FHWA Vulnerability Assessment Framework and INVEST Sustainability Tool

Southeast Florida Regional Climate Leadership Summit
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Climate Change and Extreme Weather Vulnerability Assessment Framework

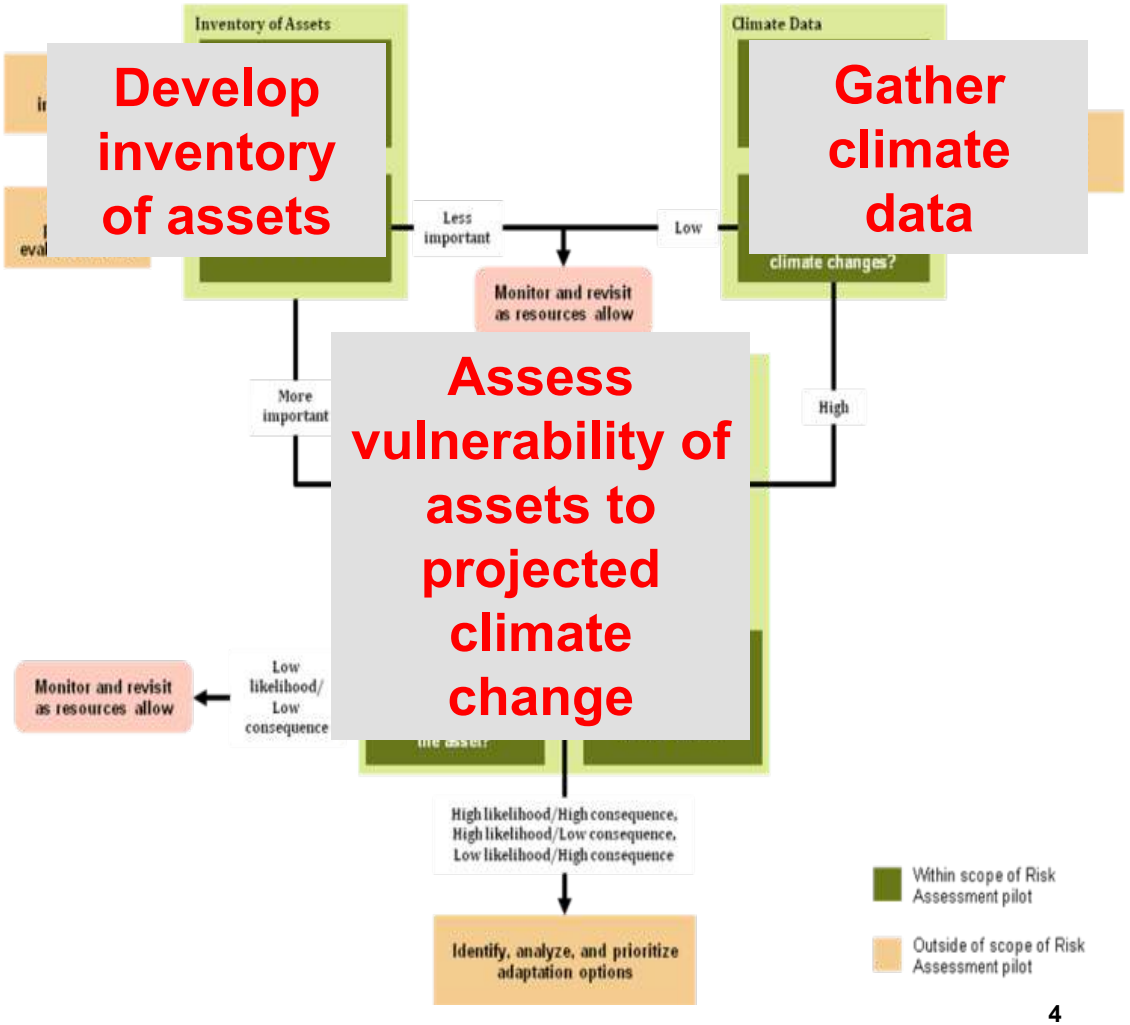
Climate Change Adaptation at FHWA

- **Goal:** Systematic consideration of climate change vulnerability and risk in transportation decision making, at system and project level
- **Approach:** Develop and share information on tools and methodologies that state DOTs and MPOs can use to assess risk and prioritize actions

Photo: Flooding of the Hugh L. Carey Tunnel in NYC due to Hurricane Sandy. Source: MTA

