



FHWA Climate Change Adaptation and Resiliency Initiatives

AMPO Annual Conference
Portland, OR
October 23, 2013



Three breaches in NC12 after Hurricane Irene. Credit: Tom MacKenzie, FWS



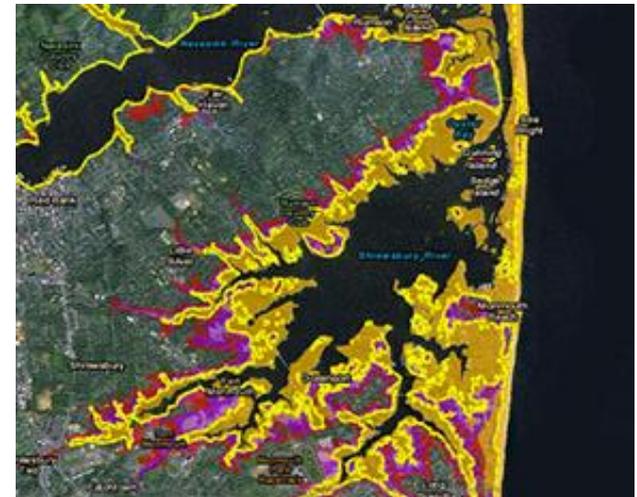
Climate Change Adaptation at FHWA

- Goal: Systematic consideration of climate change vulnerability and risk in transportation decision making, at system and project level
- Approach: Develop and share information on tools and methodologies that state DOTs and MPOs can use to assess risk and prioritize actions



President's Climate Policy

- President delivered major speech and action plan on climate change June 25, 2013.
- Actions he can take without relying on Congress
- Cut Carbon Pollution
 - New and existing power plants – EPA under Clean Air Act
 - Renewable energy on federal lands
 - Heavy duty vehicle fuel economy standards, renewable fuels standard
 - Efficiency standards for appliances
- Prepare for the Impacts of Climate Change
 - Provide tools for climate resilience to help state and local governments
 - Support climate resilient investments by removing policy barriers, ensuring federally funded projects address climate risks
 - Rebuild and learn from Superstorm Sandy
- Lead International Efforts



US DOT Policy Statement

“The United States Department of Transportation (DOT) shall integrate consideration of climate change impacts and adaptation into the planning, operations, policies, and programs of DOT in order to ensure that taxpayer resources are invested wisely and that transportation infrastructure, services and operations remain effective in current and future climate conditions.”

