Gulf Coast 2 and FHWA Climate Resilience Efforts

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Photo: Culvert under Airport Boulevard (Mobile, AL)

Climate Change Adaptation at FHWA

Goal: Regular/Systematic consideration of climate change vulnerability and risk in transportation decision making, at:

- 1) **Systems Level**: Transportation planning, Asset Management
- 2) **Project Level**: Environmental process, Preliminary Engineering, Design, Construction, Operations, Maintenance

Systems Level Goal: Consideration in Transportation Planning, Asset Management

Key Product:

- Updated *Climate Change & Extreme Weather Vulnerability Assessment Framework* (2015)

Activities:

- Climate Resilience Pilots – round 2
- *Gulf Coast 2 (Mobile)*
- *Hurricane Sandy Follow-up and Vulnerability Assessment & Adaptation Analysis*
- *Central NM Climate Change Scenario Planning Project*

Project Level Goal: Consideration in Environmental Process, Preliminary Engineering, Design, Construction, Operations, Maintenance

Key Products:

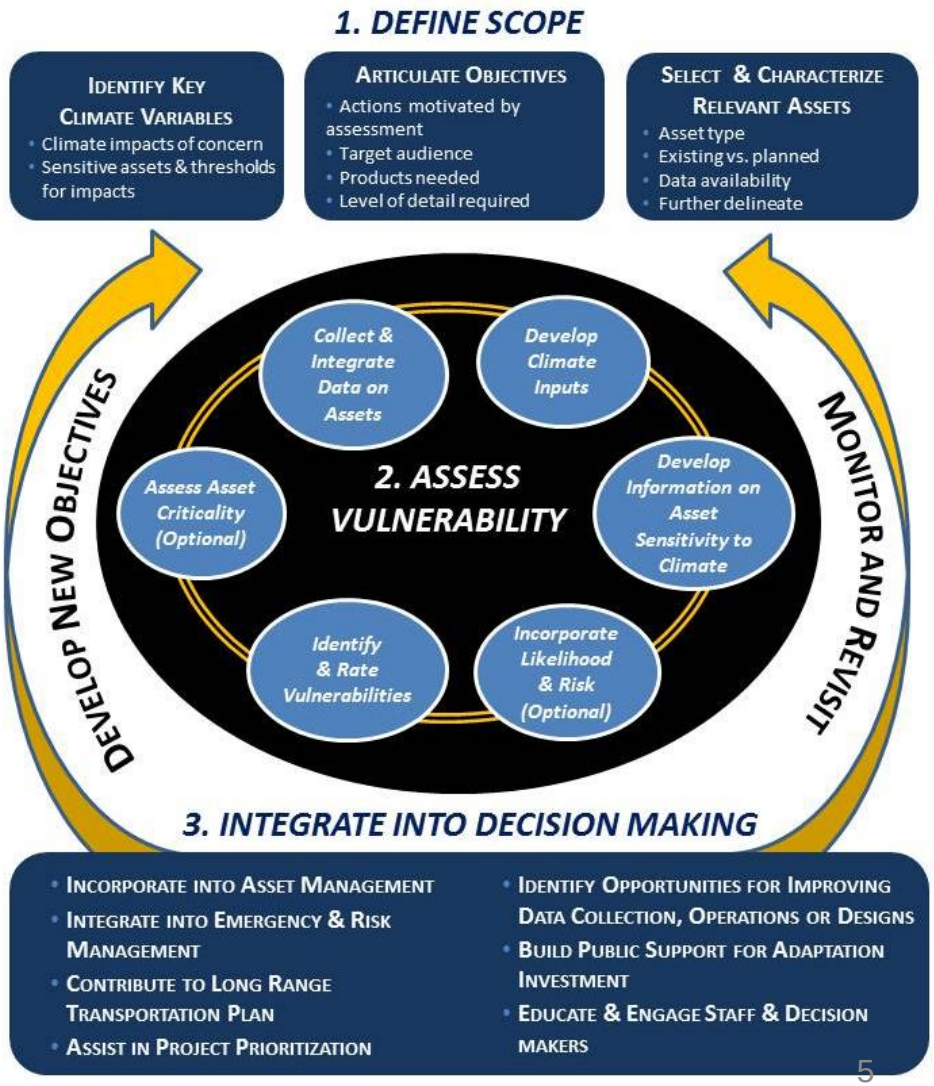
- Updated engineering manuals, methods and processes

Activities:

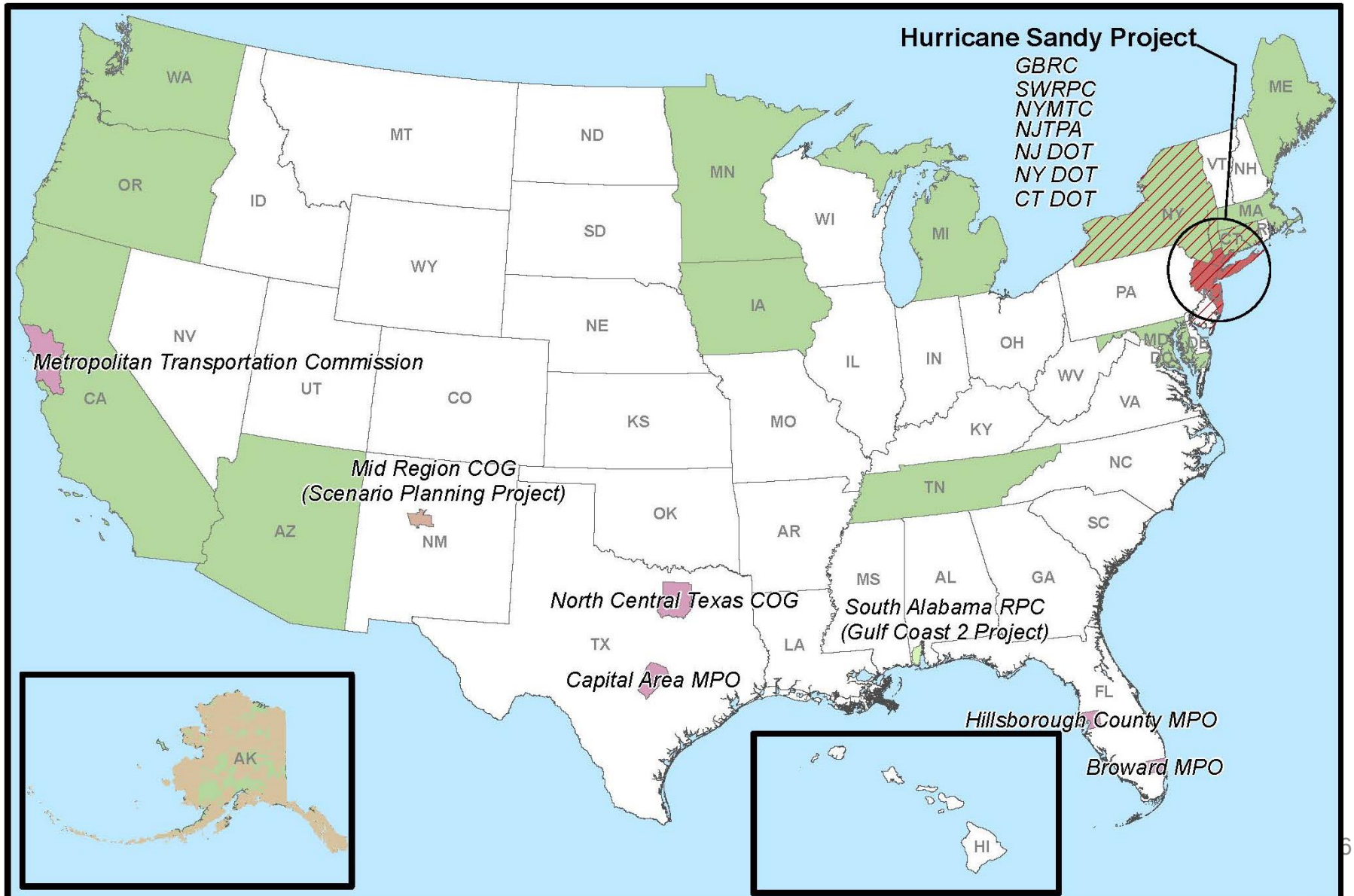
- Engineering Assessments
  - *Gulf Coast 2 (Mobile)*
  - *Hurricane Sandy Follow-up and Vulnerability Assessment & Adaptation Analysis*
  - *Transportation Engineering Approaches to Climate Resiliency*
  - Climate Resilience Pilots
- *HEC 25 - Vol 2: Highways in the Coastal Environment: Extreme Events*
- Hydrology, hydraulic engineering research efforts, etc.