FHWA's Vulnerability Assessment Conceptual Model/Framework

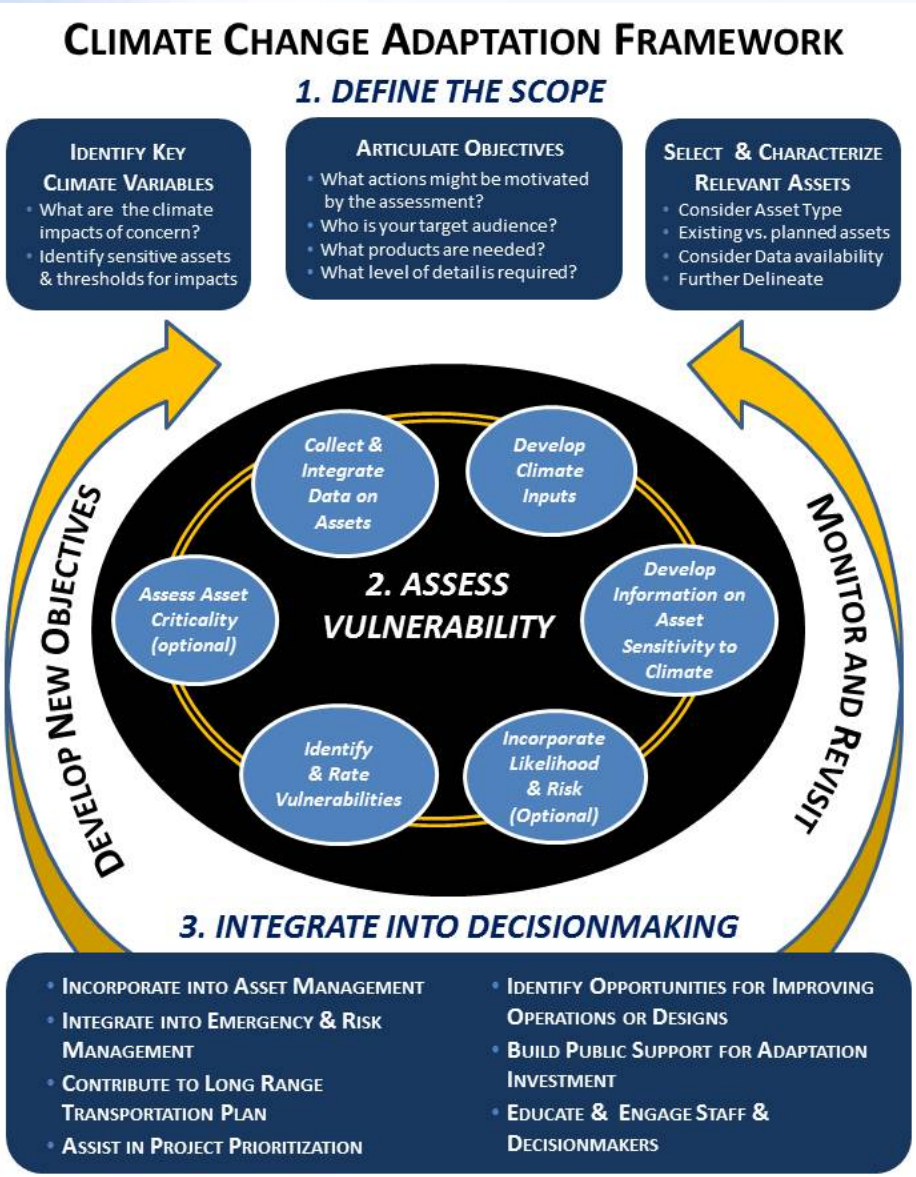
- Draft framework developed in 2010
- Conducted pilot program 2010-2011
  - Help DOTs and MPOs more quickly advance existing adaptation assessment activities
  - Assist FHWA in test driving the framework



