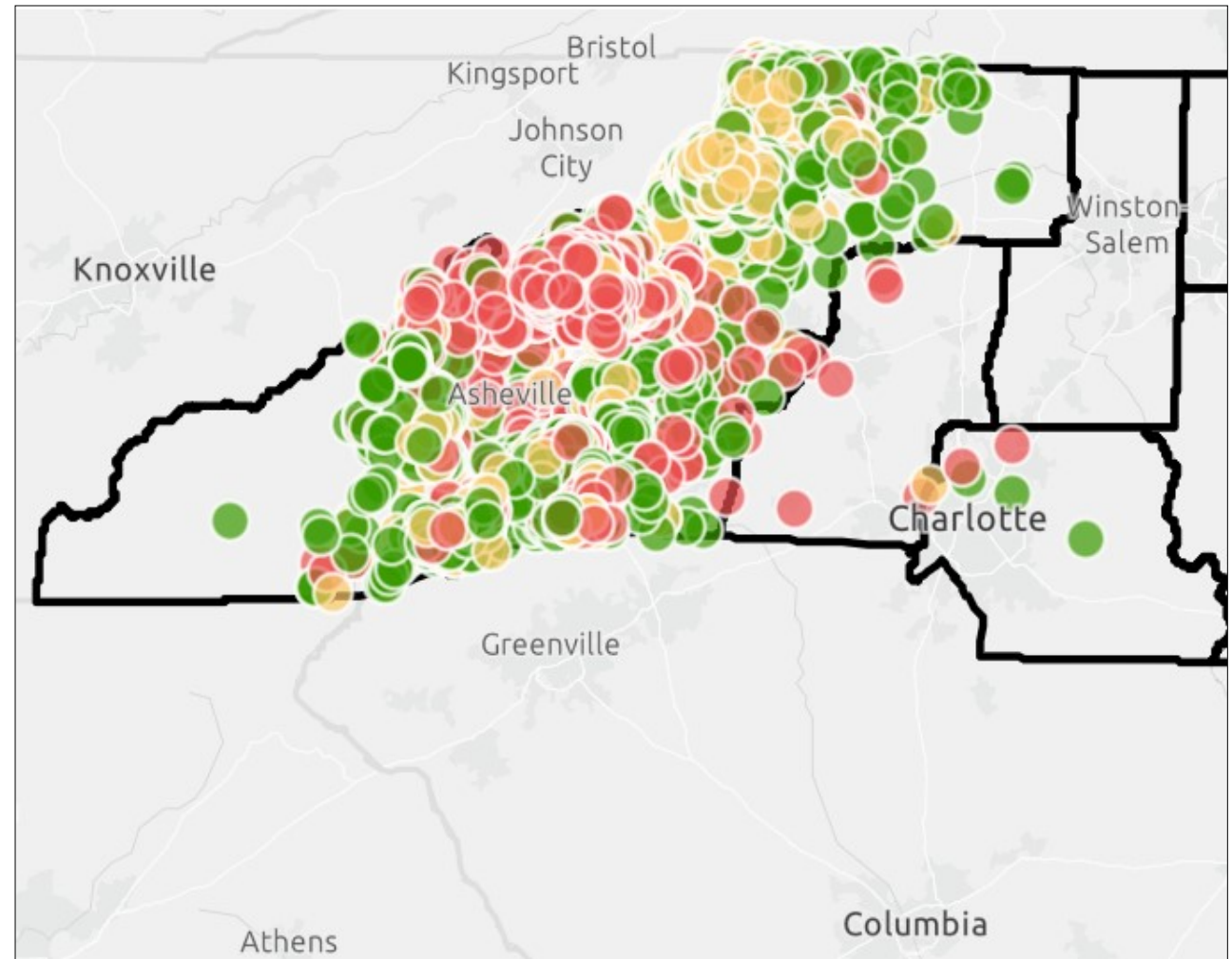
- 9,442 damage sites
- >10 million CY of debris
 - 1,400 roads closed
- 137 state-maintained roads
- 5,000 miles of state-maintained road
 - 848 state bridges damaged
- Over 5,000 private bridges damaged
 - Over 1,600 culvert pipes damaged
 - Over 2,000 documented landslides
- 108 confirmed NC Deaths due to Helene

The Numbers:

- Estimated \$4.9 billion in damages to state-maintained roads
 - Total NC Spent to-date \$1.18B
 - FEMA Reimbursed to-date \$151.8M
 - FHWA Reimbursed to-date \$194.4M
 - Temporary Access (Bridges/Culverts) – 72
 - 6,000+ sites repaired
 - I-40 Repair Completion Est –late 2028



Jan. 2025



Sept. 2025



I-40

Division 14

Project Description

12-mile stretch of I-40 damaged at the Pigeon River Gorge

Project Information

Estimated Cost: \$1.3B

Procurement Type: Construction Manager General Contractor

Timeline

Construction Started:
February 2025

Projected Completion: Fall 2028

Record Flooding & Massive Debris



> 10 million CY of Debris



**French Broad River crested at
24.8 feet**

Landslides

- Estimated 6,000 – 7,000 landslides and debris flows



Storm Impacts: Transportation



I-40 Borrow Site

RS&H

Helene proved that 1,000-year rain events are a new reality. This event forces a re-evaluation of how critical infrastructure is built and protected in high-risk mountain terrain.

Questions?

Thank you for your time.