FHWA's *Climate Change & Extreme Weather Vulnerability Assessment Framework* (2012)

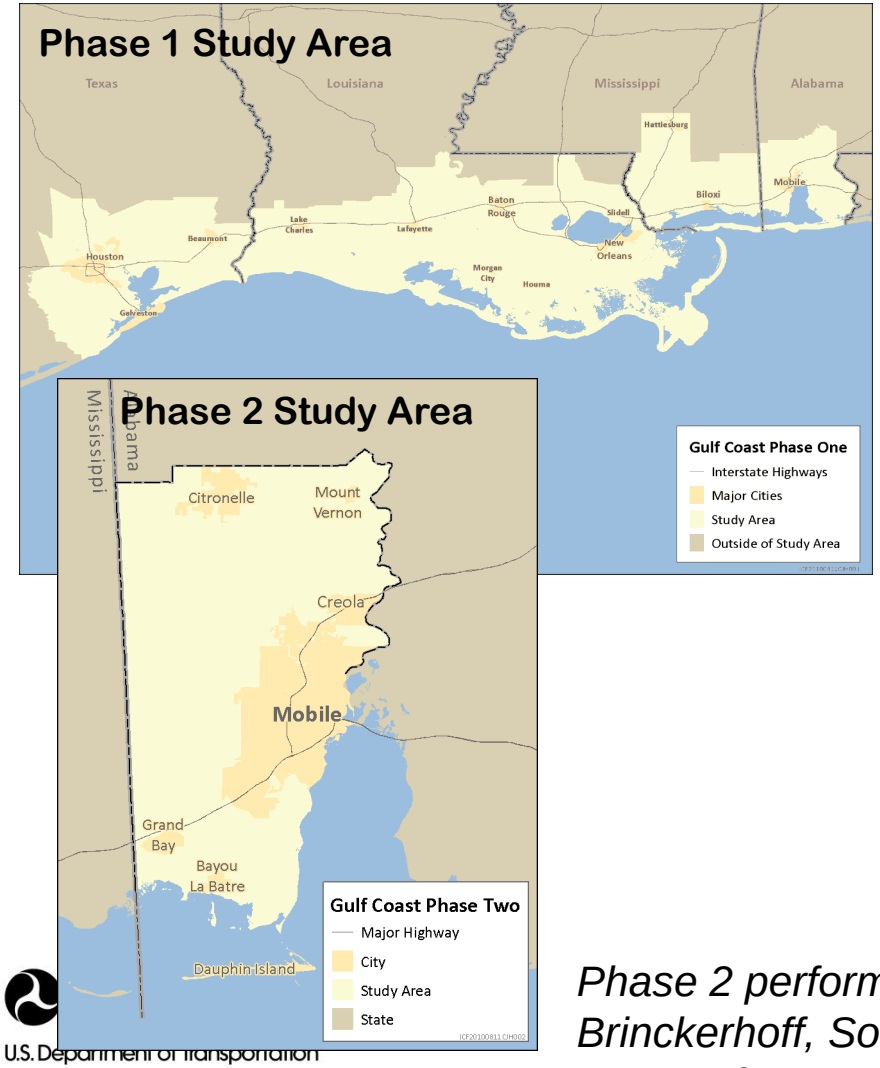
1. Define Project Scope
   - Objectives
   - Relevant Assets
   - Climate Variables
2. Assess Vulnerability
   - Climate Inputs
   - Asset data, criticality, sensitivity
   - Vulnerabilities, risk
3. Integrate Vulnerability Into Decision Making



Climate Resilience Pilot & Other Project Locations



Gulf Coast 2 Project (Mobile, AL)



- **Primary Phase 2 Tasks**
  - Task 1: Identify critical transportation assets in Mobile (complete)
  - Task 2: Identify climate effects, assess infrastructure sensitivity (complete)
  - Task 3: Assess vulnerability of critical assets (Summer 2014)
  - Task 4: Develop transferable risk management tools (Summer 2014)
- **Completed tasks: FHWA website**

Phase 2 performed by ICF International (prime), Parsons Brinckerhoff, South Coast Engineers, and Texas A&M, with support from USGS and Katharine Hayhoe (Texas Tech)

Projected Climate Change in Mobile: *Temperature and Precipitation*

- **Increases in Temperature**
  - The number of heat events above **95°F** and **100°F** are projected to increase dramatically

