

NCDOT Flood Detection Systems Appendices

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Appendix A

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VIDEO: NCDOT Equips State Roads With Cutting-Edge Flood-Warning System

TUE MAY 31, 2022 - SOUTHEAST EDITION

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



Stream gauge on NC 42 bridge over Neuse River in Clayton



When the next hurricane strikes North Carolina, the state will be armed with an advanced flood-warning system that relies on a network of 400 river and stream gauges.

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In making the announcement May 23, the state's Department of Transportation (**NCDOT**) said on its website that the new system will allow the agency for the first time to analyze, map and communicate in real-time any flood risks to roads, bridges and culverts.

This critical information will be sent to NCDOT maintenance staff responding to flooded roads and washed-out culverts. In addition, the system's reports will help local emergency management officials and the public accessing the department's [DriveNC.gov](https://www.drive-nc.gov) website for prompt weather-related closures.

"This state-of-the-art warning system our department has created will help us be better prepared for the next major storm," North Carolina Transportation Secretary Eric Boyette explained in the online news release. "Even though we've had some quiet hurricane seasons recently, we cannot let our guard down."

The last major storm to impact North Carolina's road network was Hurricane Florence in 2018. In 2022, researchers at N.C. State University in Raleigh, and the National Hurricane Center are predicting an above-average hurricane season, which officially begins June 1.

N.C. Equipped With Armada of Flood Gauges

After Florence, the state Legislature gave NCDOT a \$2 million grant to develop sophisticated software and install more flood gauges. The system, though, primarily taps into existing gauges operated by other agencies, such as the N.C. Emergency Management and the U.S. Geological Survey and includes an interactive online dashboard and flood mapping based on three-dimensional ground surveys.

One part of the new early flood-warning system covers almost 3,000 mi. of state-maintained roads, mostly east of Interstate 95 where hurricanes tend to have the greatest impact. It also will allow NCDOT to monitor flood conditions for some 15,000 bridges and culverts statewide.

The transportation department's hydraulics unit has been fine-tuning the system and training staff on it with smaller storms over the past year.

In its online statement, NCDOT noted that it has formed a recent partnership with the University of North Carolina at Chapel Hill's Renaissance Computing Institute and the U.S.

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forecast modeling data on how storm surge may affect the state's road network in coastal areas.

Maintenance Crews at the Ready

Beyond the flood-warning system, NCDOT has been preparing for the hurricane season in other ways as well. For example, the agency has been reviewing procedures and conducting exercises internally and with partner agencies.

Also, some highway divisions in the state's coastal counties have held employee training events this spring to review response and recovery operations. Each of the agency's 14 highway divisions have been taking inventory of supplies, doing maintenance on chainsaws and other equipment, and readying emergency on-call contracts that will supplement what NCDOT employees do in responding to a storm.

Public Preparations

State transportation officials remind Tarheel residents now is the time to prepare supplies for the possibility of an extended power outage, restricted traveling, or the need to be at a shelter. North Carolina Emergency Management also maintains a comprehensive list of items to include in an emergency supply kit.

After a hurricane or tropical storm has passed, people should remember to never drive through flooded waters on roads or around barricades. It only takes one foot of water to sweep a vehicle away, according to NCDOT.

For more preparation tips, including evacuation routes and evacuation zones by coastal county, visit www.ReadyNC.org and watch the short video on how to prepare for severe tropical weather.

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Appendix B



NCDOT develops early flood warning system for roads

Published 9:54 pm Thursday, May 26, 2022

By **Staff Reports** (<https://www.thecoastlandtimes.com/author/ctadministrator/>)



This stream gauge over the Neuse River on NC 42 in Johnston County is one of several the NCDOT will rely on to gather data for a new early flood warning system. Courtesy NCDOT

When the next hurricane strikes, the North Carolina Department of Transportation has reported it will be armed with an advanced flood warning system that relies on a network of 400 river and stream gauges.

The new system will allow the NCDOT for the first time to analyze, map and communicate in real-time any flood risks to roads, bridges and culverts, stated a press release from NCDOT.

