



U.S. Department of Transportation
Federal Highway Administration

Climate Change Resilience: 20 Questions in 20 Minutes

ARC/FHWA Climate Resilience Peer Exchange
October 4-5, 2016

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CLIMATE
CHANGE



1) Why is climate resilience important?

Climate change and extreme weather events are disrupting transportation systems across the country



Impacts of climate change are being felt now, and will accelerate significantly in the future.

–National Academy of Sciences and National Climate Assessment

2) What is FHWA's policy?

 **Order**

U.S. DEPARTMENT OF
TRANSPORTATION

Federal Highway
Administration

Subject: **Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events**

Classification Code	Date	Office of Primary Interest
5520	December 15, 2014	HEP/HIF/FLH

Par.

1. What is the purpose of this directive?
2. Does this directive cancel an existing FHWA directive?
3. What is the background of this directive?
4. What authorities govern this directive?
5. What is the scope of this directive?
6. What definitions are used in this directive?
7. What is the FHWA's policy concerning climate change and extreme weather event preparedness and resilience?
8. What are the FHWA's responsibilities?
9. Where can I obtain additional guidance?

1. **What is the purpose of this directive?** The purpose of this directive is to establish the Federal Highway Administration (FHWA) policy on preparedness and resilience to climate change and extreme weather events. This directive further serves to implement relevant provisions of title 23 of the United States Code (U.S.C), to comply with Executive Order 13653, Preparing the United States for the Impacts of Climate Change (EO 13653), dated November 1, 2013, and further the U.S. Department of Transportation (DOT) Policy Statement on Climate Change Adaptation.

2. **Does this directive cancel an existing FHWA directive?** No. This is a new FHWA directive.

3. **What is the background of this directive?**

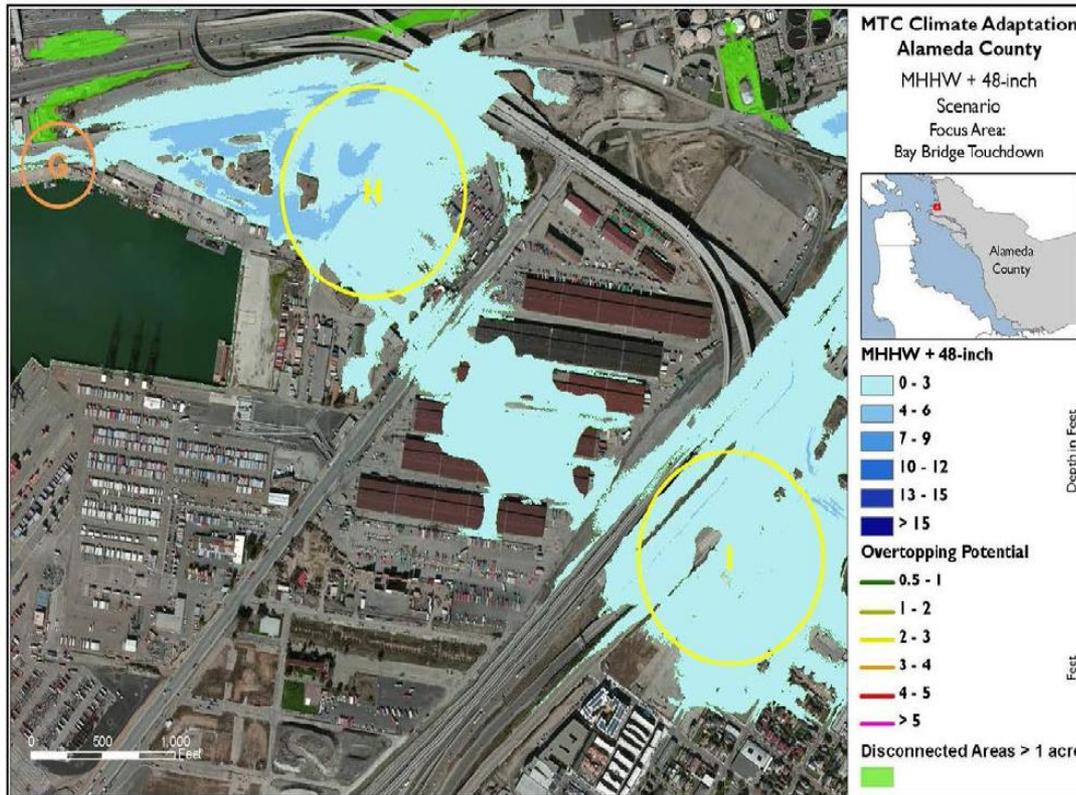
- a. Climate change and extreme weather events present significant and growing risks to the safety, reliability, effectiveness, and sustainability of the Nation's transportation infrastructure and operations.
- b. The impacts of a changing climate (such as higher temperatures, sea-level rise, and changes in seasonal precipitation and the intensity of rain events) and extreme weather events are affecting the lifecycle of transportation systems and are expected to intensify. For example, sea level rise coupled with storm surges can inundate coastal roads that would not have inundated in the past, necessitate more emergency evacuations, and require costly, and sometimes