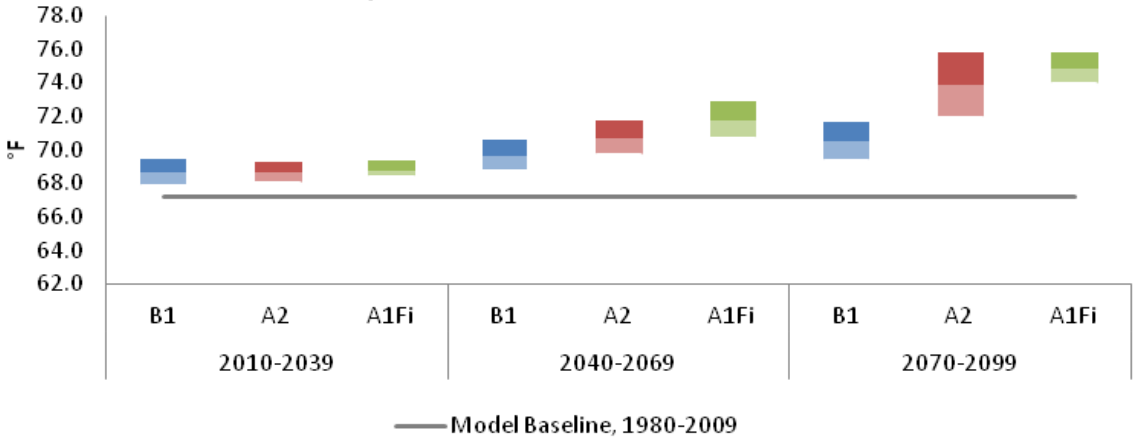
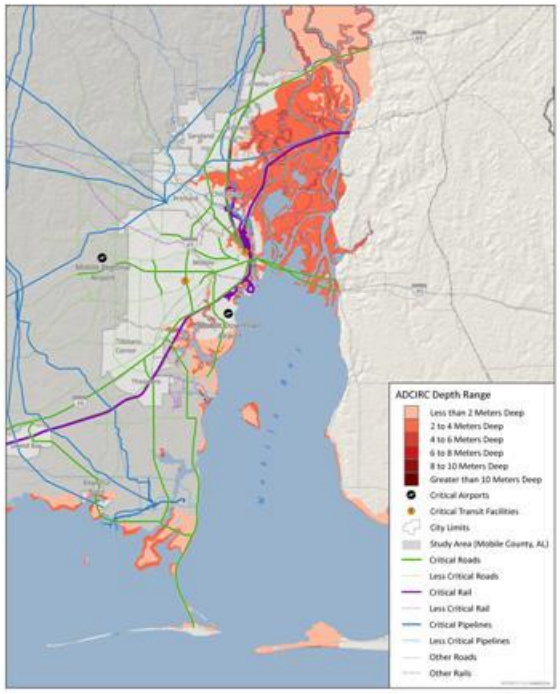


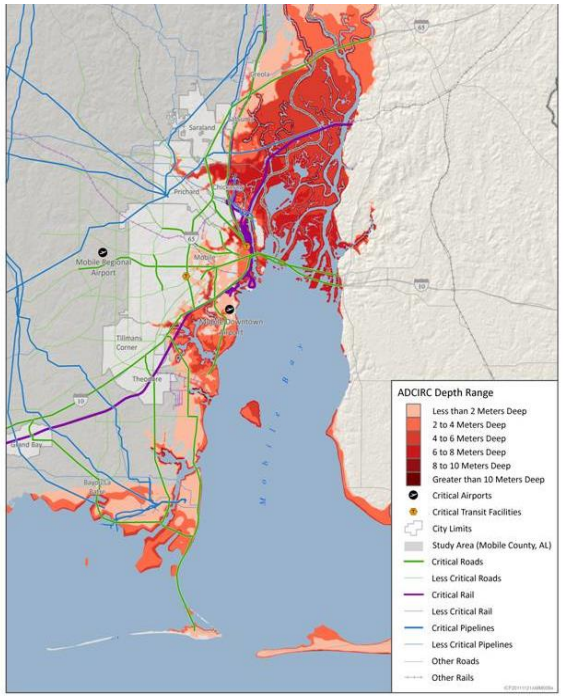
Figure: Projected average mean temperature (°F)

- **Uncertain changes in Precipitation**
  - 100-year precipitation event is projected to be more intense in the future, though there is a wide spread of results across models