This critical information will go to NCDOT maintenance staff responding to flooded roads and washed-out culverts and it will benefit local emergency management officials and the public accessing the department's [DriveNC.gov](https://u7061146.ct.sendgrid.net/ls/click?upn=4tNED-2FM8iDZIQyQ53jATUSzsim5PNYjqb0b4YdAHbAc-3Dw3vj_gXXWQWuTunB-2BASBZZ7-2B-2Bd4ueNx6tdPIIERQia50ZL5z4LURaU1r1Yq0xPor5DI2o3SfEPoah9LQEttiT5UxMqydhYq6l0b1NXITJCZrDww4MlCWIs27AvTvS0RNnBK0qj6BpjY-2FybA7zBSndLqWJshy1eibu-2BXqNriDRUX1rHstdlPkrNdYTU9C9KErZgOX8KpiucgRW1e1YIZkakjnJOsqxfN8u84QYWvAs9KayzPKLqTq0a-2FmEojH1rP80w7gmYZSuNqIN5d-2FGGrJTjGtEHspul7zafBR2dygP21DtZjkVJVCmVmkInQ-2Biepo05u0LUO-2FuxyHdOoObW4BL7tjmbyZxUFdrzOkDIQ66GshoA0-3D) (https://u7061146.ct.sendgrid.net/ls/click?upn=4tNED-2FM8iDZIQyQ53jATUSzsim5PNYjqb0b4YdAHbAc-3Dw3vj_gXXWQWuTunB-2BASBZZ7-2B-2Bd4ueNx6tdPIIERQia50ZL5z4LURaU1r1Yq0xPor5DI2o3SfEPoah9LQEttiT5UxMqydhYq6l0b1NXITJCZrDww4MlCWIs27AvTvS0RNnBK0qj6BpjY-2FybA7zBSndLqWJshy1eibu-2BXqNriDRUX1rHstdlPkrNdYTU9C9KErZgOX8KpiucgRW1e1YIZkakjnJOsqxfN8u84QYWvAs9KayzPKLqTq0a-2FmEojH1rP80w7gmYZSuNqIN5d-2FGGrJTjGtEHspul7zafBR2dygP21DtZjkVJVCmVmkInQ-2Biepo05u0LUO-2FuxyHdOoObW4BL7tjmbyZxUFdrzOkDIQ66GshoA0-3D) website for timely weather-related closures.

2FuxyHdOoObW4BL7tjmbyZxUFdrzOkDIQ66GshoA0-3D)

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“This state-of-the-art warning system our department has created will help us be better prepared for the next major storm,” said Transportation Secretary Eric Boyette. “Even though we’ve had some quiet hurricane seasons recently, we cannot let our guard down.”

“The last major storm to impact the state’s road network was Hurricane Florence in 2018,” stated the release. “Researchers at N.C. State University and the National Hurricane Center are predicting an above-average hurricane season, which officially starts June 1.”

Armada of flood gauges

After Florence, the state legislature gave the NCDOT a \$2 million grant to develop sophisticated software and install more flood gauges. The system, however, mostly taps into existing gauges operated by other agencies, such as the N.C. Emergency Management and the U.S. Geological Survey, stated NCDOT. The system includes an interactive online dashboard and flood mapping based on three-dimensional ground surveys.

One part of the new early flood warning system covers almost 3,000 miles of state-maintained roads, mostly east of Interstate 95. The system also will allow NCDOT to monitor flood conditions for some 15,000 bridges and culverts statewide. The agency’s Hydraulics Unit has been fine-tuning the system and training staff on it with smaller storms over the past year.

In addition, the NCDOT has formed a recent partnership with the University of North Carolina at Chapel Hill’s Renaissance Computing Institute and the U.S. Department of Homeland Security’s Coastal Resilience Center of Excellence to receive forecast modeling data on how storm surge may affect the state’s road network in coastal areas.

Learn the components of a gauge in the video found [here](https://www.youtube.com/watch?v=23PIs9jwajs) (<https://www.youtube.com/watch?v=23PIs9jwajs>):

Stream gauge on NC 42 bridge over Neuse River in Clayton



Maintenance crews ready

The NCDOT has been preparing for the hurricane season in other ways. The agency has been reviewing procedures and conducting exercises internally and with partner agencies.

Some highway divisions with coastal counties held employee training events in the spring to review response and recovery operations. All of the agency’s 14 highway divisions also have been taking inventory of supplies, doing maintenance on chainsaws and other equipment and readying emergency on-call contracts that will supplement what NCDOT employees do in responding to a storm.

