



Natural Resources

Addresses the restoration of landscapes, dams/dikes/levees, and waste clean-up

1. Summary

The following is the documentation of the methodology used to estimate natural resource damage and needs due to Hurricane Florence.

Preliminary estimates are based on early reports from affected entities and costs associated with similar damages during prior storms. Inspections and damage assessments are ongoing. Total impact is estimated at be at least \$554.4 million. \$119.6 million is expected to be covered by Federal, Private, and State sources of funding, resulting in a potential unmet natural resource need of \$434.8 million.

Preliminary Damage & Need Estimate (Millions)							
Category	Direct	Indirect/ Induced ¹	Total Impact	Expected Funding		Appro- priated	Unmet Impact
				Federal	Private	State	
Hazardous waste/ Waste management	\$3.0	\$0.0	\$3.0	\$0.0	\$0.0	-	\$3.0
Dredging ²	\$89.8	\$0.0	\$89.8	\$0.0	\$0.0	-	\$89.8
Beach renourishment ²	\$287.9	\$0.0	\$287.9	\$0.0	\$0.0	-	\$287.9
Dams, dikes, & levees	\$29.2	\$0.0	\$29.2	\$0.0	\$29.2	-	\$0.0
FEMA Public Assistance	\$0.0	\$0.0	\$0.0	\$66.5	\$0.0	-	\$0.0
Subtotal	\$409.9	\$0.0	\$409.9	\$66.5	\$29.2	-	\$314.2
Resiliency - Lumberton	\$0.0	\$0.0	\$14.0	\$0.0	\$0.0	-	\$14.0
Resiliency - Other	\$0.0	\$0.0	\$130.5	\$0.0	\$0.0	-	\$130.5
State appropriations ³	-	-	-	-	-	\$23.9	
Total	\$409.9	\$0.0	\$554.4	\$66.5	\$29.2	\$23.9	\$434.8

1. Zero does not indicate that indirect and induced losses do not exist for these categories, only that estimates are not available.

2. Dredging and beach renourishment figures may qualify for federal funds.

3. 11% of this state funding is already allocated to this category; 89% represents a share of federal match money that has not been specified to any specific category

2. Scope

Structures in scope for natural resources estimates include:

- Hazardous waste/ Waste management
- Dredging/ Beach renourishment
- Dams, dikes, and levees

This report does not include comprehensive estimates of damages and needs related to:

- Water quality damage and testing
- Flood abatement and water quality protection measures

These needs will be evaluated in the coming months when/if further data becomes available.

3. Methodology

Hazardous waste/Waste management

- *Underground Storage Tanks (USTs):* Flood waters can cause USTs to shift, float to the ground surface or fill with water. DEQ's Division of Waste Management has not had an opportunity to verify and categorize the 78 reported UST incidents resulting from Hurricane Florence. Average costs of soil and groundwater remediation vary by incident size, scope, and location. DEQ has estimated preliminary damages of \$3.0 million based on average site costs of Hurricane Matthew UST incidents by type applied to the number of Hurricane Florence incidents reported to date.
- *Landfills:* DEQ is aware of three landfills damaged during the storm. Currently, the extent of damages to these landfills – or damages to other landfills – is unknown.
- *Hazardous Waste:* DEQ has contacted all hazardous waste sites and no releases were reported. DEQ is not aware of any damages or needs associated with hazardous waste sites due to Hurricane Florence.

Dredging/ Beach renourishment

- Dredging and beach renourishment damages and needs are \$89.8 million and \$287.9 million respectively. These estimates are based on a DEQ request to local partners in hurricane-impacted counties for dredging and beach nourishment needs due to Hurricane Florence. This survey information has not been verified and represents a preliminary estimate of damages. Some projects may also be on the current Six Year Water Resources Development plan and may already be receiving, or planned to, receive federal, state, and local funds. Engineers will need to survey and assess beach shorelines and channels for damage to understand the impacts of the hurricane – a process

that can take months. In addition, some channels that were due to be dredged were cleared by the hurricane, while others were shoaled in; this may have an off-setting effect on damages and needs.

Dams, dikes, and levees

- Ensuring the structural integrity of dams and dikes is critical to reducing the risk of life and property loss and surface and groundwater contamination that could result from dam breaches and failures. DEQ provided a preliminary estimate of \$29.2 million for damages to 19 dams. Included in this total are dam breaches at Boiling Spring Lakes and Sutton Lake, which represent an estimated \$20 million in damages. This is not a complete estimate of damages incurred, as costs due to dam and dike damages is expected to increase as DEQ continues to receive updated damage reports.
- After hurricane Matthew, the City of Lumberton identified a need for floodgates and channel drainage improvements to their levee to protect residents from repeated flooding risks. The project has not been initiated and the city experienced additional flooding in Hurricane Florence.