- June 2011

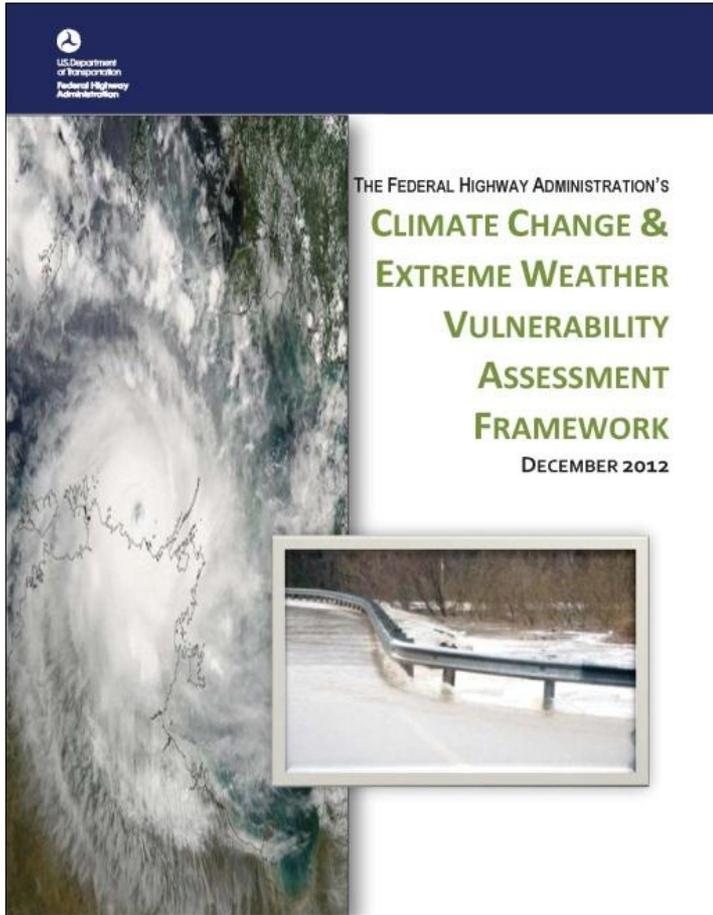


Memo on Using FHWA Highway Funds for Adaptation Work

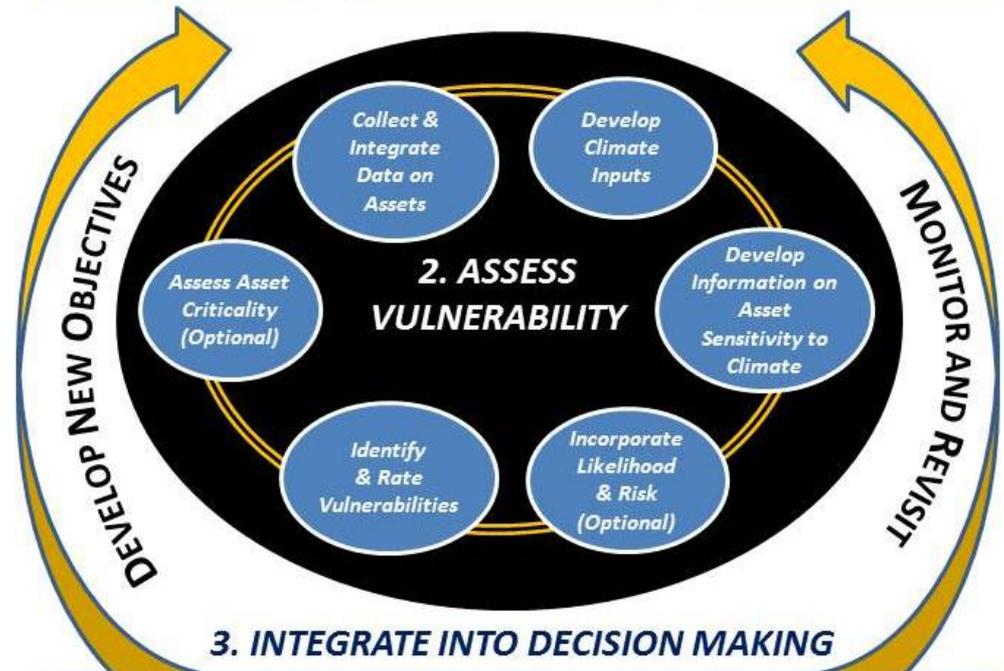
- Released September 2012
- Clarifies existing eligibility
- **Activities** to plan, design, and construct highways **to adapt** to current and future climate change and extreme weather events **are eligible** for reimbursement under the Federal-aid program and for funding under the Federal Lands program.
- Eligible Activities:
 - Vulnerability and risk assessments to climate change and extreme weather events
 - Consideration of climate change and extreme weather events in project development, environmental review and design work
 - Construction of projects or features to protect existing assets from impacts and damage
 - Evaluation of potential impacts of climate change and extreme weather events on asset management cycles, life cycle costs, etc.



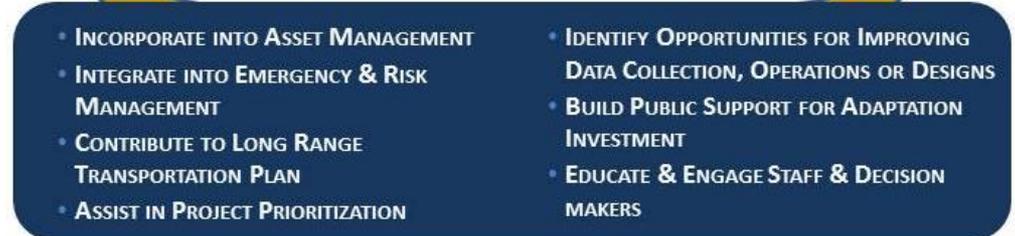
FHWA Climate Change & Extreme Weather Vulnerability Assessment Framework



