

Investigating the Efficacy of Natural and Nature-based Features to Increase the Service Life of Coastal Roadways

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22GTLU25

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Lead Institution:

Louisiana State University

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Tran-SET

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\$ 120,000



Evaluating the efficacy of natural and nature-based features

Seven of the top ten costliest U.S. natural disasters are coastal events, with hurricanes alone causing \$23.5 billion in damage annually to infrastructure. Moreover, rising sea levels will amplify transportation infrastructure vulnerability to coastal storms, nuisance flooding, and wave actions, especially towards pavement infrastructure which are critical based on the mileage of the intermodal transportation network that connects communities, waterways, ports, and rail. To protect pavement infrastructure from flooding, the state-of-practice involves hard (grey) structures, raising roadway elevations, reinforcing infrastructure, and relocating roadways further inland. In the last decade, NOAA and USACE led an initiative to explore the design and integration of natural and nature-based features (NNBFs) in increasing the resilience of coastal communities while providing ecosystem benefits. Natural features are existing ecosystems that include coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, forests, coastal rivers and floodplains, and barrier islands that provide multiple benefits to communities, such as storm protection through wave attenuation or flood storage capacity and enhanced water services and security. In recent years, the FHWA also began exploring NNBFs as innovative green infrastructure to protect coastal highways, starting with an implementation guide and pilot studies. Before NNBFs can be effectively transferred into practice in Louisiana, there is an important need to establish the level of flood protection and economic metrics to compare NNBFs and grey infrastructure; and to assess the long-term efficacy of NNBFs to protect transportation infrastructure under a range of flooding scenarios. The objective of this research project is to establish the level of flood protection and economic metrics to compare natural and nature-based features (NNBFs) and grey infrastructure; and to assess the long-term efficacy of NNBFs to protect transportation infrastructure under a range of flooding scenarios.

Problem Statement

Seven of the top ten costliest U.S. natural disasters are coastal events, with hurricanes alone causing

\$23.5 billion in damage annually to infrastructure. Moreover, rising sea levels will amplify transportation infrastructure vulnerability to coastal storms, nuisance flooding, and wave actions, especially towards pavement infrastructure which are critical based on the mileage of the intermodal transportation network that connects communities, waterways, ports, and rail. To protect pavement infrastructure from flooding, the state-of-practice involves hard (grey) structures, raising roadway elevations, reinforcing infrastructure, and relocating roadways further inland. In the last decade, federal agencies such as NOAA, FHWA, and USACE have led an initiative to explore the design and integration of natural and nature-based features (NNBFs) in increasing the resilience of transportation infrastructure while providing ecosystem benefits. Natural features are existing ecosystems that include coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, forests, coastal rivers and floodplains, and barrier islands that provide multiple benefits to communities, such as storm protection through wave attenuation or flood storage capacity and enhanced water services and security. In recent years, the FHWA also began exploring NNBFs as innovative green infrastructure to protect coastal highways, starting with an implementation guide and pilot studies. Before NNBFs can be effectively transferred into practice in Louisiana, there is an important need to establish the level of flood protection and economic metrics to compare NNBFs and grey infrastructure; and to assess the long-term efficacy of NNBFs to protect transportation infrastructure under a range of flooding scenarios.

Objectives

The objectives of this research project are to (1) evaluate the damage to transportation infrastructure after Hurricane Ida, (2) evaluate the efficacy of grey infrastructure and NNBFs to provide hurricane surge and wave protection, and

(3) quantify the potential economic benefits of NNBFs to its resiliency towards extreme events.



Figure 1. Overview of Natural and Nature-based Features (NNBFs) along Highway 1.

Intended Implementation of Research

Workforce Development, Education, and Outreach: State DOTs spend significant effort (time and expenses) to continually obtain information regarding the current state of structures and population during a natural disaster. The procedures and methodologies stated in this research will aid these agencies to obtain the required information more efficiently. Dr. Jafari has participated in outreach activities at LA Sea Grant Ocean Commotion Marsh Maneuvers and LSU's College of Engineering. Through this research, Dr. Jafari will develop a classroom and outreach demonstration that will allow students to envision the effect of natural disasters on infrastructure and how civil engineers respond to rehabilitate our infrastructure.

Anticipated Impacts/Benefits of Implementation

The benefit to DOTs is more sustainable and resilience transportation systems.

Web links

- Tran-SET's website
<https://transet.lsu.edu/research-in-progress/>

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit [our website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.

