

NOAA Office for Coastal Management  
NOAA Climate Resilience Regional Challenge (2023)

**NC 615**  
**Knotts Island Causeway**  
**Improvements**

<b>Funding Track</b>	<i>Track 2: Implementation of Resilience and Adaptation Actions</i>
<b>Lead Applicant</b>	<i>North Carolina Department of Transportation (NCDOT) 1 S Wilmington Street, Raleigh, NC 27699-1534</i>
<b>Project Director</b>	<i>Kevin Bowen, PE, Eastern Deputy Chief Engineer, NCDOT, 919-707-2512, 1 S Wilmington Street, Raleigh, NC 27699-1534, kgbowen@ncdot.gov</i>
<b>Federal Funding Request</b>	<i>\$30,000,000</i>
<b>Geographic Description</b>	<i>The Knotts Island Causeway spans from the Virginia/North Carolina border to Knotts Island Road in unincorporated northeastern North Carolina.</i>
<b>Participating Jurisdictions</b>	<i>NCDOT</i>
<b>Collaborators</b>	<i>NCDOT, Mackay Island National Wildlife Refuge</i>
<b>Period of Performance</b>	<i>October 1, 2024 – October 1, 2029</i>



## Resilience Vision

This causeway stabilization project supports climate change adaptation by maintaining causeway connectivity as well as preserving and enhancing the surrounding marsh wetland system. The causeway carrying NC 615 is the only means of transportation into and out of Knotts Island when the ferry is inoperable. This effort will stabilize the shoreline and move a section of the causeway to the south, closing an existing canal which is experiencing significant erosion and scour, reducing the structural stability of the existing bridge. The proposed improvements also incorporate a living shoreline to enhance wetland habitat that will protect the causeway from storm surge flooding, wave damage, erosion, and the potential impacts of sea level rise<sup>1</sup>. The result will be a roadway link with lower maintenance needs that ensures reliable vehicular access to Knott's Island by better withstanding and adapting to future climate and sea level conditions.

## Regional Context

Estuarine environments are naturally dynamic and shift with continued erosion as currents and storms slowly change the landscape. This process is complicated when hardscape structures such as roadways and bridges are introduced. Standard approaches in North Carolina to preventing erosion are shoreline stabilization methods including engineered structures using materials like riprap, sheet piling, and gray infrastructure. Vegetative solutions have also been explored and recently NCDOT has partnered with coastal communities and the [North Carolina Coastal Federation](#) to implement some Nature Based Solutions. However, the vast need for these projects in coastal North Carolina has resulted in NCDOT searching for other funding opportunities. NCDOT is very excited about the opportunity the NOAA Climate Resilience Regional Challenge presents and believes the proposed Knotts Island Causeway improvements are a great candidate for this funding.

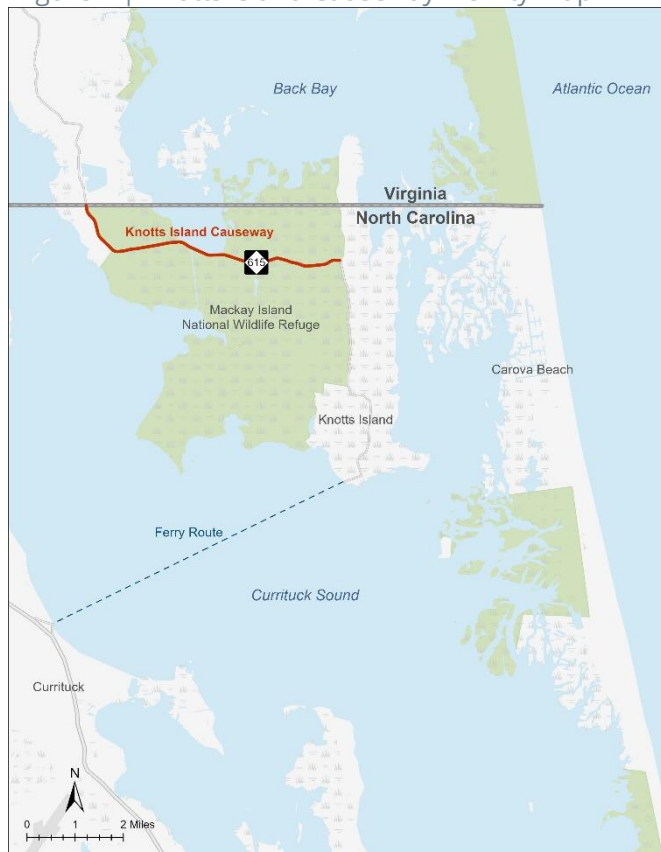
[Knotts Island](#), with population of 2000, is unique. Driving to it in Currituck County involves traveling through Virginia, or alternatively taking a 45-minute ferry from Currituck. The Knotts Island Causeway spans from the Virginia/North Carolina border to Knotts Island Road between the Currituck Sound and Back Bay. Knotts Island is home to the [Mackay](#)