1. DEFINE SCOPE

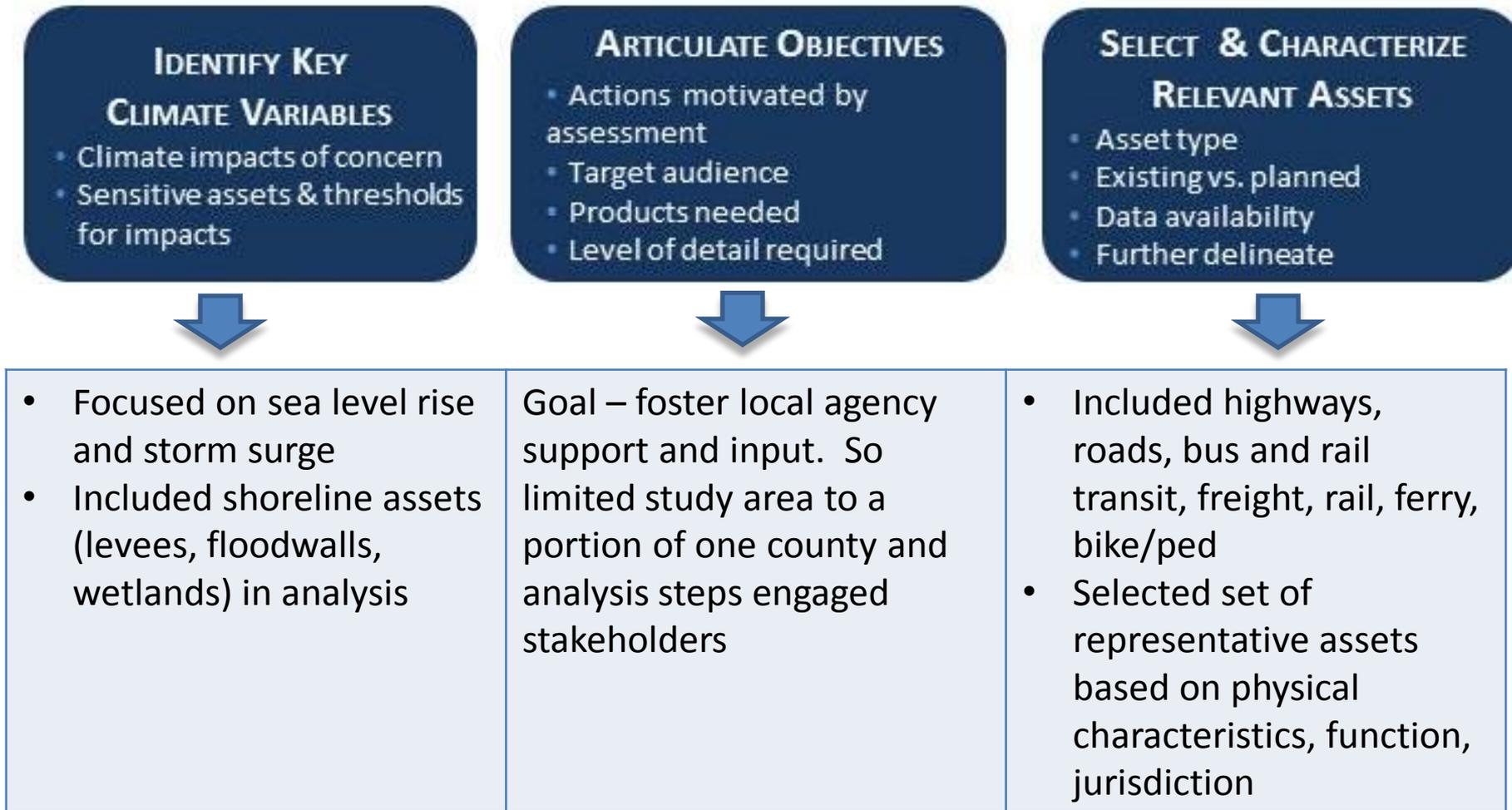


3. INTEGRATE INTO DECISION MAKING



Define Scope:

Example from MTC- San Francisco Pilot



Assessing Vulnerability: Example from Washington DOT Pilot

Used climate data from University of Washington.

Framework has suggestions on sources for climate data and interpretation.

Used a workshop-based approach to leverage knowledge of maintenance staff, engineers, etc.

Impact



10		<p>Complete Failure</p> <p>Results in total loss or ruin of asset. Asset <i>may</i> be available for <i>limited</i> use after at least 60 days and would require major repair or rebuild over an extended period of time. "Complete and/or catastrophic failure" typically involves:</p> <ul style="list-style-type: none"> ▪ Immediate road closure ▪ Travel disruptions ▪ Vehicles forced to reroute to other roads ▪ Reduced commerce in affected areas ▪ Reduced or eliminated access to some destinations <p>May sever some utilities. May damage drainage conveyance or storage systems.</p>
9		
8		
7		
6		<p>Temporary Operational Failure</p> <p>Results in minor damage and/or disruption to asset. Asset would be available with either full or limited use within 60 days. "Temporary operational failure" typically involves:</p> <ul style="list-style-type: none"> ▪ Temporary road closure, hours to weeks ▪ Reduced access to destinations served by the asset ▪ Stranded vehicles <p>Possible temporary utility failures.</p>
5		
4		
3		<p>Reduced Capacity</p> <p>Results in little or negligible impact to asset. Asset would be available with full use within 10 days and has immediate limited use still available. "Reduced capacity" typically involves:</p> <ul style="list-style-type: none"> ▪ Less convenient travel ▪ Occasional/brief lane closures, but roads remain open ▪ Some vehicles may move to alternate routes.
2		
1		