Items considered but limited/ incomplete information available: these needs will continue to be evaluated in the coming months when/if further data becomes available.

Water quality damage and testing

At present, estimates of water quality-related damages are unavailable. As DEQ's Recreational Water Quality Program noted in their September 11 news release: "Floodwaters and stormwater runoff can contain pollutants such as waste from septic systems, sewer line breaks, wildlife, petroleum products and other chemicals." These pollutants can affect the water quality of public water supply and private wells, as well as of rivers and the ocean.

- *Public water supply* - DEQ's Dashboard of Hurricane Florence-related incidents, last updated October 2, identified seven systems with use restriction advisories. At that time, use restrictions ranged from limited boil advisories to a complete system closure, affecting approximately 21,270 people. The needs associated with repairing physical damage to water treatment facilities are captured in the Utilities section of this report.
- *Private wells* - Wells are a primary source of drinking water for many residents in impacted counties. DHHS has requested \$60,000 for private well-water testing. However, tests have not yet been completed on private wells to assess contamination and necessary remediation. FEMA is expected to cover 75% of testing costs.
- *River and ocean water quality* - River and ocean quality have been impaired due to Hurricane Florence. Poor water quality in rivers and the ocean can create hazards for recreational and commercial use, result in fish kills and algae blooms, and degrade wetlands and wildlife habitat. Water quality damages associated with recreational and commercial activities are captured in the Business section of this report; damages associated with fish kills and wetland and habitat degradation cannot be quantified at this time.

Substantial fish kills occurred throughout the rivers of the coastal plain due to reduced dissolved oxygen levels resulting from Hurricane Florence. In some areas, fish kills are ongoing. Wildlife Resources Commission staff continue to assess the extent of the low dissolved oxygen conditions and fish kills.

Research conducted by the agency following previous hurricane-induced fish kills shows that river species richness and abundances can recover within about 3 years, but size and age structures (especially for sportfish species) recover in 5-6 years. These fish kills will alter angler practices and impact angling success; however, it is unknown if that will reduce angling effort and license sales during the recovery period. Waterbodies impacted include:

- Black River from Garland to the Cape Fear River
- Cape Fear River from Tar Heel to Southport
- Cashie River from Windsor to the mouth at Albemarle Sound
- Chowan River upstream of Winton
- Contentnea Creek downstream of Hookerton
- Greenfield Lake in Wilmington
- Lake Mattamuskeet outfall canals
- Lumber River from Lumberton into South Carolina
- Neuse River from Goldsboro to Fort Barnwell
- North River
- Northeast Cape Fear River from Kenansville to Wilmington
- Pasquotank River
- Pungo River upstream of Belhaven
- Roanoke River downstream of Highway 45 to the mouth at Albemarle Sound
- South River from Garland to the Black River
- Sutton Lake near Wilmington
- Trent River from Pleasant Hill downstream to the mouth at New Bern
- Waccamaw River from the headwaters into South Carolina
- White Oak River from the headwaters to Stella

Flood abatement and water quality protection measures

- *Stormwater control measures* - Stormwater control measures slow down and filter the flow of polluted runoff from impervious surfaces after storm events. Examples include bioretention cells, infiltration systems, permeable pavement, sand filters, and green roofs. Data on damages to existing stormwater control measures is unavailable at this time. Additional stormwater management planning and installation of stormwater control measures is needed to reduce downstream flooding, protect water quality, and protect receiving streams from physical damage. Several of the local resiliency plans developed post-Hurricane Matthew identify stormwater management as a priority.
- *Conservation measures for water management* - Conservation measures such as restoring and protecting wetlands, streams, and riparian buffers and

protecting natural shorelines provide natural flood protection and reduce erosion. In addition to their storm damage mitigation benefits, healthy wetlands, streams, and shorelines perform important water quality protection and groundwater recharge functions, provide wildlife and fishery habitats, and support both recreational and commercial uses.

An estimate of damage to these natural areas due to Hurricane Florence cannot be determined at this time. The geographic extent of the damages will not be known until on-ground assessments or new LIDAR data are available. Additional protection and restoration efforts would improve the state's resilience in future storm events.