Public preparations

State transportation officials remind people now is the time to prepare supplies for the possibility of an extended power outage, restricted traveling or the need to be at a shelter. North Carolina Emergency Management maintains a [comprehensive list of items](https://u7061146.ct.sendgrid.net/ls/click?upn=4tNED-2FM8iDZIQyQ53jATUb9urU0Rd3gefnRnybukjTtq938uZbCQ-2FZWIGYqM6-2BL7ffioUdSdy9xz2ub32htsjg-3D-3DMvjM_gXXWQWuTunB-2BASBZZ7-2B-2Bd4ueNx6tdPI1ERQia50ZL5z4LURaU1r1Yq0xPor5DI2o3SfEPoah9LQEtT5UxMqyDthYq6l0b1NXITJCZrDww4MICWIs27AvTvS0RNnBK0qj6BpjY-2FybA7zBSndLqWJshy1eibu-2BXqNriDRUx1rHstdlPkrNdYTU9C9KErZgOX8KpiucgRW1e1YIZkakjnJPDMs6zknbjT2enjdbjleFoXkvL8i1QIQF-2FWM4ED-2BnlvCRoXcH5OXMZddidSRwi9AgwqA5w4-2BCCCJ2iLNI0NhJvnirPBW4hH9IK9jwkQtSfyrLLO1z-2FEq61ud2ZyCtG56oqUNLAc7-2BoFjLMJDVoN8mU-3D) (https://u7061146.ct.sendgrid.net/ls/click?upn=4tNED-2FM8iDZIQyQ53jATUb9urU0Rd3gefnRnybukjTtq938uZbCQ-2FZWIGYqM6-2BL7ffioUdSdy9xz2ub32htsjg-3D-3DMvjM_gXXWQWuTunB-2BASBZZ7-2B-2Bd4ueNx6tdPI1ERQia50ZL5z4LURaU1r1Yq0xPor5DI2o3SfEPoah9LQEtT5UxMqyDthYq6l0b1NXITJCZrDww4MICWIs27AvTvS0RNnBK0qj6BpjY-2FybA7zBSndLqWJshy1eibu-2BXqNriDRUx1rHstdlPkrNdYTU9C9KErZgOX8KpiucgRW1e1YIZkakjnJPDMs6zknbjT2enjdbjleFoXkvL8i1QIQF-2FWM4ED-2BnlvCRoXcH5OXMZddidSRwi9AgwqA5w4-2BCCCJ2iLNI0NhJvnirPBW4hH9IK9jwkQtSfyrLLO1z-2FEq61ud2ZyCtG56oqUNLAc7-2BoFjLMJDVoN8mU-3D) to include in an emergency supply kit.

“After the storm has passed, people should remember to never drive through flooded waters or around barricades,” stated the NCDOT release. “It only takes one foot of water to sweep a vehicle away.”

For more preparation tips, including evacuation routes and evacuation zones by coastal county, visit [ReadyNC.org](https://www.readync.org) (https://u7061146.ct.sendgrid.net/ls/click?upn=4tNED-2FM8iDZJQyQ53jATUfL2MspZiKdUA2p36aHyAy8-3DfS4e_gXXWQWuTunB-2BASBZZ7-2B-2Bd4ueNx6tdPI1ERQia50ZL5z4LURaU1r1Yq0xPor5DI2o3SfEPoah9LQEtTiT5UxMqydtHq6l0b1NXITJCZrDww4MICWIs27AvTvS0RNnBK0qj6BpjY-2FybA7zBSndLqWJshy1eibu-2BXqNriDRUx1rHstdlPkrNdYTU9C9KErZgOX8KpiucgRW1e1YIZkakjnJLp4Z3SrDazAwqqefeuvsZTkMiyRjfdnsrljW5-2FFAOUMgxSYAypLqwk5-2BeN25QPgUZrG2Ow5vpQPfVd-2FWm6beqjBVEYwWgIhLiubOeHV2arbq6naabmhCNJFCbL7LTyX8Mgj3dYATZ7legsdLqESrMg-3D) and watch the video found [here](https://www.youtube.com/watch?v=TV2DmirDW68) (<https://www.youtube.com/watch?v=TV2DmirDW68>) (and below) on how to prepare for severe weather:



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Appendix C

A new flood warning system will help NCDOT monitor road flooding during the next big storm.

RALEIGH, N.C. (WTVD) -- A new flood warning system will help the North Carolina Department of Transportation monitor road flooding during the next big storm.

"The primary reasons we developed the product was to save lives, help the department prepare for, respond to and recover more quickly from extreme events and really ultimately just operate the transportation network more efficiently," NCDOT engineer Matt Lauffer said.

The system allows NCDOT to monitor flood levels from 400 different gauges on area rivers and streams. Those gauges will help NCDOT more quickly respond to areas where floodwaters are threatening bridges, roads or culverts.

In addition to helping NCDOT and local emergency officials more quickly respond to dangerous problem areas, it will also improve the department's [DriveNC.gov](https://drive.nc.gov) weather-related road closures. That will help drivers be better informed about possible weather-related delays or detours before they hit the road.

"This state-of-the-art warning system our department has created will help us be better prepared for the next major storm," Transportation Secretary Eric Boyette said. "Even though we've had some quiet hurricane seasons recently, we cannot let our guard down."

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"It'll hopefully provide information to save lives, to provide information about roads that are vulnerable, roads that are being flooded and help us to manage resources better," Lauffer said.

This new system is the fruit of a \$2 million investment given to NCDOT after Hurricane Florence in 2018. The state legislature tasked the department with installing more flood gauges and developing improved software to better serve the entire state when the next big storm hits.