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<sup>1</sup> Nature-Based Solutions for Coastal Highway Resilience - An Implementation Guide. Web. [https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing\\_and\\_current\\_research/green\\_infrastructure/implementation\\_guide/fhwahep19042.pdf](https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/green_infrastructure/implementation_guide/fhwahep19042.pdf)

[Island National Wildlife Refuge](#). This refuge consists of over 9,500 acres of habitat and is home to many threatened, endangered, and protected species, including the Bald Eagle<sup>2</sup>.

Figure 1 | Knotts Island Causeway Vicinity Map



The causeway travels over a man-made canal that's flow is determined by storm surge and wind. [Hydrodynamic Modeling and a Scour Analysis](#) have been conducted for the causeway and canal. The canal has been widening due to natural scour, which is slowly eating away at the marsh and impacting natural processes. The canal was blasted with dynamite in the 1920s. By 1936 the canal was approximately 38 feet wide and 3 feet deep and now varies between 150 and 200 feet wide. The bridge has been identified as in need of replacement after only fifteen years due to extreme erosion and scour. There is a 40-foot-deep scour hole under the bridge, which is only expected to grow as water continues to move through the canal at high velocities. These scour depths destabilize the bridge

foundation and channel banks rendering bridge replacement non-viable. Figures 2 and 3 illustrate canal widening between 1961 and present day.

To assess the complicated hydraulic interactions of Corey's Ditch, Back Bay, and Currituck Sound, NCDOT worked with Coastal and Hydraulic Engineering firms to perform hydrodynamic modeling in accordance with [HEC 25, Highways in the Coastal Environment - 3rd Edition - Federal Highway Administration \(FHWA\)](#). To assess hurricane and higher frequency storm event water surface elevations and wave heights, simulations with [Mike 21 HD and SW](#) were conducted with and without sea level rise. The Mike model was also used to set the boundary conditions for the [SRH2D](#) model used to predict scour conditions in Corey's Ditch. The state-of-the-art model results, calibrated to Virginia Beach, are being used to provide information for alternatives analysis, design considerations, and stake

<sup>2</sup> Mackay Island National Refuge. Web. <https://www.fws.gov/refuge/mackay-island>

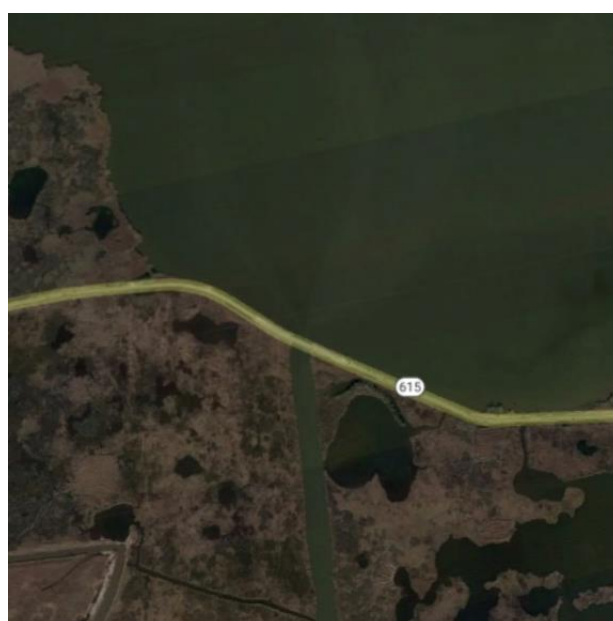
holder interaction. More information about this can be found on the [supplemental material website](#).