Sample of Storm Surge Analyses



Hurricane Katrina
Natural Path Scenario

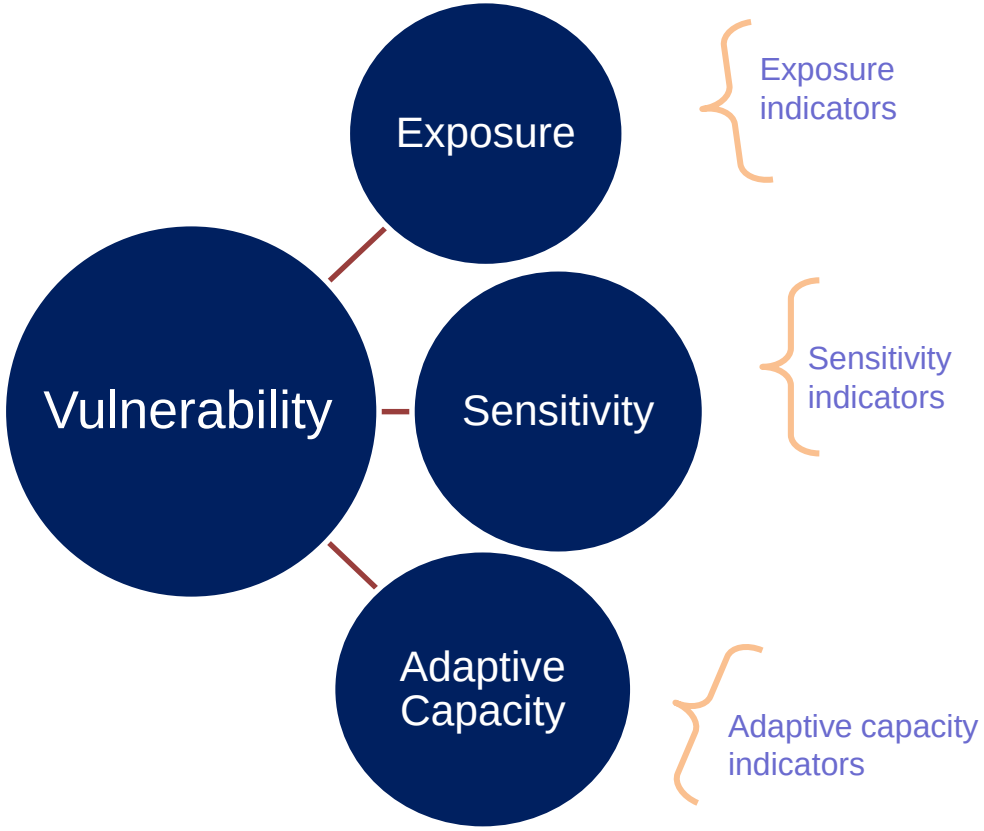


Hurricane Katrina Shifted
Path Scenario with 0.75
meter Sea-Level Rise

- Scenarios based on historic hurricanes, with varying
  - Track
  - Intensity
  - Sea level rise
- Does not examine loss of barrier islands

Using Indicators to Score Vulnerability

- V = Function of (E, S, A)
- Chose indicators to represent exposure, sensitivity, and adaptive capacity
  - Characteristics that could indicate an asset may or may not be vulnerable
- Averages of indicators drive scoring
  - Weighting



Example Indicators

Exposure

- **Temp**-Days above 95°F
- 24-hour **precipitation**
- **Storm surge** height
- **Wind** speed exceeds threshold above which impacts may occur (yes/no)
- Inundated by **sea level rise** (yes/no)

Sensitivity

- **Temp** - Pavement binder, traffic (roads)
- **Precip** - FEMA flood zones, ponding, surface permeability (all modes)
- **Storm surge** – Height & condition (bridges), electric signaling & soil type (rail), access (transit)
- **Wind** - Building height, materials, roof type; road sign or signal density (road and rail)
- **Sea level rise** – Drainage (air), protection (transit, roads)