1

- FHWA Order 5520: Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events
 - Establishes FHWA policy and responsibilities related to preparedness and resilience to climate change and extreme weather events
 - Signed: December 15, 2014
 - See: <http://www.fhwa.dot.gov/legisreg/directives/orders/5520.cfm>

3) What is preparedness?

- **Preparedness** = Actions taken to plan, organize, equip, train, and exercise to build, apply, and sustain the capabilities necessary to prevent, protect against, ameliorate the effects of, respond to, and recover from climate change related damages to life, health, property, livelihoods, ecosystems, and national security



4) What is adaptation?

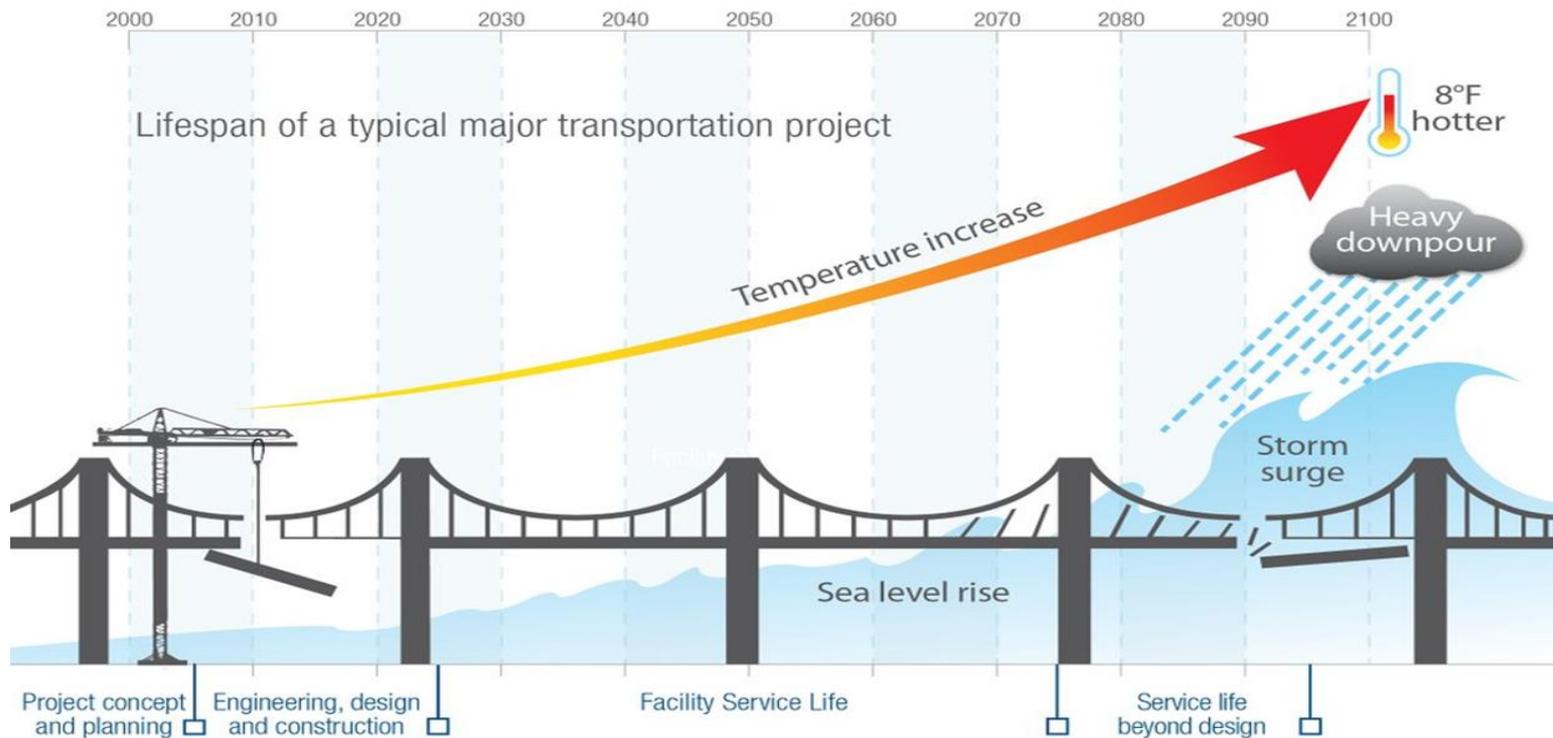


NC 12 North Carolina Outer Banks after Hurricane Irene.

- **Adaptation =** Adjustment in natural or human systems in anticipation of or response to a changing environment in a way that effectively uses beneficial opportunities or reduces negative effects

5) What is resilience?

- **Resilience =** Resilience or resiliency is the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions



6) What are FHWA's responsibilities?

Mainstream consideration of climate change vulnerability and risk in transportation decision making



Planning

- Long Range Transportation Plans
- Asset Management Plans



Project Level

- Environmental Processes
- Engineering
- Design



Operations and Maintenance

- Emergency Relief
- Snow Removal Programs

7) What can transportation agencies do?

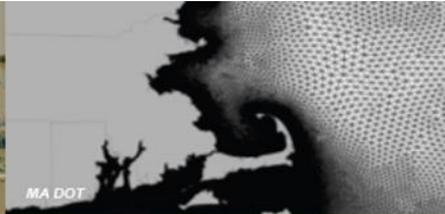