As previously mentioned, the causeway is the only access to Knotts Island when the ferry, which can carry up to 20 vehicles, is down due to weather conditions, lack of staffing, mechanical problems, or compliance issues, among other things. Ferry closure can be sudden and unpredictable and can result in a 30-to-40-minute commute increase. In total, the ferry has missed 2,961 runs between 2019 and June 2023 according to the North Carolina Ferry Division. This can impact emergency extraction. If the ferry and causeway were closed at the same time, the remaining emergency evacuation option would be by helicopter. This is cause for concern as the causeway suffers from inundation vulnerability.

Figure 2 | Knotts Island Causeway Canal 1961



Figure 3 | Knotts Island Causeway Canal 2023



Many local community members have expressed concerns about the causeway and its condition. NCDOT has held several scoping meetings with various resource agencies, such as the NOAA Office for Coastal Management, the US Army Corps of Engineers, and the US Fish and Wildlife Service to discuss various options. NCDOT is currently weighing several alternatives to address these concerns, including moving the causeway to the south, installing a living shoreline, and closing the canal.

## Proposed Activities & Outcomes

Several alternatives are being considered to address site challenges and a preferred alternative will be selected before the February 2024 due date. Anticipated improvements to be implemented along this causeway include installation of living shoreline along the north side of the causeway, installation of new causeway to the south, and a closure structure made of riprap up to the elevation of the causeway at the south end of the canal as shown in Figure 4.

Figure 4 | Proposed Knotts Island Causeway Improvements



Referencing resources from the US Army Corps of Engineers' (USACE) [Engineering with Nature](#) and FHWA's [Nature-Based Solutions for Coastal Highway Resilience - An Implementation Guide](#), living shoreline will utilize green infrastructure to create new habitat along the causeway that serves as a buffer in storm events. Figure 5 is from the 1,000-foot living shoreline completed on NC 24 in Carteret County by NCDOT and NCCF and is a good indication of what the living shoreline could look like and NCDOT's ability to successfully deliver.

The closure of the canal and installation of living shoreline will improve existing habitat and create new habitat for wildlife, benefiting the National Wildlife

Refuge. The installation of causeway rather than a bridge will eliminate bridge maintenance and future bridge replacements and reduce associated future maintenance costs.

The Knotts Island Causeway Improvements will have positive benefits on disadvantaged communities in the surrounding area. Currituck County and Virginia Beach contain Justice 40 and EPA IRA Disadvantaged Communities according to the Environmental Protection Agency's (EPA) [Environmental Justice Screening and Mapping Tool](#). While the causeway itself is not within the disadvantaged communities, not all impacts conform to these boundaries. Those that live in the disadvantaged communities visit and/or work on Knotts Island and will be benefited by resilient infrastructure, especially when emergency services are needed or when preparing for and recovering from storm events.

Figure 5 | NC-24 Causeway Living Shoreline



This project will require a Coastal Area Management Act (CAMA) Major Permit, as well as an Individual Section 404 permit with the US Army Corps of Engineers, and likely a National Wildlife Refuge Special Use Permit. NCDOT will engage with the public and a variety of stakeholders in accordance with its [Statewide Public Involvement Plan](#).

## Budget Summary

These are planning level estimates, and final recommendations could involve alternative variations not represented here. NCDOT is currently identifying a preferred alternative for the causeway and will update cost estimates in January 2024. For the purposes of establishing this grant request amount, the cost estimate below was developed.

Table 1 | Knotts Island Causeway Improvements Cost Estimate

Activity	Cost
Living Shoreline	\$8,000,000
New Causeway/Closure Structure	12,000,000
<b>Subtotal</b>	<b>\$20,000,000</b>
Contingency (50%)	\$10,000,000
<b>Final Total</b>	<b>\$30,000,000</b>