Climate Change Vulnerability and Risk Assessment 2010-2011 Pilot Locations

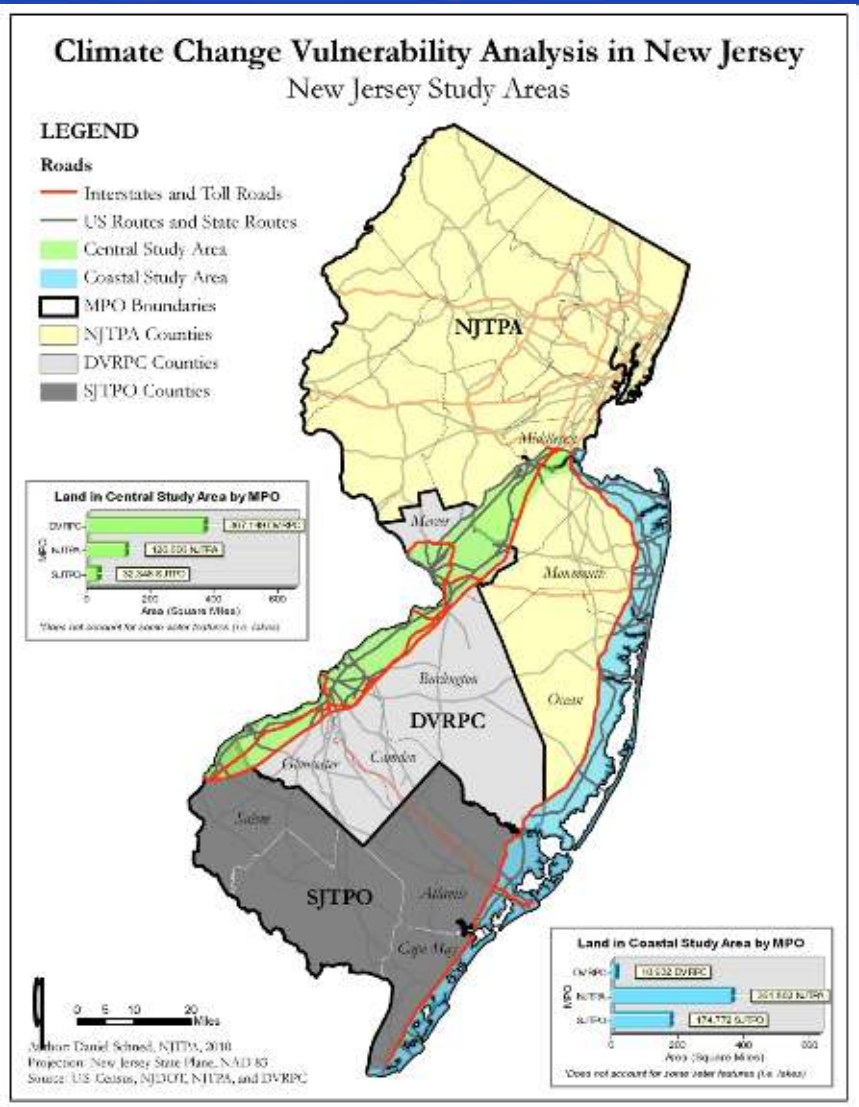
Vulnerability Assessment Framework

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



Defining Project Scope - Objectives

- Articulate Objectives
  - What actions might be motivated by the assessment?
  - Who is your target audience?
  - What products are needed?
  - What level of detail is required?



Defining Project Scope – Choose Relevant Assets for Assessment

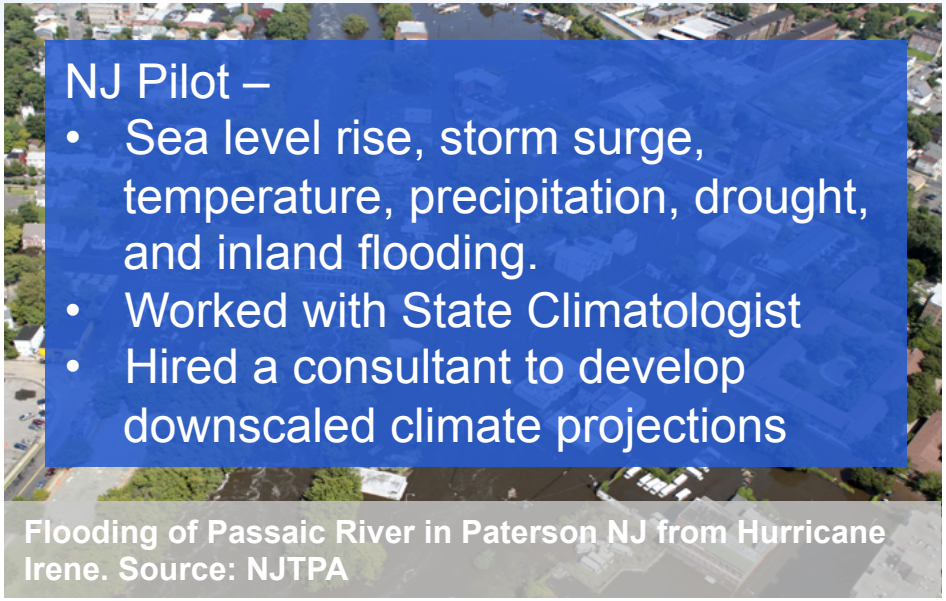
- Select and Characterize Relevant Assets
  - Asset Type
  - Existing vs. planned assets
  - Ownership / Jurisdiction
  - Consider Data availability