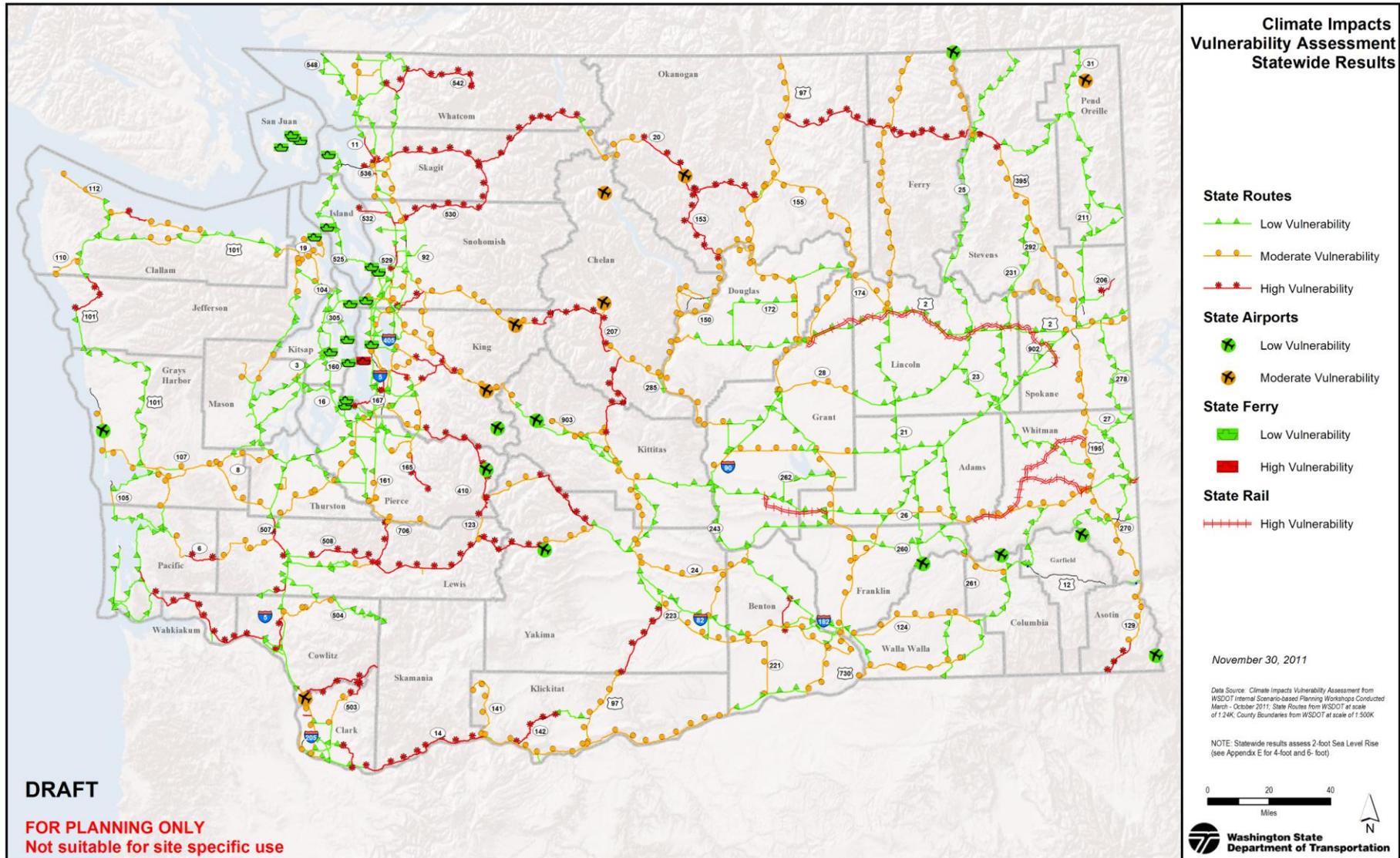
Complete Failure

Temporary Operational Failure

Reduced Capacity



Assessing Vulnerability: Example from Washington DOT Pilot

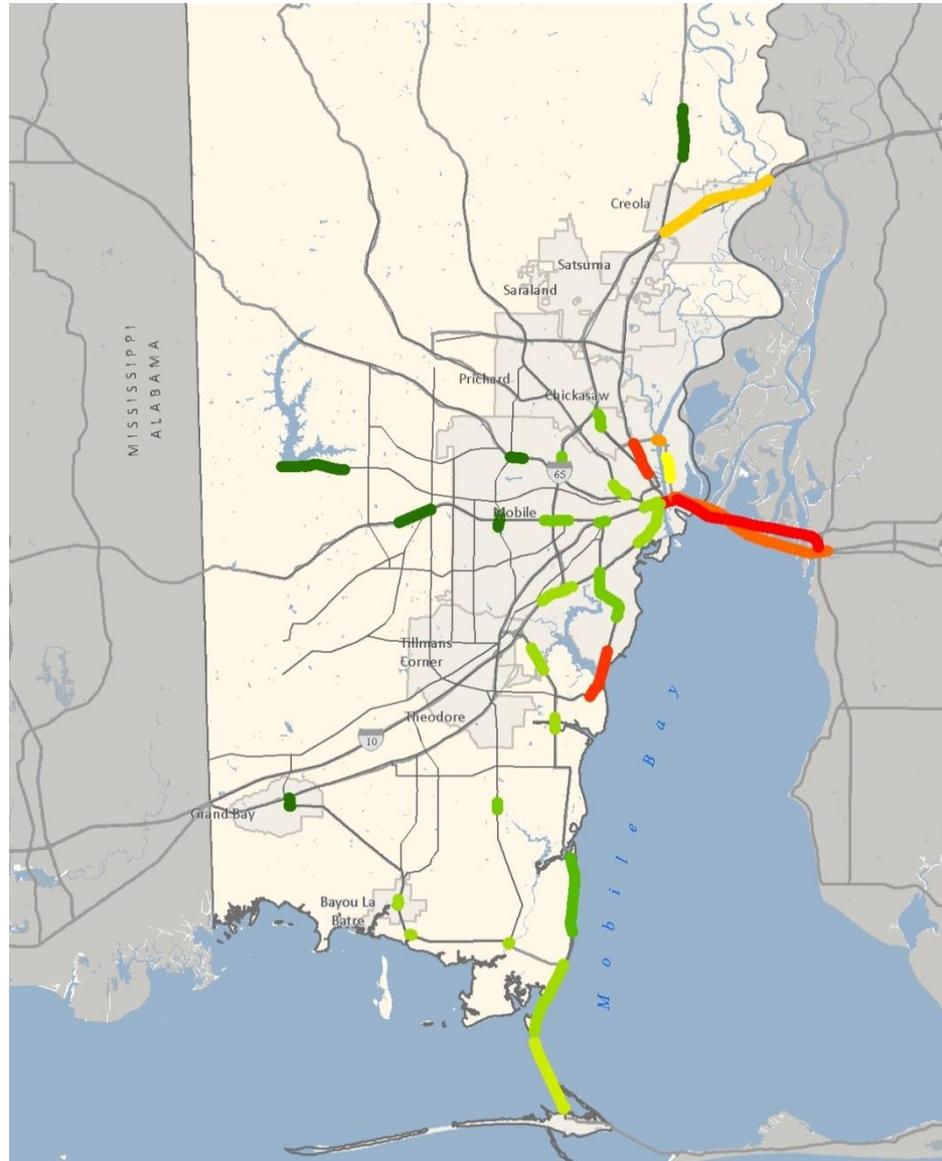
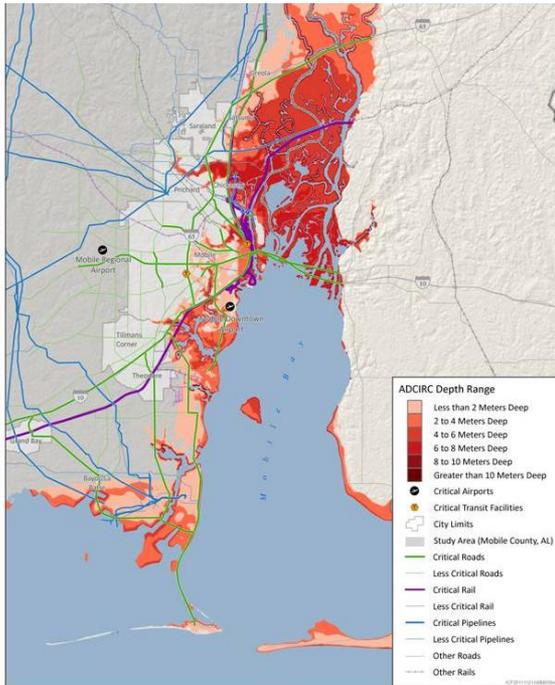