The improved system now covers nearly 3,000 miles of roads--mostly east of Interstate 95. It also actively monitors flood conditions on 15,000 bridges and culverts.

NCDOT shows new gauge on NC 42 bridge over Neuse River in Clayton

Stream gauge on NC 42 bridge over Neuse River in Clayton



NCDOT said its team has been training on the new system with smaller storms during the past year.

[SEE ALSO: What's in Big Weather's hurricane emergency kit](#)

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Appendix D



The North Carolina Department of Transportation (NCDOT) [has announced the implementation](#) of an advanced flood-warning system that relies on a network of 400 river and stream gauges throughout the state.

The [new system](#) will allow the NCDOT to analyze, map and communicate flood risks to roads, bridges and culverts in real-time.

The information will then go to NCDOT maintenance staff responding to flooded roads and washed-out culverts, and it will benefit local emergency management officials and the public accessing the department's website for weather-related closures.

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"This state-of-the-art warning system our department has created will help us be better prepared for the next major storm," Transportation Secretary Eric Boyette said. "Even though we've had some quiet hurricane seasons recently, we cannot let our guard down."

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Researchers at N.C. State University and the National Hurricane Center are predicting an above-average hurricane season, which officially starts June 1.

After Hurricane Florence hit North Carolina in 2018, the state Legislature gave the NCDOT a \$2 million grant to develop [sophisticated software](#) and install more flood gauges. The system includes an interactive online dashboard and flood mapping based on three-dimensional ground surveys.

The system will also allow NCDOT to monitor flood conditions for 15,000 bridges and culverts statewide. The agency's Hydraulics Unit has been fine-tuning the system and training staff on it with smaller storms for the past year.

In addition, the NCDOT has formed a recent partnership with the University of North Carolina at Chapel Hill's Renaissance Computing Institute and the U.S. Department of Homeland Security's Coastal Resilience Center of Excellence to receive forecast

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Some highway divisions with coastal counties held employee training events this spring to review response and recovery operations. All of the agency's 14 highway divisions also have been taking inventory of supplies, doing maintenance on chainsaws and other equipment, and readying emergency on-call contracts that will supplement what NCDOT employees do in responding to a storm.

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Appendix E

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NCDOT upping hurricane preparedness with new system to track flooded roads

 By **Brenna Flanagan** May 25, 2022



Created in partnership with DPS-NCER Risk Management and NCDOT, the transportation flood monitoring warning system will allow local officials and the public to track closed or dangerous roads, and alert NCDOT to repair and correct issues more quickly. Researchers have been developing the program since March 2019. (Courtesy photo)

SOUTHEASTERN N.C. — Hurricane season officially starts June 1 and the North Carolina Department of Transportation is implementing a new program that will notify it of flooded roadways in real time.

“This state-of-the-art warning system our department has better prepared for the next major storm,” Eric Boyette, North Carolina transportation secretary, said in a press release.

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Created in partnership with DPS-NCEM Risk Management and NCDOT, the transportation flood monitoring warning system will allow local officials and the public to track closed or dangerous roads, and alert NCDOT to repair and correct issues more quickly. Researchers have been developing the program since March 2019.

The product builds upon the 15-year investment in flood warning gauges and geospatial data investment by the state. It relies on 400 river and stream sensors to track flood risks to roads, bridges and culverts. The system will be able to monitor almost 3,000 miles of state-maintained roads and some 15,000 statewide bridges and culverts.

The system mostly utilizes gauges already in place from other agencies, such as from N.C. Emergency Management and the U.S. Geological Survey. There are 18 in the tri-county area. Three more are being added.

Two gauges over Calabash River and Town Creek on NC 133 are considered critical routes in coastal communities that are subject to surge and flooding during extreme weather, according to NCDOT. During Hurricane Florence, homes in these areas flooded, some to [their roofs](#).

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Another gauge over Rockfish Creek on Interstate 40 is considered a vital corridor and the department wants to monitor the location since it flooded during Hurricane Florence.

The solar-powered gauges use a sensor that fires ultrasonic or microwave beams to the water below it to measure the water level. The level is then immediately sent to

Funded by a \$2-million state grant, NCDOT developed the software and installed flood gauges after Hurricane Florence. The Category 1 storm washed out Highway 241 between Pender and New Hanover County and took two years to reconstruct.

"Even though we've had some quiet hurricane seasons recently, we cannot let our guard down," Boyette said in the release.

Many weather agencies, including the National Weather Service's NOAA Climate Prediction Center and the National Hurricane Center, are forecasting an above-average 2022 hurricane season. NOAA predicts up to 21 named storms and six to 10 hurricanes with winds topping 74 miles per hour or higher. It would mark the seventh consecutive above-average hurricane season.

Local officials and the public can view weather-related road closures track on [DriveNC.gov](https://drive.nc.gov). Using three-dimensional ground surveys, the online dashboard offers flood-mapping and interactive features.