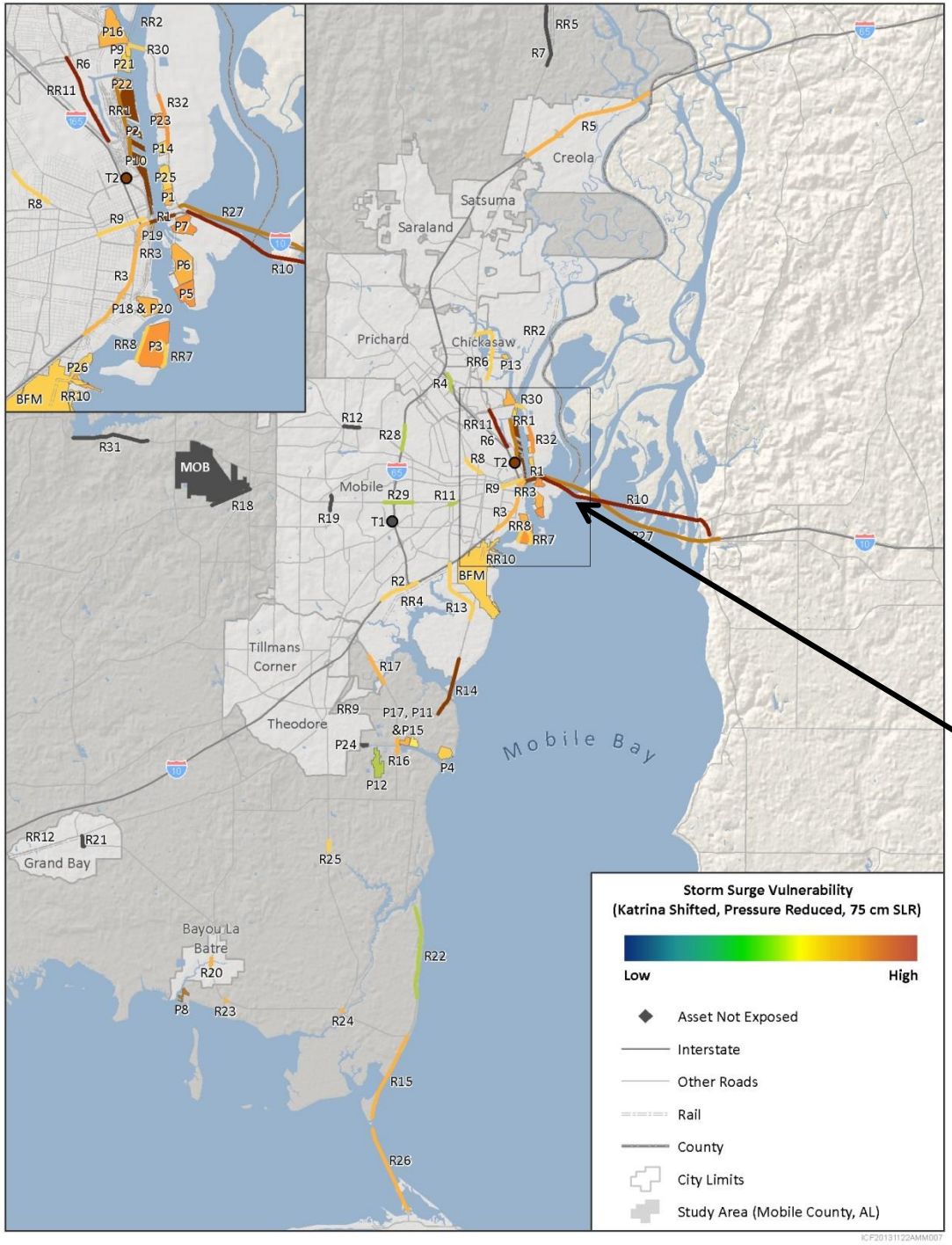
Adaptive Capacity

- **Speed to recover asset** – cost of improvement (bridges), identified as a priority in emergency planning (rail, air, transit)
- **Redundancy** - detour length (bridges, air), number of terminals/ runways (air), ability to reroute (transit and rail), rail yard interchange utility (rail)
- **System disruption duration** (climate variable-specific)

Highways Storm Surge Vulnerabilities

Segment Name	Vulnerability Score (Least Extreme)	Vulnerability Score (Most Extreme)	Data Availability*
Telegraph Road, from Downtown to Baybridge Road	3.2	4.0	92%
The Causeway (Battleship Parkway)	3.2	4.0	91%
I-10 Tunnel (Wallace Tunnel)	3.2	3.6	87%
SR-163 (Dauphin Island Parkway), from Island Road to Terrell Road	3.2	3.6	81%
I-10 Bridge across Mobile Bay	2.5	3.3	86%
Old Spanish Trail, between Cochrane Bridge and the tunnels	2.7	3.1	87%
Dauphin Island Bridge	2.6	3.0	100%
SR-188, where it crosses the river just North of Bayou la Batre	2.5	2.9	87%
Intersection of SR-188 and CR-59 (Bellingrath Road), near Fowl River	2.5	2.9	87%
SR-193 (Dauphin Island Parkway), from Dauphin Island Bridge to CR-188	2.5	2.9	92%