DRAFT

FOR PLANNING ONLY
Not suitable for site specific use

Assessing Vulnerability: US DOT Gulf Coast Study Phase II

Storm Scenario: Katrina
Shifted + Pressure
Reduced + 75cm SLR



Also assessed vulnerability to heat, rainfall, and wind.



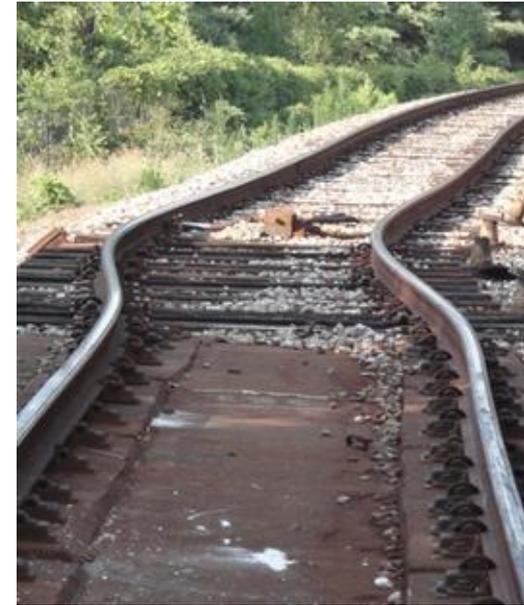
Integrating Results into Decision-making: Example from Chicago Transit Authority FTA Pilot

Calculated net present value (NPV) of adaptation options

- **Example: Rail buckling:** Curved section of Orange Line track
- **Option 1:** Improve existing track structure (e.g. tie spacing, granite ballast, drainage)
- **Option 2:** Replace existing overpass with concrete track bed
- Accounted for construction costs, repair costs, passenger time
- Varied different factors to see impact on NPV:
 - Frequency of impacts (# of rail buckling events / year)
 - Capital costs
 - Passenger time value
- Analysis showed high return on investment for both options.
- NPV positive for both, higher for option 1. Option 2 is more expensive but would mean fewer disruptions long term.

Integrating into asset management system

- Flag vulnerable assets



Heat kink de-rails DC Metro train July 6, 2012.

55 passengers evacuated, severe delays, emergency track work performed, scheduled track work cancelled.



Integrating Results into Decision-making: Example from New York City Special Initiative for Rebuilding and Resiliency

<http://www.nyc.gov/html/sirr/html/report/report.shtml>

- NYC performed risk assessment. Used data on damage from Sandy, 100yr floodplain, NYPCC climate data
- Developed 18 initiatives for transportation, in addition to coastal protection plan

Examples of initiatives

Protect assets to maintain system operations

- Reconstruct and resurface key streets damaged by Sandy to upgraded resiliency
- Elevate traffic signals & provide backup power
- Protect NYCDOT tunnels in Lower Manhattan from flooding
- Install watertight barriers to protect moveable bridge machinery

Prepare to restore service after events

- Plan temporary transit services and HOV requirements in event of subway system suspension