Assets to Consider:

- ☑ Bridges and tunnels
- ☑ Culverts
- ☑ Road segments
- ☑ Key evacuation routes
- ☑ Rail lines and rail yards
- ☑ Transit system facilities and vehicles
- ☑ Port and airport infrastructure
- ☑ Signals and traffic control centers
- ☑ Emergency operations systems
- ☑ Intelligent Transportation Systems (ITS)
- ☑ Signs and other roadside assets
- ☑ Pipelines
- ☑ Wetlands
- ☑ Floodplains

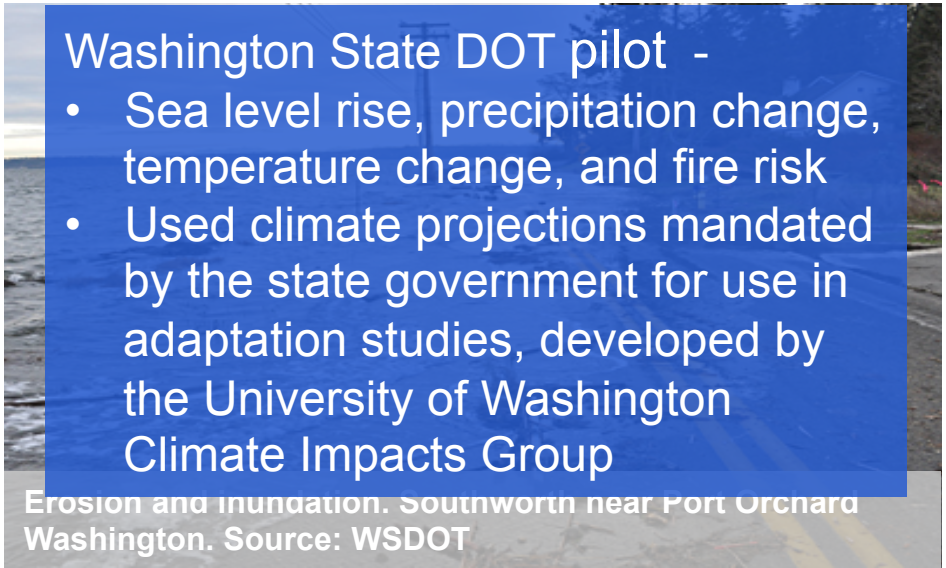
Defining Project Scope – Climate Variables

- What are climate impacts of concern?
  - Flooding
  - Sea level rise and storm surge
  - More intense precipitation events
  - Snowpack changes
  - Increase in hurricane intensity
  - Increase in very hot days
  - Permafrost thawing



NJ Pilot –
- Sea level rise, storm surge, temperature, precipitation, drought, and inland flooding.
- Worked with State Climatologist
- Hired a consultant to develop downscaled climate projections

Flooding of Passaic River in Paterson NJ from Hurricane Irene. Source: NJTPA



Washington State DOT pilot -
- Sea level rise, precipitation change, temperature change, and fire risk
- Used climate projections mandated by the state government for use in adaptation studies, developed by the University of Washington Climate Impacts Group

Erosion and inundation. Southworth near Port Orchard Washington. Source: WSDOT

Assessing Vulnerability

- **Assess Vulnerability**
  - Develop Climate Inputs
  - Collect and Integrate Data on Assets
  - Assess Asset Criticality
  - Develop Information on Asset Sensitivity to Climate
  - Identify and Rate Vulnerabilities
  - Incorporate Likelihood and

Assessing Vulnerability – WSDOT Criticality Assessment

Very low to low				Moderate		Critical to Very Critical			
1	2	3	4	5	6	7	8	9	10
Criticality of asset									

Notice that along with the qualitative terms there is an associated scale of 1 to 10, this is to serve as a facilitation tool for some people who may find it useful to think in terms of a numerical scale – although the scoring by each individual is of course subjective. The scale is a generic scale of criticality where "1" is very low (least critical) and "10" is very critical.