4. Assumptions

- Due to lack of verified damage assessments for most of the natural resource areas, most of these estimates rely on unverified incident counts, incomplete information on the extent of the damages, and average repair or remediation costs from prior hurricane incidents. Specific assumptions not outlined in the methodology descriptions are explained below.
- Dredging and beach renourishment projects are assumed to require a specific request for funding from the Federal government. Historically, the federal government may require a match of up to 25% of project costs from non-federal partners. The non-federal match may be up to up to 35% for beach renourishment projects. Federal projects that are not already designated as a federal project (not currently receiving federal funding) could potentially be eligible for FEMA Public Assistance funds. Federal projects that are designated as a federal project could be funded through supplemental appropriations through the US Army Corp of Engineers.
- There is no federal funding for the reconstruction of privately owned dams.

5. Primary data sources

- Department of Environmental Quality (DEQ)
- Department of Health and Human Services (DHHS)
- Division of Emergency Management (DEM)

6. Potential Source of Funding for Unmet Impact

Federal

- Dredging and Beach Nourishment: Typically, some federal funding for disaster response is made available to cover total project costs for dredging and, potentially, beach nourishment. FEMA Public Assistance funds may also be available for projects, as well as funding from the US Army Corps of Engineers described below. It remains to be seen what this level of funding will be, although it is typically 50% for beach renourishment and 75% for dredging projects.

- The US Department of Commerce can provide assistance for coastal resource restoration (such as habitat improvement and oyster reef repair), research, and data collection when a fishery failure has occurred. The Governor must request a fishery failure determination from the US Secretary of Commerce. Funding is dependent upon the Secretary's determination and Congressional appropriations.
- FEMA Public Assistance funds may be available for natural resource-related needs. OSBM estimates \$66.5 million in federal FEMA funds may be allocated to North Carolina with a state matching requirement of \$22.2 million for a total of \$88.7 million.
- FEMA Hazard Mitigation funds may be available for natural resource-related needs. OSBM estimates \$30.9 million in federal FEMA funds may be allocated to North Carolina with a state matching requirement of \$10.3 million for a total of \$41.2 million. These funds are not currently included in the federal funding estimate, as on-the-ground Hazard Mitigation estimates are yet to be completed.
- DEQ expects FEMA funding, through US EPA Region 4, for conducting assessment and field responses to actual or threatened hazardous material releases and oil discharges in counties impacted by Hurricane Florence. These funds would require a 25% state match.
- The U.S. Army Corps of Engineers (USACE) supports states by assessing, funding, and constructing various types of public engineering projects to mitigate and prevent flood damage. Many of their projects are applicable to the natural resources damage suffered from Hurricane Florence, including:
 - Coastal Storm Damage Reduction and Shore Protection: Beach erosion and dredging projects. North Carolina may receive \$380.0 in USACE funding for projects to restore its coastline.
 - Emergency Stream Bank and Shore Protection: Constructs stream bank protection works to protect highways, bridges, and non-profit public services. Based on damage caused by river and stream flooding during Hurricane Florence, North Carolina may receive \$100.0 in USACE funding for these projects.
 - Flood Risk Management: Funds studies and construction projects to reduce risks from coastal floods and storms. North Carolina may receive \$100.0 in USACE funding for projects to increase coastal resilience to flooding.

Private

- Private funding from dam owners, often utilities, HOAs, or individual land owners, will be required for dam repair.

7. State funding recommendations for Unmet Impact

Rebuilding - \$27 million

Dredging/ Beach Nourishment Needs Assessment – \$5.0 million

Provides funds to survey beaches and channels for hurricane-related damage and to assess disposal areas for dredged material to prepare for any future emergency and supplemental federal funding.

FEMA Match Funds – \$22.2 million

Provides the state match for FEMA public assistance funds for natural resource-related public assistance. Based on FEMA estimates as of October 5, 2018, the state is expected to receive a total of \$739 million in Public Assistance funds. Using FEMA allocations from Hurricane Matthew, \$89 million of those funds will be for natural resources projects. The expected state match need is \$22.2 million. Additionally, the State Lab of Public Health anticipates distributing 2,500 well-water testing kits to local health departments in impacted areas; each test costs \$36 to test. DHHS assumes two-thirds of tests will be returned for a total cost of \$60,000. FEMA is expected to cover 75% of total costs.

Resiliency - \$145 million

Clean Water Management Trust Fund (CWMTF) – \$25.0 million

Provides funds to help finance conservation and restoration projects in Hurricane Florence-impacted counties that specifically address flood abatement and surface water quality protection and improvement.