Increase system flexibility and redundancy

- Expand ferry services
- Expand Select Bus Service network



Credit: NYCDOT

Battery Park Underpass flooding from Hurricane Sandy



Credit: The Elizabeth River Tunnel Project

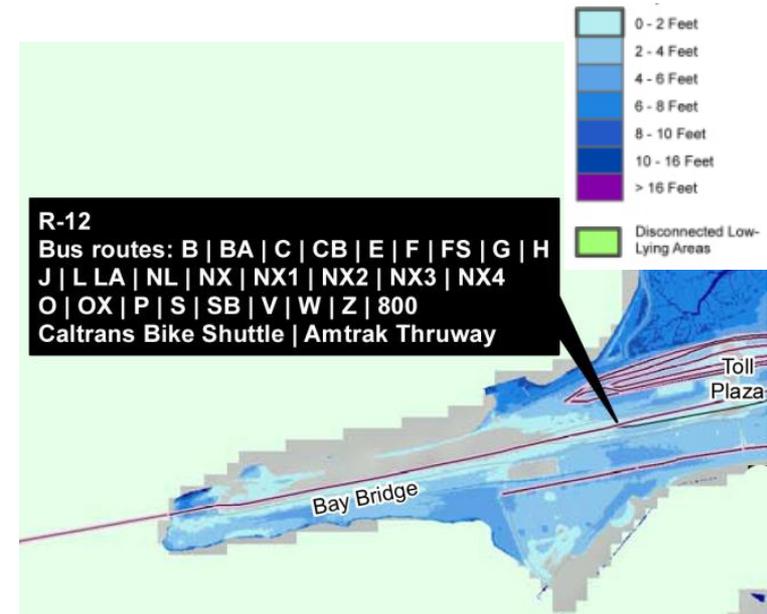
Closeable flood doors, Elizabeth River Tunnels, Portsmouth, VA



Integrating Results into Decision-making: Example from MTC - San Francisco Pilot

- Tested methodology for analyzing adaptation options for 2 assets based on equity, economy, ecology, governance
- San Francisco-Oakland Bay Bridge touchdown and toll plaza on Oakland side would be inundated under 100 year storm with 2050 sea level rise

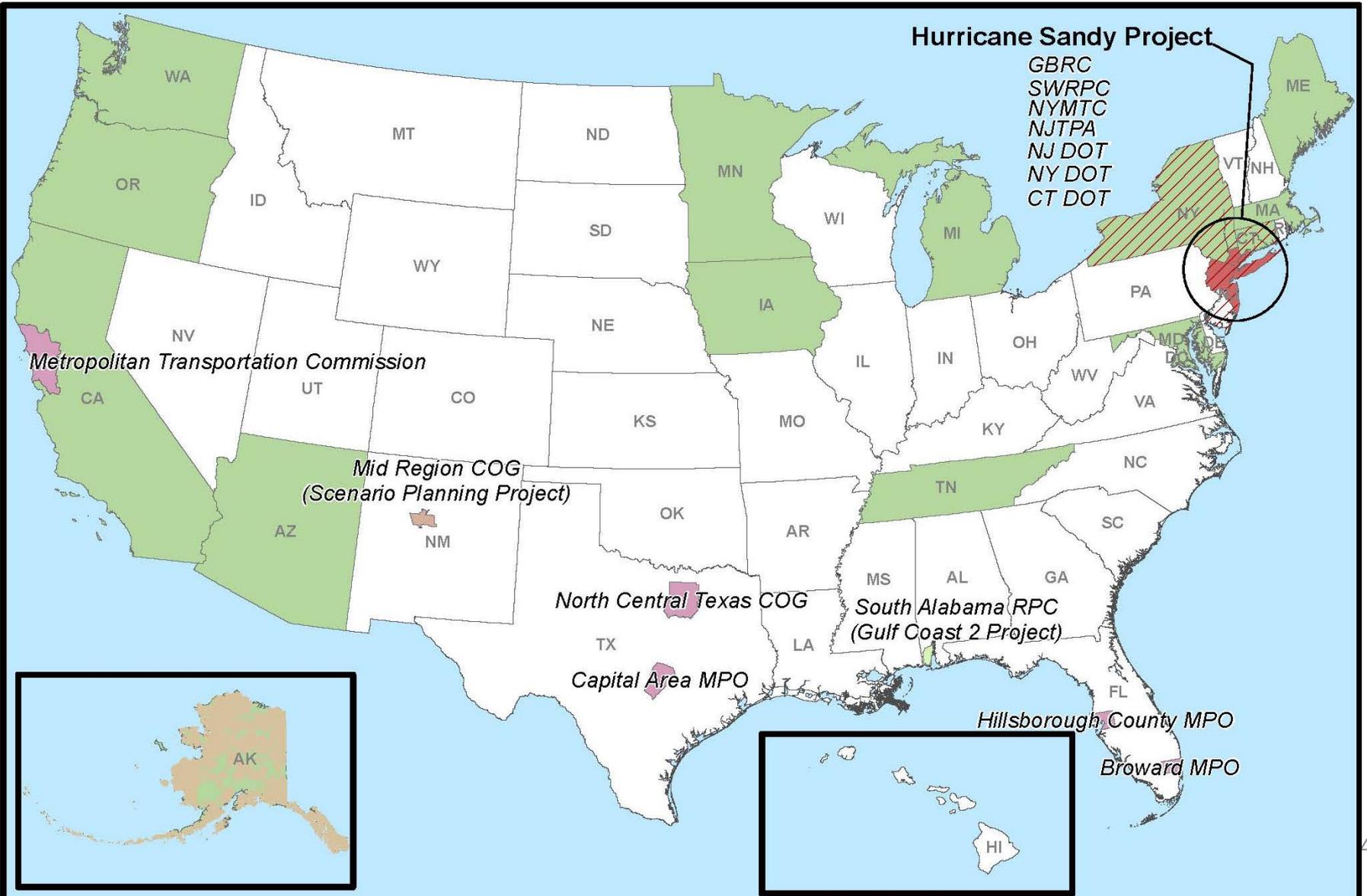
OPTIONS	Mid-century	End-of-Century
Asset-specific adaptation	<ul style="list-style-type: none"> • Improve drainage • Retrofit – waterproof • Raise touchdown & toll plaza area • Partial closure 	<ul style="list-style-type: none"> • Raise road surface • Build causeway
Regional adaptation	<ul style="list-style-type: none"> • Create berm • Wetland restoration/creation • Construct floodwall 	<ul style="list-style-type: none"> • Build levee • Build floodwall • Wetland restoration/creation
Nonstructural adaptation	<ul style="list-style-type: none"> • Building & design codes • Transportation planning guidance and policy • Multi-jurisdictional partnerships 	<ul style="list-style-type: none"> • Continue implementation and revision of nonstructural adaptation measures as needed