Typically involves:
- non-NHS
- low AADT
- alternate routes available

Typically involves:
- some NHS
- non-NHS
- low to medium AADT
- serves as an alternative for other state routes

Typically involves:
- Interstate
- Lifeline
- some NHS
- sole access
- no alternate routes

Assessing Vulnerability – WSDOT Impact Ratings

Impact

10 9 8 7

Complete Failure

Results in **total loss or ruin of asset**. Asset *may* be available for *limited* use after at least 60 days and **would require major repair or rebuild over an extended period of time**.

"Complete and/or catastrophic failure" typically involves:

- Immediate road closure
- Travel disruptions
- Vehicles forced to reroute to other roads
- Reduced commerce in affected areas
- Reduced or eliminated access to some destinations

May sever some utilities. May damage drainage conveyance or storage systems.

Complete Failure

6 5 4

Temporary Operational Failure

Results in **minor damage and/or disruption** to asset. Asset would be available with either full or limited use within 60 days.

"Temporary operational failure" typically involves:

- Temporary road closure, hours to weeks
- Reduced access to destinations served by the asset
- Stranded vehicles

Possible temporary utility failures.

Temporary Operational Failure

3 2 1

Reduced Capacity

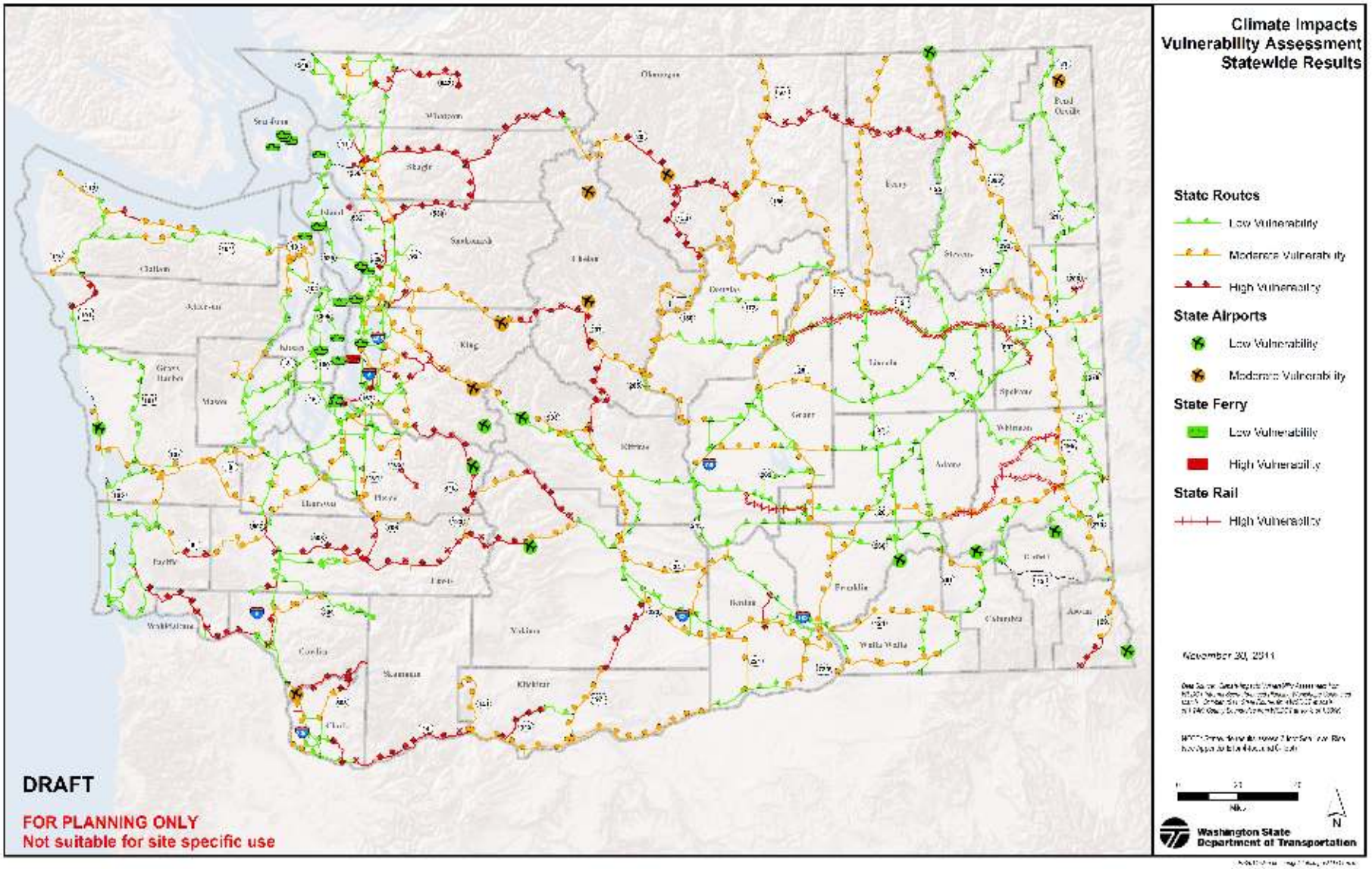
Results in **little or negligible impact** to asset. Asset would be available with full use within 10 days and has **immediate limited use still available**.

