Taking the High Road:
Strengthening Coastal Flood Resilience of Transportation Infrastructure || More here

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Read Ahead Material

The Nicholas Institute for Environmental Policy Solutions of Duke University, the Coastal Flood Resilience Project, and the Resilience Roadmap are sponsoring a webinar to review challenges and opportunities related to strengthening coastal flood resilience of transportation infrastructure. This read ahead document provides background information on coastal flood and sea level rise risks, examples of transportation agency work to address these risks, and questions to be addressed in the webinar. It will be helpful to review prior to attending the webinar.

Introduction

Two recent events emphasize the importance of strengthening coastal flood resilience of transportation infrastructure in the United States. First, in November of last year, Congress enacted major bipartisan infrastructure legislation, significantly increasing funding for new and upgraded transportation infrastructure. Then, in February of this year, NOAA published updated information about projected coastal flooding and sea level rise providing estimates of rising sea levels by 2050, 2100 and 2150. Some forty percent of Americans live in coastal counties, and as a result much of the transportation infrastructure funding will be in places that are at risk of flooding from coastal storms and rising sea levels.

With major new investments in transportation infrastructure, it is more important than ever to consider coastal flood risks in the siting and design of these projects. Federal and state transportation agencies and transportation stakeholders are increasingly recognizing that climate change is driving both more severe coastal storm surges and higher sea levels. Although attention to coastal flood risks to transportation assets is increasing, the policies, programs, and practices that address these risks can be improved.

Coastal Storm and Sea Level Rise Risks

A warming climate is increasing coastal flood risks by generating more severe coastal storm surges and driving higher sea levels. Higher sea levels cause storm surges to reach further inland but also cause permanent inundation of coastal land areas all along the coast.

More Severe Coastal Storms: Coastal storms are a risk to life and property and major storms can deliver storms surges of over fifteen feet. A warming climate is causing an increase in the number of the strongest storms. These storms bring more extensive coastal flooding, higher storm surges, and increased rainfall. Research indicates that intense storms are slowing down and thus raining on a given place for longer, generating more rainfall and flooding over a longer period of time.

Even as storms move more slowly, they intensify more rapidly, making their landfall harder to predict and more likely to result in major damage and loss of life without adaptive and resilient responses. Some storms deliver intense precipitation to inland areas that then comes downstream to worsen coastal flooding.

Steadily Rising Sea Level: The National Oceanic and Atmospheric Administration (NOAA) recently issued new estimates of future sea level rise concluding that the rate of sea level rise along the American coasts is accelerating and is likely to rise as much over the next 30 years (i.e., about 1.3 feet by 2050 in the "Intermediate" scenario) as it has over the last 100 years. Sea level rise averaging as high as 1.7 feet around the coastline is possible over this period and could reach as high as 2.2 feet in some places in the US (e.g., in the Western Gulf of Mexico).

Many Americans are already seeing that rising sea levels are causing high tides to reach further inland. In the new report on rising sea levels, NOAA looks to 2050 and sees "major and moderate high tide flood events occurring as frequently as moderate and minor high tide flood events occur today."

By the year 2100, NOAA projects sea level rise along the American coasts to average about 4 feet (in the "Intermediate" scenario) while an average increase of over 7.2 feet is possible. Sea level rise in some regions could be higher.

By 2150, NOAA forecasts average sea level rise of over 7 feet in the "Intermediate" scenario with the possibility of average increases as high as 12.8 feet. NOAA expects sea level will continue to rise for centuries after 2150.

Flood and Sea Level Rise Risks to Transportation Infrastructure

Coastal storm surge flooding and rising seas have been recognized as a risk to transportation infrastructure for some time. A 2009 report by the National Research Council looking at all climate change-related threats to the transportation system found that sea level rise, coupled with storm surges and exacerbated in some locations by land subsidence, was a top concern.

More information about different types of transportation assets affected by sea level rise is provided below.

Highways: In 2018 the fourth National Climate Assessment identified significant risks to transportation infrastructure due to storms and rising seas: "Sea level rise (SLR) is progressively making coastal roads and bridges more vulnerable and less reliable. The more than 60,000 miles of U.S. roads and bridges in coastal floodplains are clearly already vulnerable to extreme storms and hurricanes that cost billions in repairs. Higher sea levels will cause more severe flooding and more damage during coastal storms and hurricanes."

For example, in the Northeast region of the United States, increased high tide flooding is contributing to disruptions in the transportation network. The fourth National Climate Assessment reported that impacts include, "repeatedly blocked railways, flooded interstates, and halted freight movement, impacting access to critical services."

In Charleston, South Carolina, US Route 17, "currently floods more than 10 times per year and is expected to experience up to 180 floods annually by 2045, with each flood costing the city $12.5 million (in 2009 dollars)."

Experts suggest that the rate of nuisance flooding (also known as tidal flooding) has already increased and will continue to do so for the foreseeable future. Nuisance flooding currently attributes to over 100 million hours of vehicle delay annually in the United States. Under an intermediate-low sea level rise scenario, this could result in over 1 billion hours of vehicle delay by 2060.

Railways: Coastal flood risks to railways is especially serious on the Eastern Seaboard from Boston to Washington DC. In 2018, Bloomberg News reported on an internal Amtrak study that found that coastal storms and rising seas threaten to erode track, signals, power poles, and power substations and that parts of the corridor are at risk of "continual inundation." A ten-mile stretch of track around Wilmington, Delaware, is of special concern, but track along the Connecticut coast faces flood risks and, because some of these sections lack alternative routes, this flooding could result in disruption along the larger corridor. Some states, such as California, are protecting or relocating railways.