Transportation Agencies Using FHWA Resources to Build Resilience

FHWA partnered with 22 climate resilience pilots in two rounds as well as four cooperative projects in the Gulf Coast, Northeast, Southeast, and New Mexico. These 26 projects are shown in the map below. In total, at FHWA's latest count, 24 state DOTs and 30 MPOs have conducted vulnerability assessments of the highway system to address climate change and extreme weather events.

- State DOT Pilot
- MPO Pilot
- Cooperative Projects



Iowa DOT and local universities used global climate models and the state's hydrological model to project future flood frequencies and identify bridge and roadway vulnerabilities in two river basins. Iowa plans to integrate the information into its real-time warning system to protect the traveling public. The results of the pilot may also influence guidelines for the



The Massachusetts Department of Transportation developed high resolution computer modeling of coastal storm inundation and risks to the Central Artery highway tunnel system in Boston.



New Jersey's 2011 climate pilot analysis of which roads could flood with higher sea levels and storm surge was unfortunately validated when Superstorm Sandy hit in October 2012. Following the storm, FHWA partnered with the tri-state region on a multi-jurisdictional vulnerability assessment and analysis of adaptation solutions for particularly vulnerable assets, such as the Hugh L. Carey Tunnel and NJ 7. Photo shows flood protection installed by the Port Authority of NY and NJ.