The department also partnered with the University of North Carolina at Chapel Hill's Renaissance Computing Institute and the U.S. Department of Homeland Security's Coastal Resilience Center of Excellence to receive data on the effects of storm surges on state roads in coastal areas.

NCDOT reports all of the agency's 14 highway divisions also have been taking inventory of supplies, doing maintenance on chainsaws and other equipment, and readying emergency on-call contracts in preparation for the 2022 hurricane season.

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Appendix F

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Real-time flood risks can be detected with advanced flood-warning system



Using the system, the NCDOT will be able to analyze, map, and communicate any flood risks to roads, bridges, and culverts in real-time (NCDOT)

By [WECT Staff](#)

Published: May. 23, 2022 at 11:19 AM EDT



RALEIGH, N.C. (WECT) - The North Carolina Department of Transportation (NCDOT) has developed a new early flood-warning system for state-maintained roads.

One part of the system covers close to 3,000 miles of state-maintained roads mostly east of I-95 and allows the NCDOT to monitor flood conditions for 15,000 bridges and culverts statewide. The new advanced flood-warning system operates using a network of 400 river and stream gauges.

Using the system, the NCDOT will be able to analyze, map, and communicate any flood risks to roads, bridges, and culverts in real-time.

The information tracked will help DOT maintenance staff coordinate a response to flooded roads and culverts and will speed transmission of information to emergency management officials. In turn, the public will be alerted to weather-related road closures in a timely manner through the NCDOT’s [DriveNC.gov](#) website.

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“This state-of-the-art warning system our department has created will help us be better prepared for the next major storm,” Transportation Secretary Eric Boyette said. “Even though we’ve had some quiet hurricane seasons recently, we cannot let our guard down.”

[Hurricane Florence](#) was the last major storm to impact the state’s road network in 2018.

[MAP: Keep up with road closures here](#)

After Hurricane Florence, the N.C. state legislature gave a \$2 million grant to the NCDOT to develop software and install more flood gauges. The NCDOT has also partnered with UNC Chapel Hill’s Renaissance Computing Institute and the U.S. Department of Homeland Security’s Coastal Resilience Center of Excellence to receive forecast modeling data to determine how storm surge affects the state’s coastal road network.

Researchers at N.C. State University and the National Hurricane Center are predicting an above-average hurricane season, which officially starts June 1.

[Click here to learn how the flood gauges work.](#)

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Appendix G

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North Carolina DOT launches flood-warning system

BY MELINA DRUGA (/ABOUT/EDITORIAL-TEAM/#MELINADRUGA) | MAY 25, 2022 | FEATURED
([HTTPS://TRANSPORTATIONTODAYNEWS.COM/FEATURED/](https://transportationtodaynews.com/featured/))



The North Carolina Department of Transportation (NCDOT) recently launched an advanced flood-warning system that relies on a network of 400 river and stream gauges.

The system will allow the agency to analyze, map, and communicate in real-time any flood risks to roads, bridges, and culverts. The information will be relayed to maintenance staff responding to flooded roads and washed-out culverts and used to update weather-related closures on the agency's website.



The system covers nearly 3,000 miles of state-maintained roads, mostly east of Interstate 95, and will allow NCDOT to monitor flood conditions for approximately 15,000 bridges and culverts statewide.

“This state-of-the-art warning system our department has created will help us be better prepared for the next major storm,” Transportation Secretary Eric Boyette said. “Even though we’ve had some quiet hurricane seasons recently, we cannot let our guard down.”

After Hurricane Florence in 2018, the state Legislature awarded NCDOT a \$2 million grant to install more flood gauges and develop software.

NCDOT will receive forecast modeling data on how storm surges may affect the state’s road network in coastal areas from the University of North Carolina at Chapel Hill’s Renaissance Computing Institute and the U.S. Department of Homeland Security’s Coastal Resilience Center of Excellence.

← Oregon DOT invests \$46M into multimodal transportation projects under Connect Oregon

(<https://transportationtodaynews.com/news/26749-oregon-dot-invests-46m-into-multimodal-transportation-projects-under-connect-oregon/>)

Arizona DOT submits application for I-10 project federal grant → (<https://transportationtodaynews.com/news/26753-arizona-dot-submits-application-for-i-10-project-federal-grant/>)

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Appendix H

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NCDOT prepares for hurricane season

05/23/2022 by [Staff Report](https://coastalreview.org/author/staffreport/) (<https://coastalreview.org/author/staffreport/>)



This stream gauge over the Neuse River on N.C. 42 in Johnston County is one of several the NCDOT will rely on to gather data for a new early flood-warning system. Photo: NCDOT

North Carolina State University and the National Hurricane Center researchers are predicting this year's hurricane season, which begins June 1, to be above-average and North Carolina Department of Transportation officials are taking steps to prepare.

