

FHWA RESILIENCE PRIMER



U.S. Department of Transportation
Federal Highway Administration

FHWA Resilience Primer

Wisconsin Annual Planning Conference
October 30, 2017



Sustainable Transportation and Resilience

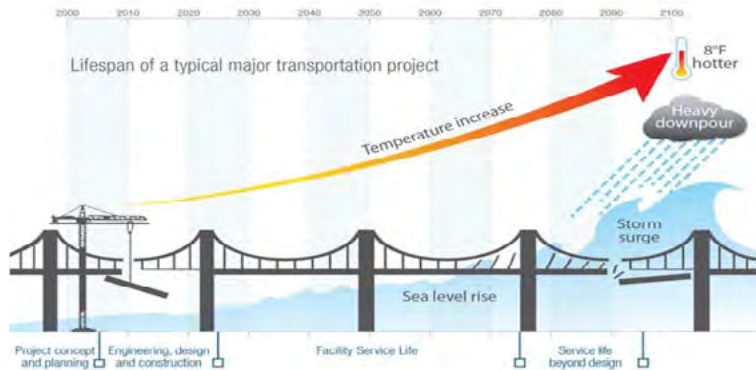
Roadmap

- Resilience
 - Definitions
 - Regulations
 - Guidance
- FHWA Resources and Tools
 - INVEST
 - Vulnerability Assessments

FHWA RESILIENCE PRIMER

What is Resilience?

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



Source: FHWA Gulf Coast Study | USGCRP, National Climate Assessment 2014

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Why is resilience important?

Extreme weather events are disrupting transportation systems across the country



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

—[National Academy of Sciences](#) and [National Climate Assessment](#)

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FHWA Resilience Related Policy & Regulations

- **Policy** Order 5520 commits FHWA to integrating climate risk considerations into programs
- Climate adaptation activities eligible for FHWA **funding**
- Risk-based **asset management** plans must include climate risks
- Assets requiring repeated repair require **analysis of alternatives** to rebuild-in-kind
- State and metro **transportation plans** should now include resilience as a planning factor
- **Emergency relief** program guidance encourages cost-effective resilience strategies

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What does the planning rule say?

23 CFR 450.200 & 23 CFR 450.300

Take into consideration resiliency needs

23 CFR 450.206(a) & 23 CFR 450.306(b)

Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation

23 CFR 450.316(b)

Consult with agencies and officials responsible for natural disaster risk reduction when developing a MTP and TIP

23 CFR 450.324(f)(7)

Assess capital investment and other strategies that reduce the vulnerability of the existing transportation infrastructure to natural disasters

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Integrating Resilience

Goal: Mainstream 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.”



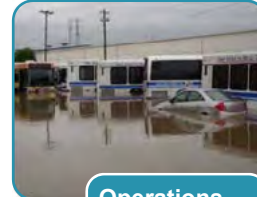
Planning

- Long Range Transportation Plans
- Asset Management Plans



Project Level

- Environmental Processes
- Engineering
- Design



Operations and Maintenance

- Emergency Relief
- Snow Removal Programs

FHWA RESILIENCE RESEARCH SNAPSHOT

Research

Gulf Coast 2 Study



Vulnerability Pilots



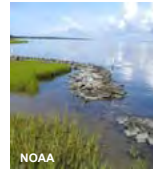
Hurricane Sandy Project



Engineering Assessments Study



Green Infrastructure Pilots



Resources

Vulnerability Assessment Framework



Guidance (HEC-25 & 17)