1. Know your **vulnerabilities**
2. Use the transportation **planning** process
3. Incorporate climate risks into **design**
4. Optimize **operations and maintenance**



In Albuquerque, New Mexico, FHWA partnered with the MPO on a scenario planning process to assess the impact of growth scenarios on climate resilience and mitigation, along with other community goals. The project analyzed how different scenarios performed on development in wildfire risk areas, development in flood risk areas, water consumption, and emissions levels. During stakeholder workshops, participants discussed policies that would help achieve a preferred scenario for the 2040 metropolitan transportation plan.



Tennessee DOT conducted a multimodal vulnerability assessment for the state, obtaining key information for asset management. Landslides, tornados, and river flooding (such as that shown above in 2010), are risks.

San Francisco's Metropolitan Transportation Commission (MTC) analyzed options for protecting transportation infrastructure, including an artificial dune or living levee north of the Bay Bridge touchdown to protect the bridge.

In Texas, increases in heat waves, wildfires, and droughts threaten transportation. The MPO for Austin, TX identified areas where clay soils shrink during heat waves and drought, cracking pavements.

Phase I of the U.S. DOT Gulf Coast Study, completed in 2008, found that with four feet of sea level rise, 27% of the Gulf Coast region's major highways, 9% of rail lines, and 72% of ports would be inundated. Gulf Coast Phase II focused in-depth on Mobile, Alabama and developed nationally applicable tools.

Maryland DOT used FHWA's Vulnerability Assessment Scoring Tool to prioritize climate risks to bridges, culverts, and road segments in two counties particularly exposed to sea level rise and storm surge.



8) What adaptation activities are eligible?

- FHWA Emergency Relief (ER) Funds can be used to rebuild a damaged highway in a manner that can prevent future damage from climate change and extreme weather events
 - If consistent with current design standards,
 - or economically justified.
 - See: <https://www.fhwa.dot.gov/reports/erm/er.pdf>
- In general, Federal-aid and the Federal Lands highway funds can be used to consider climate change and apply adaptation strategies, at the project and systems levels
 - Vulnerability and risk assessments of Federal aid-eligible highways
 - Construction of projects or features to protect existing eligible assets from impacts
 - Evaluation of potential impacts on asset management cycles, life cycle costs, etc.
 - See: <http://www.fhwa.dot.gov/federalaid/120924.cfm>

9) What resources does FHWA have?