Projected inundation - 55 inch SLR + 100yr storm surge



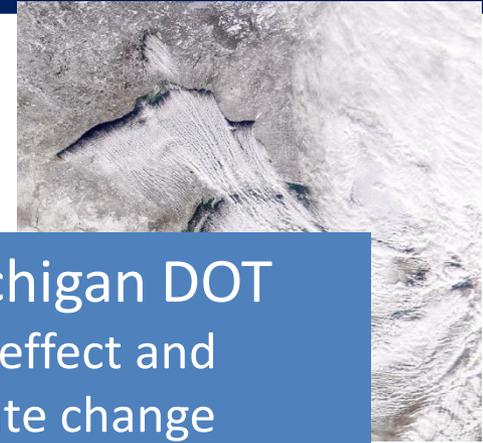
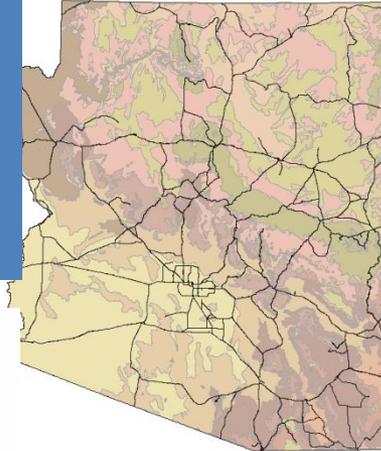
Pilot & Other Project Locations for 2013-2014



Example 2013-2014 Pilots

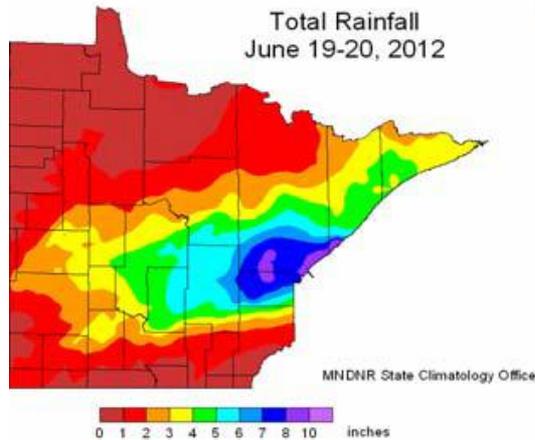
Arizona DOT

- Extreme surface temps
- Floods
- Dust storms
- Species Migration



Michigan DOT

- Lake effect and climate change
- Improve statewide, systematic approach to addressing risk