The department has a new system that will allow officials, for the first time, to analyze, map and communicate in real time any flood risks to roads, bridges and culverts, the state announced Monday.

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The advanced flood-warning system relies on a network of 400 river and stream gauges and will help NCDOT maintenance staff respond to flooded roads and washed-out culverts. The system also will benefit local emergency management officials and the public using the department's [DriveNC.gov](https://drivenc.gov/) (<https://drivenc.gov/>) website for weather-related closures.

One part of the new early flood-warning system covers almost 3,000 miles of state-maintained roads, mostly east of Interstate 95. The system also will allow NCDOT to monitor flood conditions for around 15,000 bridges and culverts statewide.

"This state-of-the-art warning system our department has created will help us be better prepared for the next major storm," Transportation Secretary Eric Boyette said in a statement. "Even though we've had some quiet hurricane seasons recently, we cannot let our guard down."

Hurricane Florence was the last major storm to impact the state's road network. After the storm hit in 2018, North Carolina Legislature gave NCDOT a \$2 million grant to develop software and install more flood gauges.

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PBS North Carolina's **State of Change** initiative examines the impact of climate change on coastal and inland communities across the state and how communities

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The system uses information collected by existing gauges operated by other agencies, such as the North Carolina Emergency Management and the U.S. Geological Survey.

The system includes an interactive online dashboard and flood mapping based on three-dimensional ground surveys. The agency's Hydraulics Unit has been fine-tuning the system and training staff on it with smaller storms over the past year.

The state agency recently has formed a partnership with the University of North Carolina Chapel Hill's Renaissance Computing Institute and the U.S. Department of Homeland Security's Coastal Resilience Center of Excellence to receive forecast modeling data on how storm surge may affect the state's road network in coastal areas.

NCDOT also has been preparing for the hurricane season by reviewing procedures and conducting exercises internally and with partner agencies.

Some highway divisions with coastal counties held employee training events this spring to review response and recovery operations. All of the agency's 14 highway divisions have been taking inventory of supplies, doing maintenance on chainsaws and other equipment, and readying emergency on-call contracts that will supplement what NCDOT employees do in responding to a storm.

State transportation officials remind residents that now is the time to prepare supplies for the possibility of an extended power outage, restricted traveling, or the need to be at a shelter. The state Emergency Management maintains a [comprehensive list](https://www.readync.gov/plan-and-prepare/get-kit) (<https://www.readync.gov/plan-and-prepare/get-kit>) of items to include in an emergency supply kit.

After a storm passes, people should remember to never drive through flooded waters or around barricades. It only takes a foot of water to sweep a vehicle away, officials said.

For more preparation tips, including evacuation routes and evacuation zones by coastal county, visit ReadyNC.org and also watch this [short video](https://www.youtube.com/watch?v=TV2DmirDW68) (<https://www.youtube.com/watch?v=TV2DmirDW68>) on how to prepare for severe weather.

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About Staff Report

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Appendix I

April 14, 2023

1:08 pm » AASHTO Offers Comments on Two Proposed Regulations

[\(https://aashtojournal.org/\)](https://aashtojournal.org/)

The North Carolina Department of Transportation recently activated a new flood-warning system that relies on a network of 400 river and stream gauges to help analyze, map, and communicate in real-time any flood risks to roads, bridges, and culverts.

[Above photo by NCDOT]

This critical information goes to NCDOT maintenance staff responding to flooded roads and washed-out culverts yet also benefits local emergency management officials and the public accessing the department's DriveNC.gov website for timely weather-related closures.

"This state-of-the-art warning system our department has created will help us be better prepared for the next major storm," explained Eric Boyette, NCDOT secretary, in a statement (<https://www.ncdot.gov/news/press-releases/Pages/2022/2022-05-23-early-flood-warning->



system.aspx). “Even though we’ve had some quiet hurricane seasons recently, we cannot let our guard down.”

[Editor’s note: The latest episode of the American Association of State Highway and Transportation Officials “2 Minute State DOT Update” video series profiles NCDOT’s workforce diversity efforts.]

2 Min. Update - Featuring Eric Boyette, Secretary of NCDOT



The damage to North Carolina’s road network caused by Hurricane Florence in 2018 spurred the development of this new flood-warning system, NCDOT noted.

Following Hurricane Florence, the state legislature gave NCDOT a \$2 million grant to develop sophisticated software and install more flood gauges. The new system, however, mostly taps into existing gauges operated by other agencies, such as the North Carolina Emergency Management and the U.S. Geological Survey, and includes an interactive online dashboard and flood mapping based on three-dimensional ground surveys.