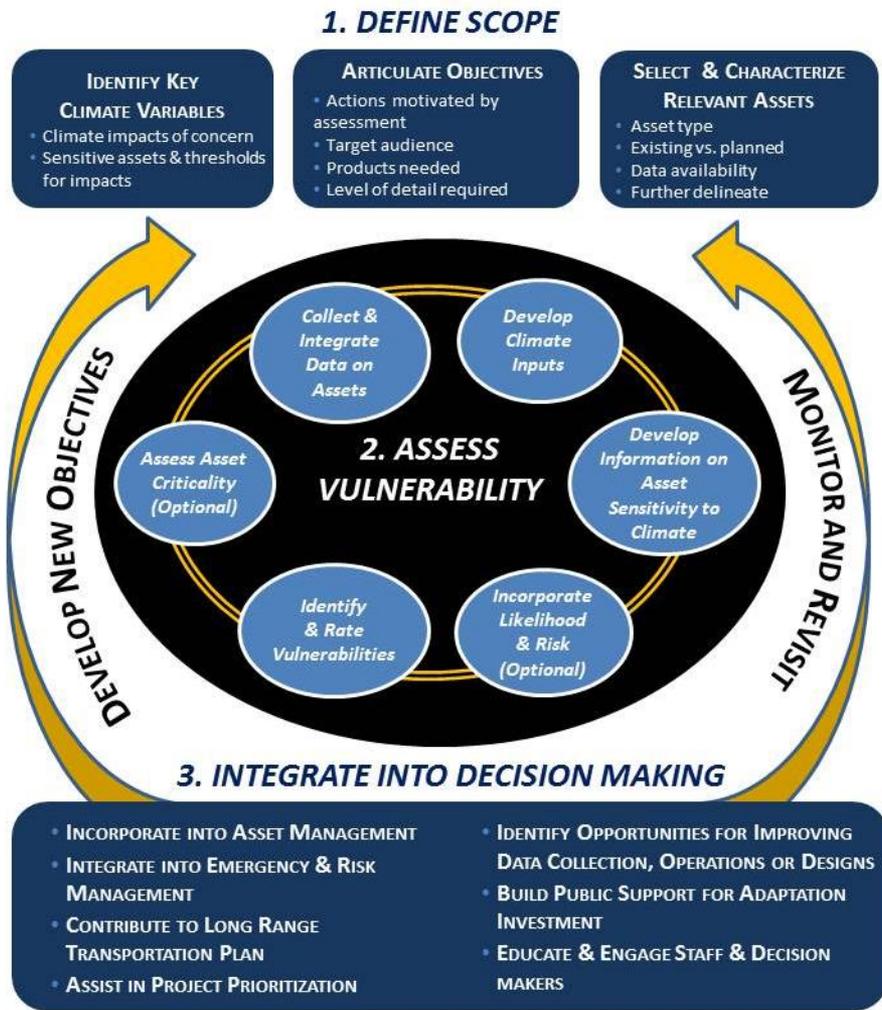
Research, Technical Assistance

- FHWA Adaptation Framework
- 19 FHWA Climate Resilience Pilots
- Gulf Coast Phase 2 Project
- Hydraulic Engineering Circulars 25 (Coast), 17 (River)
- Hurricane Sandy Follow-up Project
- Albuquerque Scenario Planning Project
- Transportation Engineering Approaches for Climate Resiliency
- Case studies
- Tools
- Videos

The screenshot displays the FHWA Climate Adaptation website. The header includes the text "CLIMATE ADAPTATION" and a graphic of a bridge over water. Below the header, a navigation path reads "FHWA → Environment → Climate Change → Adaptation → Adaptation Framework". The main content area is titled "Virtual Framework for Vulnerability Assessment" and "Module 4: Assess Vulnerabilities". A navigation bar shows tabs for "Overview", "Module 1", "Module 2", "Module 3", "Module 4" (selected), and "Module 5". The "Overview" section contains a diagram of the vulnerability assessment process, which includes steps like "Define Scope", "Assess Vulnerability", and "Integrate into Decision Making". Text to the right of the diagram explains that after defining objectives and scope, climate variables and asset types are identified, and the next step is to assess the vulnerability of selected assets. Below this, it states that findings can be integrated into transportation decision-making to prioritize measures. A "View fullsize image." link is provided. Below the overview is a "Module 4 Introductory Video" section, featuring a video player with the title "Identifying and Rating Vulnerab..." and a thumbnail image of Sandy Salisbury, a roadside area manager for the Washington State Department of Transportation, who describes how WSDOT conducted its vulnerability regional workshops.