Oyster Sanctuaries & Marine Debris Clean-up – \$3.0 million

Provides funds to DEQ to support rebuilding and repopulating of oyster reefs and marine debris clean up. According to initial assessments, the oyster population is expected to suffer a substantial die-off due to storm-induced water quality issues and increased salinity. Funds may be used to build new and repair and maintain oyster sanctuaries to help restore damaged fisheries, improve water quality, clean-up marine debris, and protect the coastline.

Dam Repair Cost-Share Fund – \$5.0 million

Provides \$5 million to establish a cost-share program for the repair of dams that pose a substantial threat to the health, safety, and welfare of downstream residents and businesses. Funds may be used when dam owners do not have the immediate resources needed to protect downstream life and property.

Mapping and Modeling – \$87.5 million

Provides funds to DEM for the following studies, mapping projects, and flood mitigation studies for design permitting, and planning specifications. Preliminary estimates of construction of the flood mitigation projects, for all three river basins, would be approximately \$105 million; this estimate will be refined by the studies. Federal funding may be available to offset the cost of these projects.

Request	Description	Total Cost (\$M)
Mapping and Modeling		
Statewide Gage, Inundation Mapping and Risk Assessment	To acquire and install additional water gauges and extend flood inundation modeling and risk assessments for inclusion in the Flood Inundation Mapping and Alert Network (FIMAN) application.	\$8.3
Acquisition and Generation of High Resolution Topography and Built Environment	To generate additional LiDAR data for: real-time structural flood damage calculations, road and bridge inundation and routing, water and power infrastructure damage assessments, extended flood hazard identification, and dam breach monitoring and alert.	\$32.3
Real-Time Road Inundation Modeling, Mapping and Routing	To expand the FIMAN application to include real-time road inundation modeling, mapping and routing. In a flooding event, the state will be able to determine whether a road or bridge was closed, and time efficient routing and re-routing as flood conditions change.	\$6.0
High and Intermediate Dam Inundation, Monitoring and Alert	To install surface elevation gages at all 1,510 high and intermediate hazard dams and enable breach monitoring and alert systems.	\$4.8
Total Mapping & Modeling Costs		\$51.4
Flood Mitigation Design Specifications		
Tar River Basin Flood Mitigation Reservoirs - Feasibility Study and Design Build	To fund feasibility studies and design build planning for three proposed flood loss mitigation reservoirs in the Tar River Basin: Stony Creek Dry Reservoir; Swift Creek Dry Reservoir; and Little Fishing Creek Dry Reservoir.	\$20.7
Neuse River Basin Flood Mitigation Reservoirs - Feasibility Study and Design Build	To fund feasibility studies and design build planning for three proposed flood loss mitigation reservoirs and levee in the Neuse River Basin: Bakers Mill Dry Reservoir; Beulah Town Wet Reservoir; and Seven Springs Levee.	\$15.0
Lumber River Basin-Fair Bluff Levee - Feasibility Study and Design Build	To fund feasibility studies and design build planning for the proposed levee in the Lumber River Basin at Fair Bluff.	\$0.6
Total Flood Mitigation Design Costs		\$36.3
Total		\$87.5

FEMA Hazard Mitigation Matching Funds – \$10.3 million

Provides the state match for FEMA hazard mitigation funds to be used for natural resource-related projects. Based on FEMA estimates as of October 5, 2018, the state is expected to receive a total of \$155 million in Hazard Mitigation funds. Using FEMA allocations from Hurricane Matthew, \$30.9 million of those funds will be available for natural resources projects. The expected state match need is \$10.3 million.

Lumberton VFW Road Underpass – \$14.0 million

Provides initial funding to the City of Lumberton for the VFW Road underpass to support floodgates and channel drainage improvements to protect residents from repeated flooding risks.

8. Funding Provided in S.L. 2018-134 and S.L. 2018-136

Coastal Beach and Dredging Needs Assessment - \$2.0 million

Allocates funds to the Department of Environmental Quality, Division of Water Resources, to conduct a survey of beaches and channels for hurricane related damage and to assess disposal areas for dredged material.

Marine Debris Cleanup - \$400,000

Allocates funds to the Department of Environmental Quality, Division of Marine Fisheries, to support the North Carolina Coastal Federation's marine debris cleanup program.

Share of State Match - \$21.5 million

North Carolina has allocated \$115 million to the Hurricane Florence Disaster Relief Reserve and Fund for the required State match for various Federal funding programs. Based on the remaining match needs across categories, an estimated \$21.5 million is expected to be dedicated to Natural Resources.