One part of the new early flood-warning system covers almost 3,000 miles of state-maintained roads, mostly east of Interstate 95 – allowing NCDOT to monitor flood conditions for some 15,000 bridges and culverts statewide.

The agency’s Hydraulics Unit has been fine-tuning the system and training staff on it with smaller storms over the past year.



In addition, the NCDOT has formed a recent partnership with the University of North Carolina at Chapel Hill's Renaissance Computing Institute and the U.S. Department of Homeland Security's Coastal Resilience Center of Excellence to receive forecast modeling data on how storm surge may affect the state's road network in coastal areas.

052722 ([HTTPS://AASHTOJOURNAL.ORG/TAG/052722/](https://aashtojournal.org/tag/052722/))



Photo by the NCDOT

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Appendix J



NORTH CAROLINA NEWS

NCDOT invests in early-flood warning system for roads, bridges

NCDOT. This stream gauge over the Neuse River on N.C. 42 in Johnston County is one of several the NCDOT will rely on to gather data for a new early food-warning...
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by: [Judith Retana](#)
Posted: May 23, 2022 / 05:28 PM EDT
Updated: May 23, 2022 / 05:28 PM EDT

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RALEIGH, N.C. (WNCN) – Flash flood warnings were in effect for several parts of North Carolina on Monday evening. Now, thanks to a network of 400 river and stream gauges, it will be much easier for the N.C. Department of Transportation to know where flooding is expected.

NCDOT said these gauges will allow them to analyze, map and communicate flood risks to roads, bridges and culverts in real-time. The system covers almost 3,000 miles of state-maintained roads and can monitor flood conditions for 15,000 bridges and culverts statewide, NCDOT said.

Information collected from the early notification system will go to maintenance staff responding to flooded roads and washed-out culverts. NCDOT said it will benefit local emergency management officials and the public who can access the department’s [DriveNC.gov](#) website for timely weather-related closures.

“This state-of-the-art warning system our department has created will help us be better prepared for the next major storm,” Transportation Secretary Eric Boyette said in a statement.



Appendix K



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HURRICANE

Here's how North Carolina is tracking heavy rainfall coming in from Hurricane Ian

The system uses hundreds of flood gauges to detect when water is approaching road levels.



Author: Julia Kauffman

Published: 9:02 PM EDT September 29, 2022

Updated: 9:33 PM EDT September 29, 2022



CHARLOTTE, N.C. — [The North Carolina Department of Transportation \(NCDOT\)](#) is using an early flood-detection system during a hurricane for the first time. The new software was installed in May 2022 and transportation officials said it could help save lives.

With heavy rain, even small creeks can flood streets, which causes danger for drivers.



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"You should be very cautious and approach roads carefully if you see water on the road and maybe don't even go in it at all," urged NCDOT spokesperson Andrew Barksdale.

Barksdale explained that after Hurricane Florence wreaked havoc on roads in 2018, NCDOT was tasked with creating a gauge system to detect flooding and unsafe conditions.

"It took two or three years to develop this system," said Barksdale, adding that they use a lot of existing stream and river gauges that were installed by other agencies, like the [United States Geological Survey](#).



RELATED: [Why floodwaters can be dangerous, especially in the wake of a hurricane](#)

The gauges measure a creek or stream that runs near a roadway and then send updates to NCDOT every 15 minutes. Barksdale said the information helps the agency deploy resources, like barricades and maintenance crews, more quickly and efficiently to areas of concern.

All 469 gauges across the state can be seen on an online, [live-updated map](#). If a gauge detects rising or receding water, an upward or downward arrow will appear on the online marker. The color of the virtual marker signifies the level of flooding.



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A key part to preventing flooded roads starts at the lakes. [Duke Energy](#) told [WCNC Charlotte](#) it's lowering lake levels to make room for the rush of rain headed to the Carolinas.

RELATED: ['Friday is going to be absolutely ugly': Brad Panovich details Ian's impacts in Charlotte](#)

"As much water that we can put in the lakes and not in the streets – that's good for us," said Rand Wheelless with Duke Energy.

NCDOT will be posting updates on flooded roads and closures throughout the storm system [online](#).



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Contact Julia Kauffman at jkauffman@wcnc.com and follow her on [Facebook](#), [Twitter](#) and [Instagram](#).

Appendix L

<https://www.charlotteobserver.com/news/state/north-carolina/article266421251.html>

Remnants of Hurricane Ian will test NCDOT's new flood early-warning system for roads

Richard Stradling The Charlotte Observer

Sep 27, 2022

The remnants of Hurricane Ian are expected to provide the first real test for the state's new flood early-warning system for roads, bridges and culverts.

The N.C. Department of Transportation and the state Division of Emergency Management have developed systems that use about 400 stream gauges, rainfall data, software and computer models to show where road flooding is likely to happen in advance and to monitor flood waters at key locations in real time.