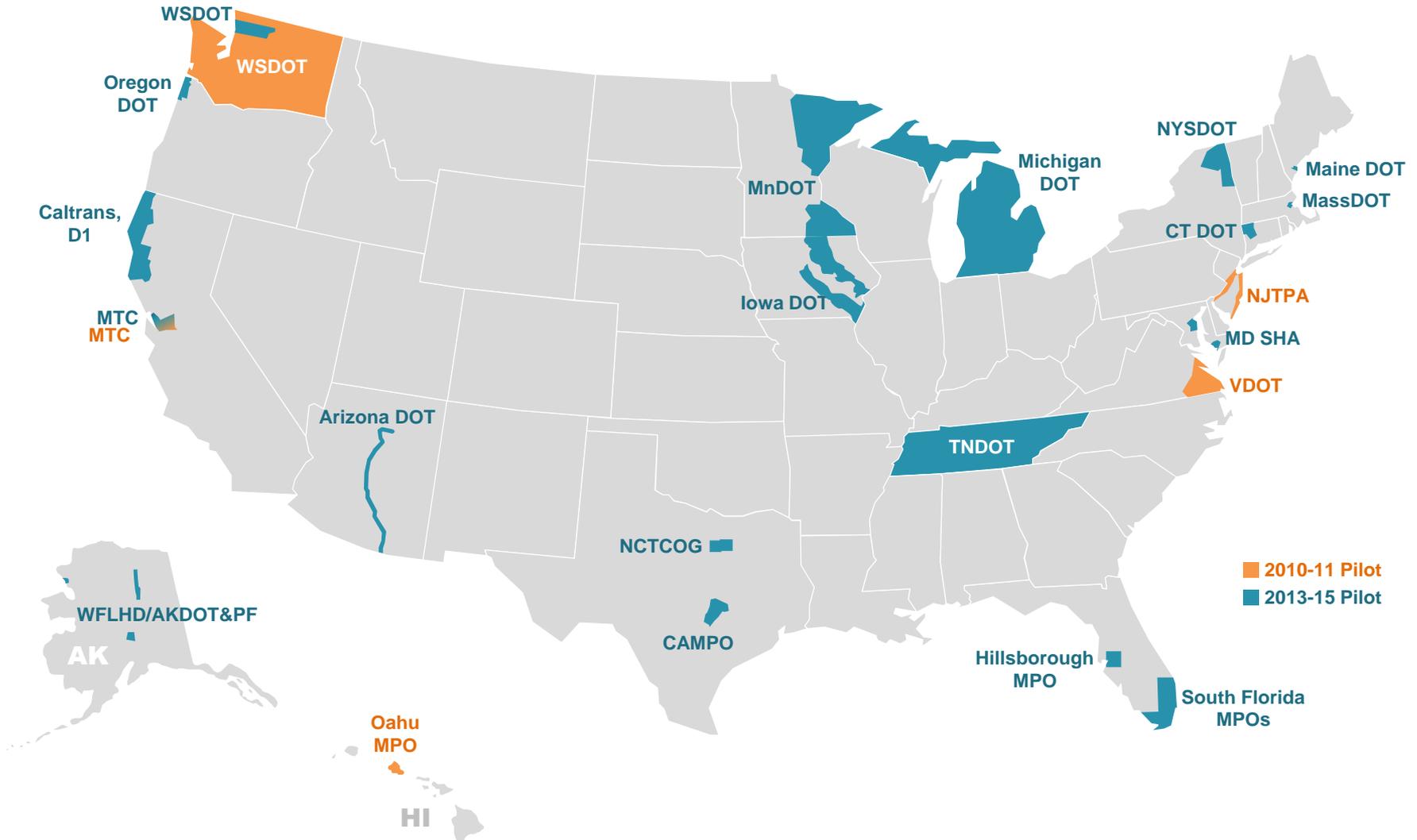
http://www.fhwa.dot.gov/environment/climate_change/adaptation

10) What is the Adaptation Framework?



- Define Project Scope
 - Objectives
 - Relevant Assets
 - Climate Variables
- Assess Vulnerability
 - Climate Inputs
 - Asset data, criticality, sensitivity
 - Vulnerabilities, risk
- Integrate Vulnerability Into Decision Making

11) Who has used the Framework?



12) Where can I find climate change data?

- NOAA Regional Climate Centers
- NOAA's Regionally Integrated Sciences and Assessments Centers (RISAs)
- National Weather Service
- State climatologists
- State and local environmental departments
- Colleges and Universities
- Consulting firms

13) What are other Federal agencies doing?

