What is Resilience?

**Resilience**: the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.
Sixteen Billion-Dollar Disasters in 2017

Credit: NOAA
FHWA Resilience Efforts

- **FHWA is working** with States and metropolitan areas to increase the health and longevity of the Nation's Highways through:
  - Assessing vulnerabilities
  - Considering resilience in the transportation planning process
  - Incorporating resilience in asset management plans
  - Addressing resilience in project development and design
  - Optimizing operations and maintenance practices
Integrating Resilience

Goal: Integrate consideration of resilience in transportation decision making

- In support of 23 U.S.C. § 503(b)(3)(B)(viii), which directs the U.S. Department of Transportation “to carry out research and development activities … to study vulnerabilities of the transportation system to … extreme events and methods to reduce those vulnerabilities.”
Extreme Weather Resilience Policy

- **USDOT FY 2018-22 Strategic Plan:** “DOT will increase its effectiveness in ensuring that infrastructure is resilient enough to withstand extreme weather”

- **FHWA Order 5520** commits FHWA to integrating extreme weather risk consideration into programs

- Extreme weather resilience **eligible** for FHWA funds
Risk-based asset management plans must address risks associated with current and future environmental conditions (23 CFR 515)

Assets requiring repeated repair require evaluation of alternatives (23 CFR 667)

State and metropolitan transportation planning should now include resilience as a planning factor (23 USC 134, 23 CFR 450)

Metropolitan transportation plans shall include an assessment of capital investment and other strategies to... reduce the vulnerability of the existing transportation infrastructure to natural disasters (23 CFR 450.324(f)(7))
“(a) Each State shall carry out a continuing, cooperative, and comprehensive statewide transportation planning process that provides for consideration and implementation of projects, strategies, and services that will address the following factors: (9) improve the **resiliency and reliability of the transportation system** and reduce or mitigate storm-water impacts of surface transportation.” -23 CFR 450.206(a)

**Effective Date:** June 27, 2016
“(b) The metropolitan transportation planning process shall be continuous, cooperative, and comprehensive, and provide for consideration and implementation of projects, strategies, and services that will address the following factors: (9) Improve the resiliency and reliability of the transportation system and reduce or mitigate storm-water impacts of surface transportation;” -23 CFR 450.306(b)

**Effective Date:** June 27, 2016
FAST Act Requirements (Statewide)

“(c) The long-range statewide transportation plan shall reference, summarize, or contain any applicable short-range planning studies; strategic planning and/or policy studies; transportation needs studies; management systems reports; emergency relief and disaster preparedness plans;” - 23 CFR 216(c)

• **Effective Date:** Long-range statewide transportation plans adopted after May 2018
“(f) The metropolitan transportation plan shall, at a minimum, include: 7) Assessment of capital investment and other strategies to preserve the existing and projected future metropolitan transportation infrastructure, provide for multimodal capacity increases based on regional priorities and needs, and reduce the vulnerability of the existing transportation infrastructure to natural disasters.” -23 CFR 450.324(f)(7)

• **Effective Date:** On or after May 27, 2018, an MPO meets requirements to adopt a metropolitan transportation plan
FAST Act Requirements
(Asset Management Plan)

• “(c) A State DOT shall establish a process for developing a risk management plan. This process shall, at a minimum, produce the following information: (6) Risk management analysis, including the results for NHS pavements and bridges, of the periodic evaluations under part 667 of this title of facilities repeatedly damaged by emergency event.”

• “(h) A State DOT shall integrate its asset management plan into its transportation planning processes that lead to the STIP, to support its efforts to achieve the goals in paragraphs (f)(1) through (4) of this section.” -23 CFR 515.7 (c)(6) and 515.9 (h)

• **Effective Date:** October 2, 2017
FAST Act Requirements (Periodic Evaluation of Facilities Due to Emergency Events)

• “State DOTs must evaluate facilities that have repeatedly been damaged in emergency events.” -23 CFR Part 667 - PERIODIC EVALUATION OF FACILITIES REPEATEDLY REQUIRING REPAIR AND RECONSTRUCTION DUE TO EMERGENCY EVENTS

• **Effective Date:** Due by November 23, 2018
Integrating Resilience in Transportation Planning

Project: Integrating Resilience into the Transportation Planning Process
https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/planning/

- Workshops and Peer Exchanges
- White Paper
- Q&A Document (February 2019)
- Case Studies (February 2019)
- Handbook (March 2019)
Approaches to Incorporating Resilience in Planning