Synthesis of Approaches for Addressing Resilience in Project Development



Green Infrastructure Techniques for Coastal Highway Resilience



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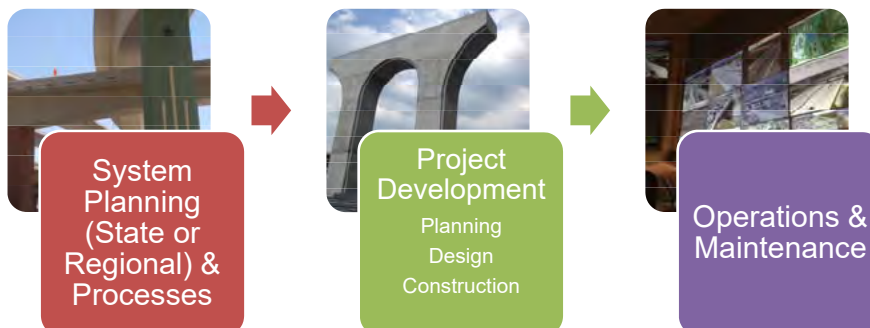
INVEST – Sustainability Assessment Tool



- Practical, web-based self-assessment tool
- Helps agencies assess and improve sustainability Triple Bottom Line
- Specific to transportation
- Voluntary, free and easy to use
- *Evaluate, Score, Improve!*

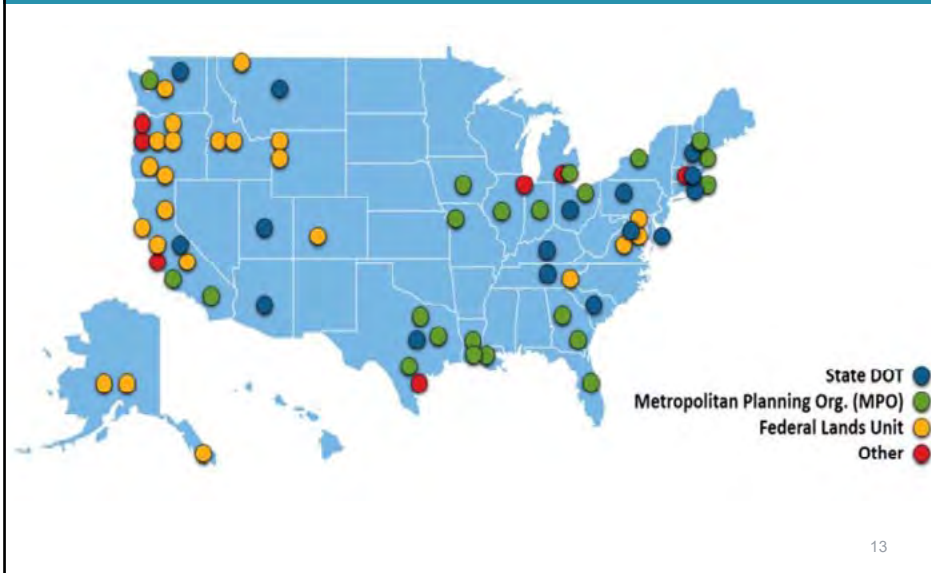
www.sustainablehighways.org

Supporting the Entire Life Cycle



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INVEST Implementation Sites



INVEST Planning Criteria

- Integration of Transportation with Land Use, Energy and Environmental Planning
- Access and Affordability
- Safety
- Systems Management and Operations
- Multimodal
- Freight
- Travel Demand Management
- Financial
- **Infrastructure Resilience**

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INVEST – One place to start

SPR-16: Infrastructure Resiliency For Regions

Goal: Anticipate, assess, and plan to respond to vulnerabilities and risks associated with current and future hazards (including those associated with climate change) to ensure multi-modal transportation system reliability and resiliency.

Identify a range of vulnerability and risks to both existing and planned transportation infrastructure.



INVEST SPR-16 Infrastructure Resilience Requirements

- 1) Develop and adopt goals and objectives
- 2) Coordinate with partner agencies
- 3) Integrate vulnerability and risk assessment information into planning documents
- 4) Develop and implement adaptation and resilience strategies
- 5) Develop performance measures
- 6) Demonstrate sustainable outcomes

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Adaptation Strategies

- 1.Planning for Redundancy
- 2.Build protection for existing facilities
- 3.Relocate vulnerable transportation facilities, whether existing or planned
- 4.Consider climate/weather changes in asset management planning
- 5.Conduct vulnerability and risk assessment to integrate climate change risk.