Storm Surge Vulnerability

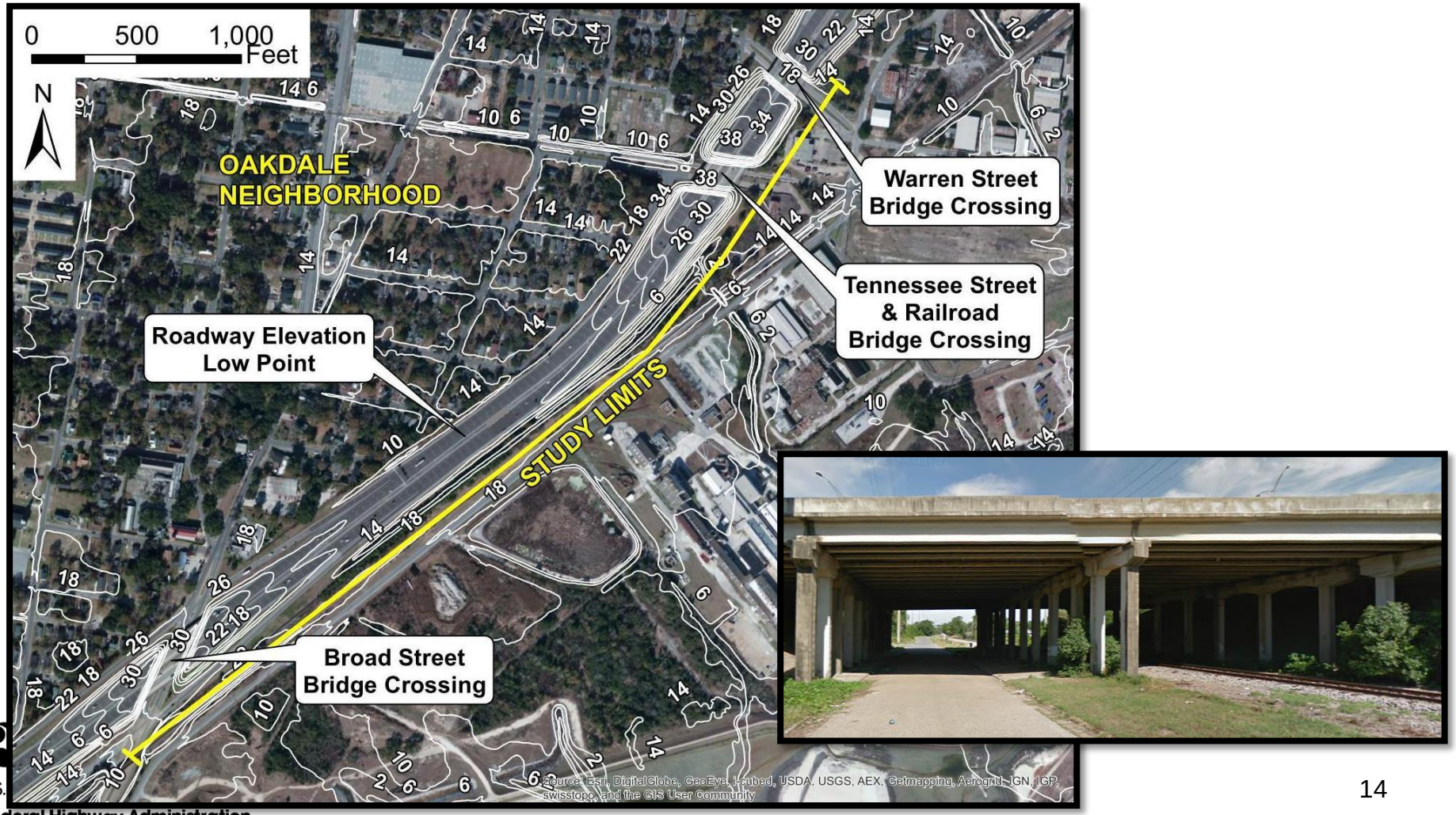


- Highest where Mobile River meets Mobile Bay
- Low-lying coastal roads and bridges
- Location is biggest driver

Example: The Causeway (R10)

- 17-29 ft. of storm surge/waves
- Damaged in past, unprotected, low approach, low embankment
- High replacement cost