- Federal agencies directed to develop adaptation plans to reduce the vulnerability of federal programs, assets, and investments to the impacts of climate change
- Developing resources and tools



<http://nca2014.globalchange.gov/>



<http://toolkit.climate.gov/>

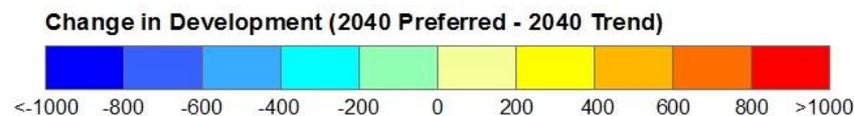
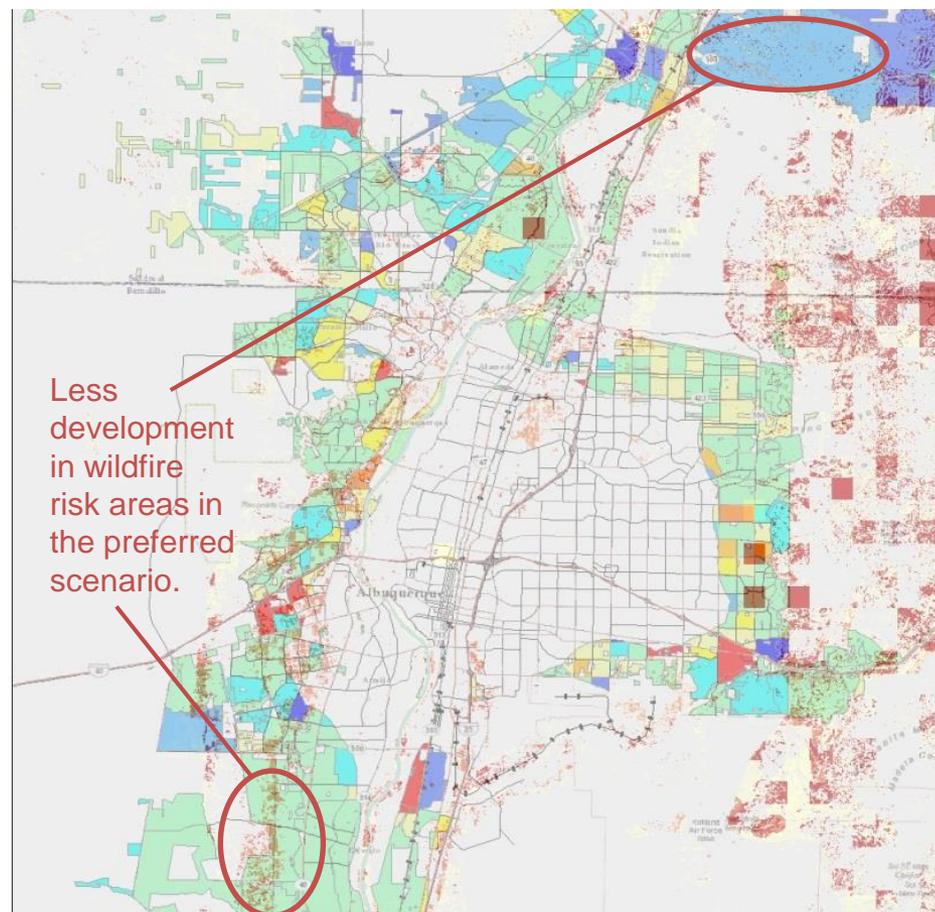
14) How are agencies integrating climate into the planning process?

Resources:

- [Integrating Climate Change into the Transportation Planning Process](#)
- Scenario Planning – [Cape Cod](#) and [New Mexico](#) reports

Example:

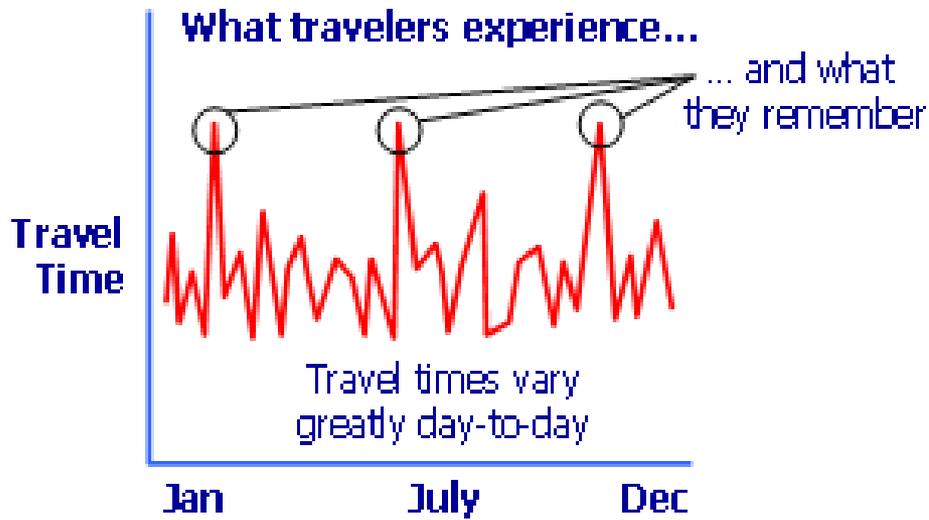
- In Albuquerque, New Mexico, FHWA partnered with the MPO on a scenario planning process to assess the impact of growth scenarios on climate resilience and mitigation, along with other community goals.



15) What about the FAST Act?

- Adds **resiliency** and **reliability** as a new planning factor
- New requirement for MPOs to coordinate with officials responsible for **natural disaster risk reduction** when developing a metropolitan transportation plan and the Transportation Improvement Program
- New requirement that the metropolitan transportation plan assess capital investment and other strategies that reduce the **vulnerability** of the existing transportation infrastructure to **natural disasters**

16) What is reliability?



- **Travel Time Reliability** = The consistency or dependability in travel times, as measured from day-to-day and/or across different times of the day.
- **Resilience** = The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions

17) What is a natural disaster?

- **Natural disaster** = A sudden and unusual natural occurrence, including but not limited to intense rainfall, floods, hurricanes, tornadoes, tidal waves, landslides, volcanoes or earthquakes which cause serious damage.



Alaska road after earthquake in 2002

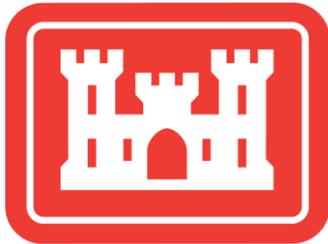


I-75 landslide in Tennessee in 2012

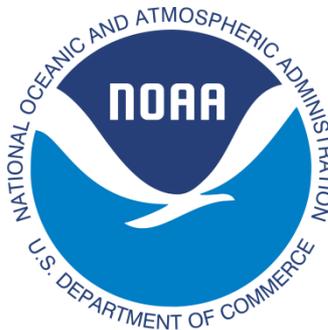
18) What agencies are responsible for natural disaster risk reduction?



Department of Homeland Security
Federal Emergency Management Agency



Department of Defense
United States Army Corps of Engineers



Department of Commerce
National Oceanic and Atmospheric
Administration

19) How can States and MPOs address resiliency in the planning process?

- Long range transportation plans
- Transportation improvement programs
- Public involvement and interagency consultation
- Risk-based transportation asset management plans
- Planning and research work programs
- Modal, subarea, and corridor planning
- Scenario planning

20) What are strategies to reduce the vulnerability to natural disasters?

- Coordinate with agencies in natural disaster risk reduction
- Assess the vulnerability of transportation assets to types of natural disasters
- Identify at-risk assets and potential impacts of disasters
- Evaluate approaches to system management, operations, and maintenance
- Determine assets to retrofit, rehabilitate, or relocate
- Analyze appropriate areas to build new facilities
- Prioritize funding using costs, benefits, risks, and impacts
- Develop systems for monitoring and reporting
- Educate and engage decision-makers, partners, and public