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Vulnerability Assessments



- FHWA's Climate Change and Extreme Weather Vulnerability Assessment Framework

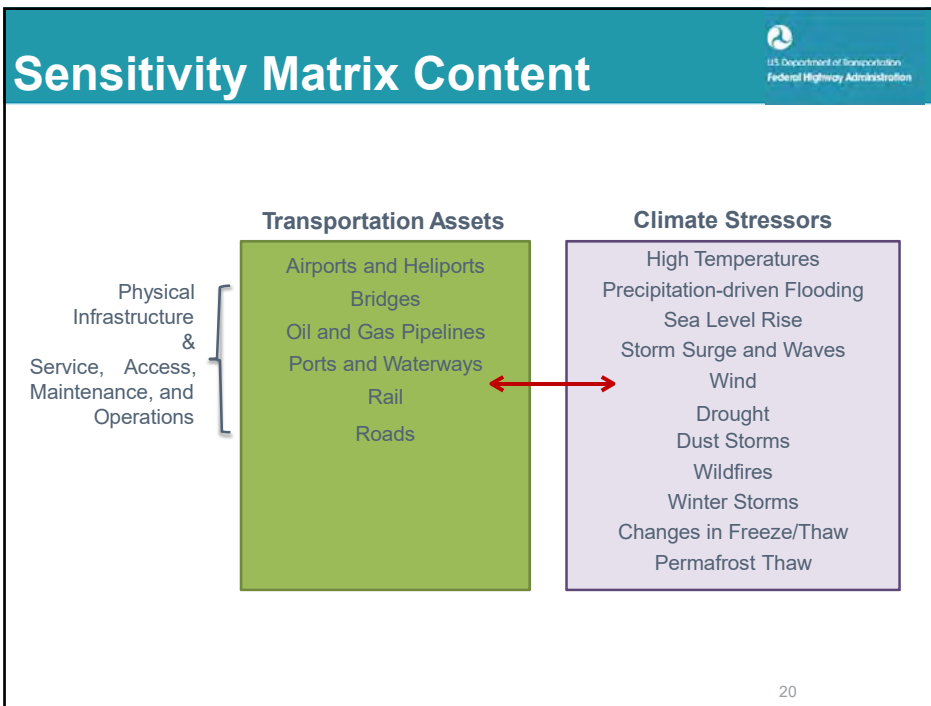
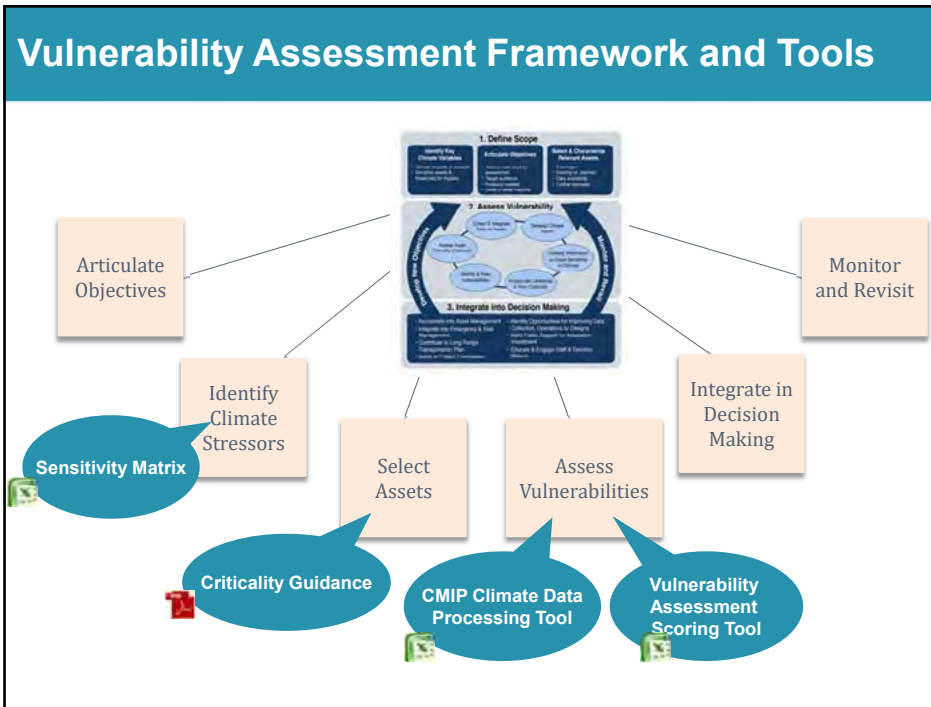
- Helps users implement the framework by providing tools, videos, case studies, and related resources