Ports: In 2014, the third National Climate Assessment reported that ports and harbors "will need to be reconfigured to accommodate higher seas." The same report pointed to the significance of ports to trade:

> "most ocean-going ports are in low-lying coastal areas, including three of the most important for imports and exports: Los Angeles/Long Beach (which handles 31% of the U.S. port container movements) and the Port of South Louisiana and the Port of Galveston/Houston (which combined handle 25% of the tonnage handled by U.S. ports)."

A recent report published by the Environmental Defense Fund discusses costs associated with elevating ports to accommodate for rising seas ranging from, "$30 million to over $200 million per km^2 of port area."

Airports: In the case of airports, the 2014 National Climate Assessment reports that "thirteen of the nation's 47 largest airports have at least one runway with an elevation within 12 feet of current sea levels…," which is "within the reach of moderate to high storm surge." Airports in the New York City area (JFK, LaGuardia, and Newark), Florida (Fort Lauderdale, Tampa, and Miami), and San Francisco area (Oakland and San Francisco) are on this list.

Addressing Flooding and Sea Level Rise Risks to Transportation Infrastructure

Federal and state transportation agencies are increasingly focusing on the risks that a climate changing climate poses for transportation infrastructure. Some of these are discussed in the section below.

Federal Agency Climate Change Adaptation Plans: The DOT Climate Action Plan for Resilience establishes an updated Climate Action Plan that focuses on actions to bolster

adaptation and increase resilience. This Plan builds from the previous Climate Action Plans prepared in 2012 and 2014 and identifies five priority actions for the Department:

- Incorporate Resilience into DOT Grant and Loan Programs;
- Enhance Resilience Throughout the Project Planning and Development Process;
- Ensure Resiliency of DOT Facilities and Operational Assets;
- Ensure Climate-ready Services and Supplies; and
- Improve Climate Education and Research on Resilience.

Infrastructure Act Authority for Resilient Transportation: The Infrastructure Investment and Jobs Act (IIJA) includes several provisions related to the resilience of transportation assets including:

- a new program "Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation" (PROTECT) to support climate resilience projects, including natural infrastructure supported by $7.3 billion in formula funding and $1.4 billion in competitive grants over five years funded from the Highway Trust Fund;
- authority to allow federal funding to be used for "protective features" designed to mitigate the risk from extreme weather events, flooding, or other natural disasters;
- authority to use up to 15% of their annual apportionment of National Highway Performance Program funding for resilience features for highways or bridges that are not part of the National Highway System;
- new funding for Transportation Resilience and Adaptation Centers of Excellence; and
- new definitions of "resilience" and "natural infrastructure".

Federal Flood Risk Management Standard: Like other federal agencies, US DOT is implementing the Federal Flood Risk Management Standard (FFRMS). The FFRMS requires that federal agencies avoid making investments in projects sited in flood risk areas or, when infrastructure must be located in a flood risk area, require elevation of the asset two feet above base flood elevation or, in the case of critical infrastructure, three feet above base flood elevation. The Flood Resilience Interagency Working Group is coordinating FFRMS with federal agencies, including DOT. This process includes integrating the new NOAA sea level rise scenarios into agency specific guidelines or regulations implementing the FFRMS.

NEPA Climate Change Guidance: Major transportation projects comply with the National Environmental Policy Act (NEPA). The Council on Environmental Quality manages implementation of NEPA and recently issued revised regulations and is planning another round of regulatory changes. In addition, in 2016, CEQ developed guidance on addressing climate change in NEPA assessments. In addition to addressing how to assess the impacts of projects on release of greenhouse gases, the guidance discussed approaches to adapt project siting and design to climate risks, including coastal flood risks. This guidance was revised in 2019 by the Trump Administration and the revised guidance was revoked by the Biden Administration in 2021. No guidance is now in effect, but CEQ is considering updates to the 2016 guidance and is expected to release new guidance later in 2022.

In a related effort, in 2021 the Transportation Research Board of the National Academies recommended that resilience of transportation projects to natural hazards and climate change impacts "should be measured and assessed using a multi-hazard, muti-step analytic process."

State Resilient Transportation Initiatives: States are also addressing climate change impacts on transportation, including risks from storm flooding and sea level rise. For example:

- California/CALTRANS has developed sea level rise "guidelines" and policies;
- the State of Rhode Island DOT is developing an Environmental Resiliency Tool that include storm flooding and sea level rise risks; and
- the State of Virginia has established design criteria for accounting for sea level rise if bridge design and are developing criteria for surface transportation.

Key Questions for Flood Resilient Coastal Transportation Infrastructure Assets

This webinar will examine the steps that governments are and could be taking to make sure that new transportation investments are resilient to risks posed by coastal storm flooding and rising sea levels. Some of the questions to be addressed in the webinar include:

- How can new authority in the Infrastructure Investment and Jobs Act related to climate resilience of transportation investments be most implemented most effectively?
- How can existing mechanisms, such as the National Environmental Policy Act and the Federal Flood Risk Management Standard, be used most effectively to reduce risk to transportation investments in coastal areas?
- Are there new approaches or tools that can strengthen resilience of transportation investments to coastal storms and rising sea levels?
- How can plans for new transportation infrastructure in coastal areas be coordinated with plans to adapt communities and ecosystems to storms and rising seas?
- What are the tools, policies, or regulations that have worked or are needed to support coastal resilience planning in transportation infrastructure?