I-10 – Mileposts 24 to 25
Road Alignment Exposure to Storm Surge



Implications

- Consider environmental conditions over project life
  - Local road; Interstate; Major bridge
- Climate change will affect maintenance cycles, investment decisions on when/where to invest, reconstruct
  - Added uncertainty (e.g., multiple scenarios)
  - Expect higher maintenance and operations costs; potentially costlier designs
- Adaptation can save funding over the long term
  - Focus on solutions
  - Emphasize proactive strategies vs. reacting to "disaster"

Tools Development

Module 1 Articulate Objectives

Module 2 Identify Climate Stressors

Module 3 Select Assets

Module 4 Assess Vulnerabilities

Module 5 Integrate in Decision Making

Module 6 Monitor and Revisit

Sensitivity Matrix

Criticality Guidance

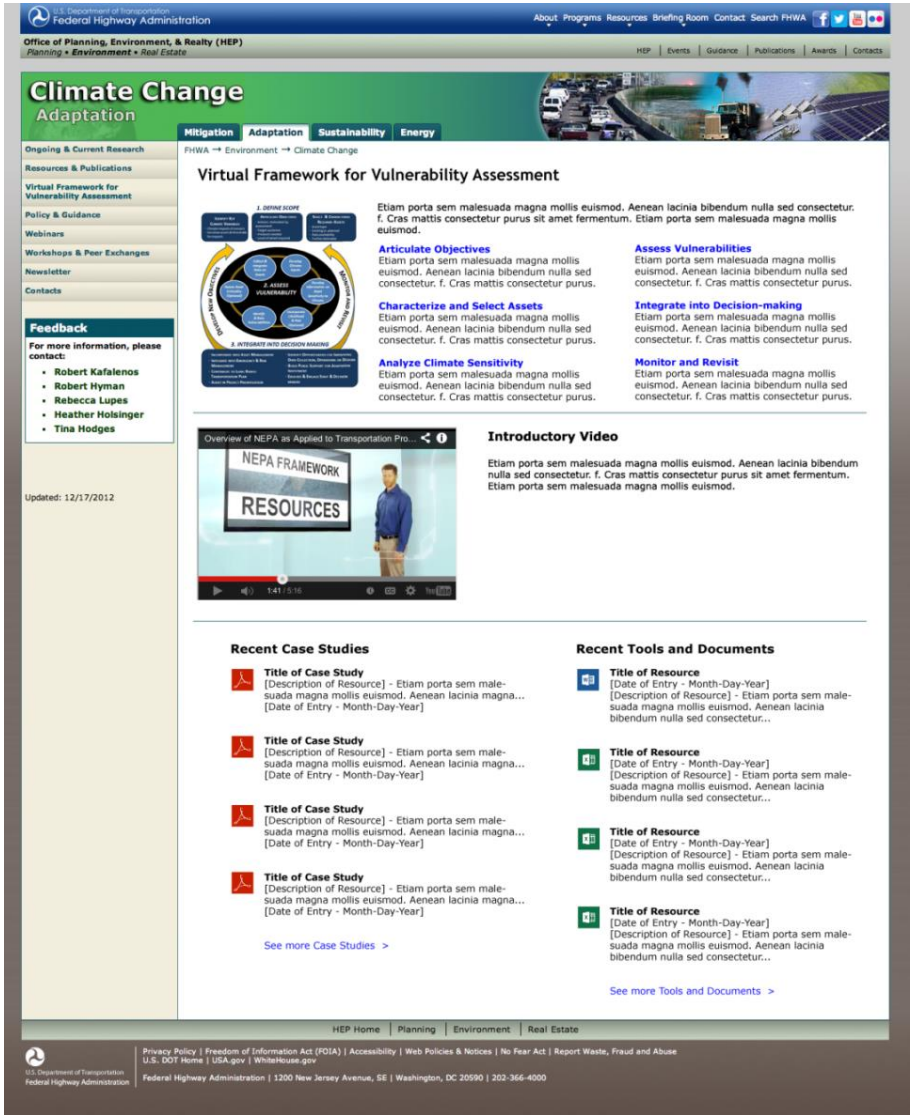
CMIP Climate Data Processing Tool

Vulnerability Assessment Scoring Tool

Engineering Case Studies

New Web Resource: Virtual Framework

- New web resource to house FHWA adaptation tools and resources
- Organized around the FHWA Vulnerability Assessment Framework
- Include guidance for each step, training videos, case studies, tools, and links to related resources
- Available mid-2014



U.S. Department of Transportation
Federal Highway Administration

Thank you

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

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