www.fhwa.dot.gov/environment/adaptationframework/

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Transportation Climate Change Sensitivity Matrix



Spreadsheet-based reference tool

Covers relationship between 6 asset types and 11 climate stressors

Answers question: **What happens when each asset type experiences each stressor?**

For each combination, provides:

- Qualitative relationship
- Thresholds
- Indicators of sensitivity
- Resources



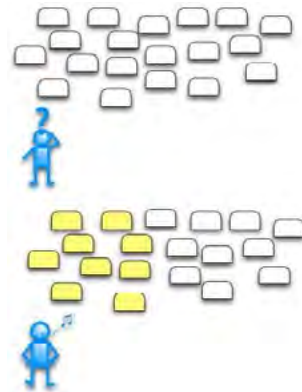
Asset Type	Climate Stressor	Qualitative Relationship	Thresholds	Indicators of Sensitivity	Resources
Airports and Airports	Increased Temperature and Extreme Heat	...	...	...	...
Airports and Airports	Sea Level Rise and Coastal Flooding	...	...	...	...
Airports and Airports	Other	...	...	...	...

Criticality Guidance



Guidance Document

- Describes process of identifying which transportation assets are critical
- Provides possible criticality indicators
- Includes examples of criticality assessments



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Example Criticality Criteria



Socioeconomic

- Lack of redundancy
- Provides access to school, government buildings
- Serves economic centers
- Provides multi-modal linkage
- Component of national and international commerce system
- Serves transit-dependent populations

Operational

- Functional classification
- Usage

Health & Safety

- Evacuation route
- Component of Disaster Relief and Recovery Plan
- Component of National Defense System
- Provides access to medical, health, and safety facilities
- Provides hazardous waste transport

CMIP Climate Data Processing Tool



• What does it do?

1. Helps a user find and access downscaled climate data at the local scale (up to 56 mi²)
2. Processes the “raw” climate data into more detailed variables

Sample Temperature Outputs

- Annual averages
- Hottest temperature of the year
- 95th and 99th percentile temps
- # of days and consecutive days per year and season above 95, 100, 105, and 110°F

Sample Precipitation Outputs

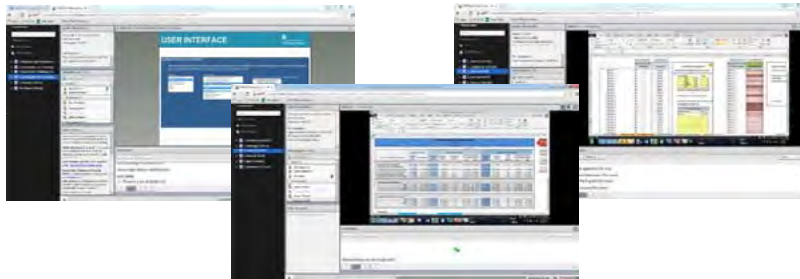
- 95th and 99th percentile 24-hour precip
- Annual and seasonal precipitation
- Annual maximum 24-hour precipitation (time series)
- Largest seasonal 3-day precip

Tool Training Resources



Training Webinars

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



User Guides

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

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Questions?

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