Gulf Coast 2 and FHWA Climate Resilience Efforts

Robert Kafalenos, FHWA
May 22, 2014

Photo: Culvert under Airport Boulevard (Mobile, AL)
**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.
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

- Hurricane Sandy Project
  - GBRC
  - SWRPC
  - NYMTC
  - NJTPA
  - NJ DOT
  - NY DOT
  - CT DOT

- Metropolitan Transportation Commission
- Mid Region COG (Scenario Planning Project)
- North Central Texas COG
- South Alabama RPC (Gulf Coast 2 Project)
- Capital Area MPO
- Hillsborough County MPO
- Broward MPO
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

![Projected average mean temperature (°F)](image)

• **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

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

Hurricane Katrina Natural Path Scenario

Hurricane Katrina Shifted Path Scenario with 0.75 meter Sea-Level Rise
Using Indicators to Score Vulnerability

• $V = \text{Function of (} E, S, A \text{)}$
• 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

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

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

Sustainable Transport and Climate Change Team
FHWA Office of Natural Environment
Robert.Kafalenos@dot.gov