MassDOT

- Impacts to the Central Artery
- Solutions



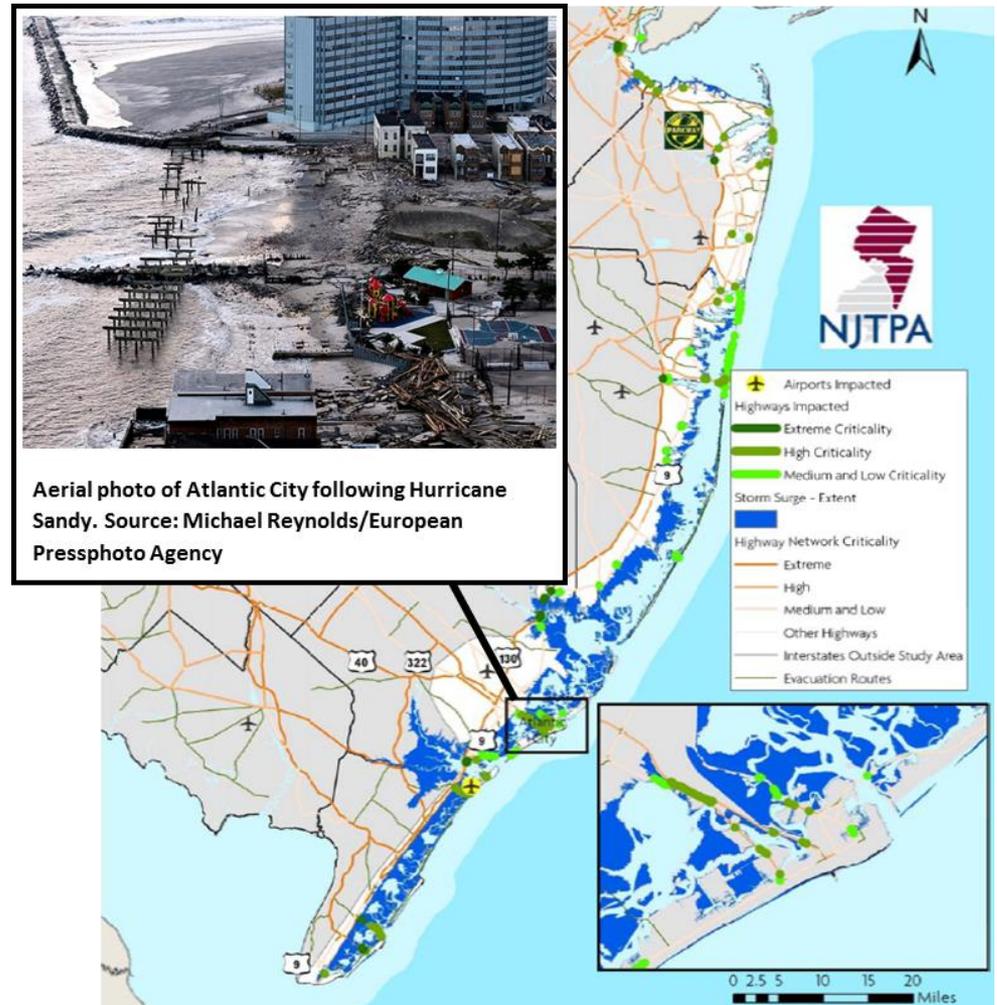
MnDOT

- Flash Flooding
- Asset Management



Sandy Follow-Up & Adaptation Analysis

- **Sandy project** builds on the 2011 NJ pilot
- Purpose: Learn from experience of Sandy and identify strategies to improve the resiliency of the transportation system to extreme weather and climate change
- Partners: FHWA; NY, NJ, and CT DOTs; Metro area MPOs; MTA; others.



SLR 1 Meter, 2100, Coastal Study Area (Roadways).

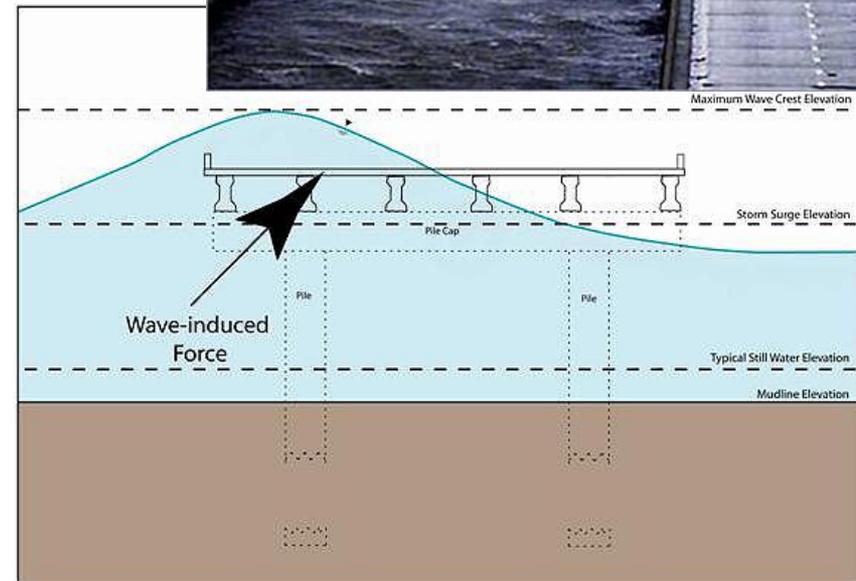
Source NJTPA 16



Hydraulic Engineering Circular (HEC) 25b

- How can engineers use already available information to design more resilient coastal infrastructure for the future?
- HEC 25b will provide technical guidance and methodologies on incorporating extreme event and climate change considerations, especially sea level rise, storm surge, and wave action.
- Completed regional peer exchanges; moving into report development

Project performed by Kilgore Consulting and Management with South Coast Engineers



What MPOs can do

- Assess vulnerability in the metro area to potential climate effects
 - What effects/impacts will be relevant for your area?
 - How will the transportation system be impacted or damaged
 - What alternatives might be available to address those impacts
- Consider as part of your LRTP Update
 - Consider climate vulnerability early in the process
 - Look to past work, other MPO examples in scoping effort
- Consider as part of corridor and sub-area studies as appropriate
- Coordinate with locals, State DOTs, academia, Feds to take advantage of lessons learned and other efforts underway



Thank you!

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Federal Highway Administration

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For more information, please contact:

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- Rebecca Lupes
- Heather Holsinger
- Tina Hodges

FHWA → Environment → Climate Change → Adaptation

Resources and Publications

PDF files can be viewed with the [Acrobat® Reader®](#)

DOT

- [FHWA Climate Change & Extreme Weather Vulnerability Assessment Framework](#) (December 2012) - This document is a guide for transportation agencies interested in assessing their vulnerability to climate change and extreme weather events. It gives an overview of key steps in conducting vulnerability assessments and uses in-practice examples to demonstrate a variety of ways to gather and process information. (PDF 2.2 MB)
- [A Framework for Considering Climate Change in Transportation and Land Use Scenario Planning: Lessons Learned from an Interagency Pilot Project on Cape Cod](#) (July 2011) - FHWA and the Volpe Center have developed a guidebook that discusses the steps taken during the pilot project and presents lessons learned and recommendations that will guide other areas in pursuing a similar multi-agency approach to reduce greenhouse gas emissions and plan for climate change impacts through integrated transportation and land use scenario planning. (PDF 2.2 MB)
- [The Use of Climate Information in Vulnerability Assessments](#) (January 2011)
This memorandum focuses on the use of climate information when performing a vulnerability assessment. The memorandum describes several sources of precipitation and temperature information, and provides some recommendations on how this information can be used by transportation planners as they consider their climate-related risks. The memorandum has an

www.fhwa.dot.gov/environment/climate_change/adaptation/

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