NCDOT will use the information internally to decide where and when to close roads and to alert first responders and the public, said spokesman Andrew Barksdale.

"It's just a lot more data at our fingertips so we can make decisions and deploy resources more efficiently and ultimately save lives," Barksdale said.

NCDOT won't rely on gauges alone to determine when to close a road, but the system will help the department decide where to send people and equipment. NCDOT will still count on its employees or local authorities to confirm that a road or bridge is flooding before broadcasting it on social media or **drivenc.gov/**, the department's statewide traffic management system.

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Still, the data should help NCDOT get closure information out faster, Barksdale said.

NCDOT and Emergency Management put the new system in place last spring but haven't seen how it works in a big storm yet. Hurricane Ian is expected to slam the Florida Gulf Coast starting Wednesday, then weaken as it moves north through Georgia into the Carolinas.

Forecasters expect the storm will bring potentially flooding rains to North Carolina on Friday into Saturday. The storm's exact track and intensity remain uncertain, but forecasters say anywhere from 2 to 7 inches of rain are possible in central and eastern North Carolina.

The early-warning system for roads is similar to the **Flood Inundation Mapping and Alert Network or FIMAN** that the state developed for buildings several years ago. FIMAN-T, as the new system is called, takes data from rain and stream gauges, folds it into models that predict flooding and then shows on maps what's expected to happen on the state's streets and highways. The system covers about 3,000 miles of road so far, mostly east of the Triangle, but will grow as more gauges are installed.

NCDOT and Emergency Management also have developed a system that monitors rainfall data generated by National Weather Service radar. The system alerts NCDOT when the volume and intensity of rain reaches levels that historically cause flooding at particular bridges and culverts, helping the department prioritize which ones to monitor and potentially close.

That part of the system allows NCDOT to monitor potential flooding at about 4,000 bridges and culverts statewide, Barksdale said.

Appendix M

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wfdd



warning system for roads

10:31AM MAY 25, 2022

by Neal Charnoff

#NCDOT #NORTH CAROLINA DEPARTMENT OF TRANSPORTATION #HURRICANE
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This stream gauge over the Neuse River on N.C. 42 in Johnston County is one of several the NCDOT will rely on to gather data for a new early flood-warning system. Photo courtesy of NCDOT.

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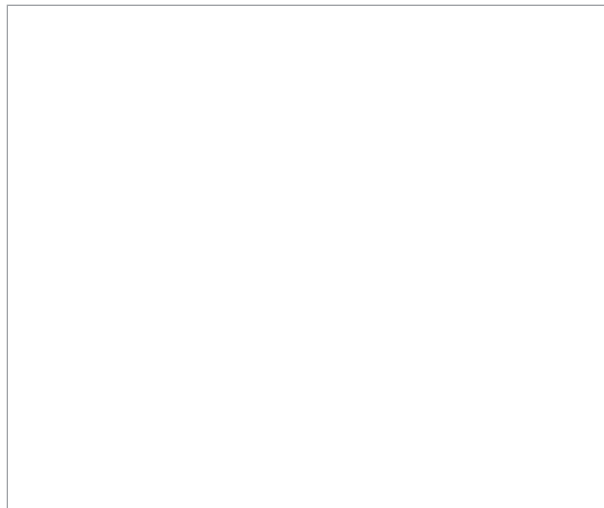
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Matt Lauffer is an NCDOT engineer. He says the state will benefit from inter-agency cooperation that will ensure safer outcomes during major storms.

"I think the great part of the story is it's a partnership, right, it's a partnership with Emergency Management as well as DOT, so you've got two cabinet agencies working well together," says Lauffer.

The NCDOT will also work with UNC-Chapel Hill and the U.S. Department of Homeland Security to analyze forecast modeling data on how storm surge may affect coastal areas.



Appendix N

ADVERTISEMENT

New early flood-warning system developed to protect drivers



Stream gauge over the Neuse River on N.C. 42 in Johnston County (NCDOT)

By WITN Web Team

Published: May. 23, 2022 at 10:35 AM EDT



RALEIGH, N.C. (WITN) - North Carolina Department of Transportation has created a new early flood-warning system for roads.

The new system will allow the NCDOT for the first time to analyze, map, and communicate in real-time any flood risks to roads, bridges, and culverts. The advanced system relies on a network of 400 river and stream gauges.

This critical information will go to DOT maintenance staff responding to flooded roads and washed-out culverts, and it will benefit local emergency management officials and the public accessing the department’s [DriveNC.gov](#) website for timely weather-related closures.

“This state-of-the-art warning system our department has created will help us be better prepared for the next major storm,” Transportation Secretary Eric Boyette said. “Even though we’ve had some quiet hurricane seasons recently, we cannot let our guard down.”

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