- Include resilience in transportation plan goals and objectives
- Identify, evaluate, and adopt strategies to address identified vulnerabilities
- Screen projects during planning to avoid making investments in particularly vulnerable areas
- Include resilience in the criteria for evaluating projects for funding
- Consider future environmental conditions in corridor planning studies
Project: Asset Management and Resilience

- Pilot projects and associated reports (Early 2019)
  - Arizona
  - Texas
  - Kentucky
  - Maryland
  - New Jersey
  - Massachusetts

- Guidebook on addressing resilience in Asset Management (Summer 2019)
Approaches to Incorporating Resilience in Asset Management

Include resilience focus in two sections of required State Transportation Asset Management Plans (TAMPs):

• **Risk management plan**...that identifies at a minimum risks associated with current and future environmental conditions, extreme weather events, etc. (23 CFR Part 515.7(c))

• **Life-cycle planning**, which should include a range of factors that could affect whole life cost of assets, including current and future environmental conditions, extreme weather events, etc. (23 CFR Part 515.7(b))

First complete TAMPs due June 2019
Integrating Resilience in Project Design

- Transportation Engineering Approaches to Climate Resiliency (TEACR)
  - Overall lessons learned for engineering
  - Coastal Hydraulics
  - Riverine Flooding
  - Pavements and Soils
  - Mechanical and Electrical Systems
- HEC 25: Highways in the Coastal Environment, V2
  - How to incorporate extreme events in coastal design
  - Sea level rise, storm surge, wave action
  - 3 approaches (low, medium, high level of effort)
- HEC 17: Highways in the River Environment
  - Strategies ranging from sensitivity analysis with higher discharges to integrating climate model rainfall projections into local hydrologic models
Approaches to Integrating Resilience in Project Design

Engineering-Focused Case Studies

- Gulf Coast 2 Study
- Adaptation Pilots
- Post-Sandy Resiliency Study
- TEACR
Assessments:
- I-10 Bridge and wave action (AL)
- Living shoreline and sea level rise (NY)
- Pavement overwashing (FL)
- Pavement and drought (TX)
- Precipitation and slope stability (VA)
- Forest fire and debris loading (CO)
- Pavement and freeze-thaw (ME)
- Pavement, permafrost thaw (AK)
- Economic Analysis (ME)
Integrating Resilience into Emergency Response

FHWA Resources:

- FHWA ER Manual
- ER and Resilience FAQ
- FHWA ER Order
- 23 CFR 667

Two ways ER funds can be used to improve resilience when repairing/rebuilding damaged highway:

1. Bring up to current standards
2. Cost-effective betterment (would save FHWA ER program money over time)

“The FHWA supports planning, designing and constructing highways to adapt to current and future climate change and extreme weather events under the Federal-aid program. Features that will improve the resilience of repaired federal aid highways should be considered and evaluated consistent with risk, cost effectiveness and regulatory conditions. The evaluation should apply the best available scientific and economic information to forecast and assess future risk factors.” FHWA ER Manual, p60.
Approaches to Incorporating Resilience into Emergency Response

1. Prior to disasters, ensure transportation plans and asset management plans include resilience.
2. Ensure State has completed evaluation of facilities repeatedly requiring repair, as required by 23 CFR 667.
3. When developing Detailed Damage Inspection Reports (DDIR), discuss the cause of the asset failure and likelihood of recurrence. Discuss potential for resilience improvements.
4. Develop and review cost effectiveness analyses for betterments.
5. After the emergency event, ensure the DOT updates the 667 evaluation.
6. Share best practices with other States through FHWA’s ongoing technical assistance and information sharing webinars, case studies, and trainings.
Vulnerability Assessment and Adaptation Framework, 3rd Edition

• Provides an in-depth and structured process for conducting a vulnerability assessment.

• Features examples from assessments conducted nationwide.

• Includes links and references to related resources and tools.
2010-11 Pilot
2013-15 Pilot
Special Studies

Post-Sandy Project
USDOT Gulf Coast Study Phases 1 and 2
Vulnerability Assessment Studies
Resilience and Durability Pilots To Date
An international conference on natural hazards & extreme weather events

CONTRIBUTE
Submit your ideas for conference topics and tracks online now at www.TR2019.org

PRESENT
Solicitation for Abstracts will commence in March 2019. More information will be forthcoming from TRB and will be posted on the TR2019 website.
Thank You!

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https://www.fhwa.dot.gov/environment/sustainability/resilience/