"Reduced capacity" typically involves:

- Less convenient travel
- Occasional/brief lane closures, but roads remain open
- Some vehicles may move to alternate routes.

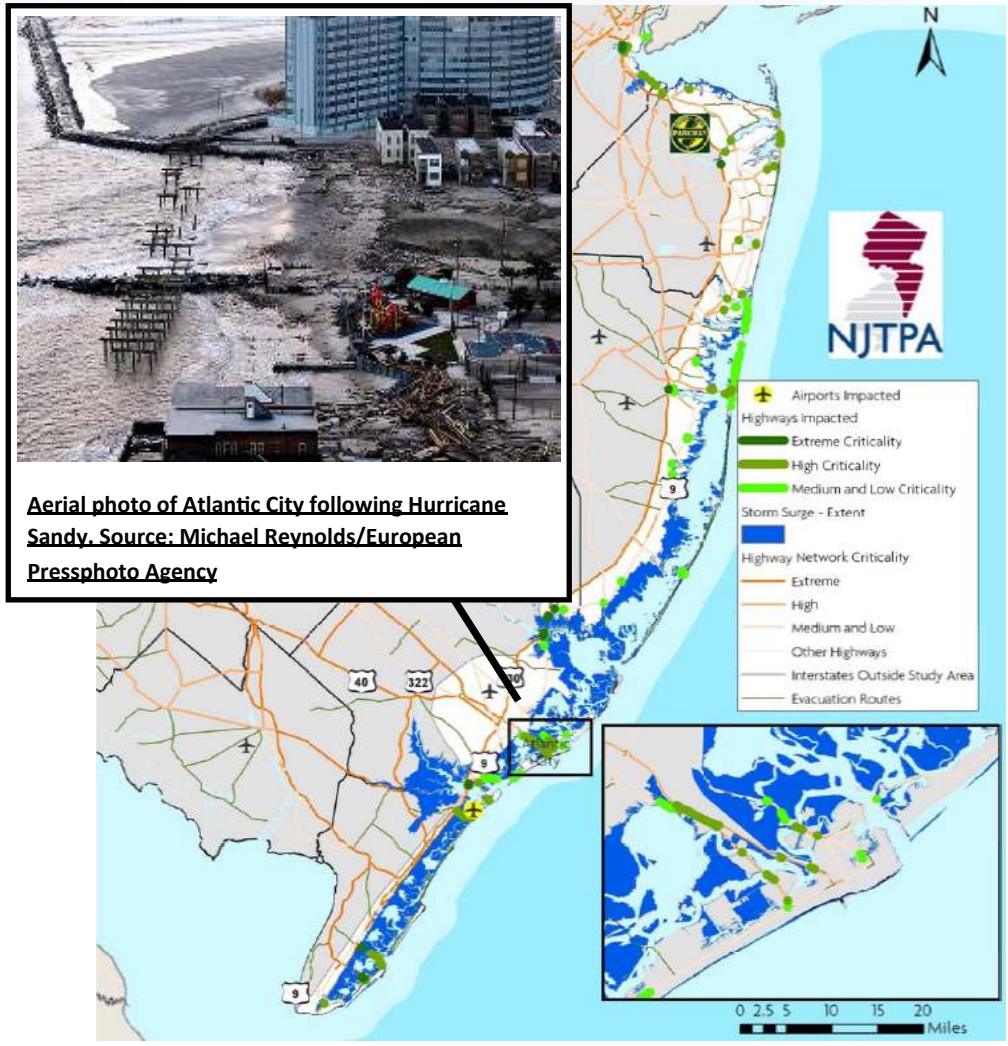
Reduced Capacity

Assessing Vulnerability – WSDOT Assessment Results



Assessing Vulnerability – NJ Assessment Results

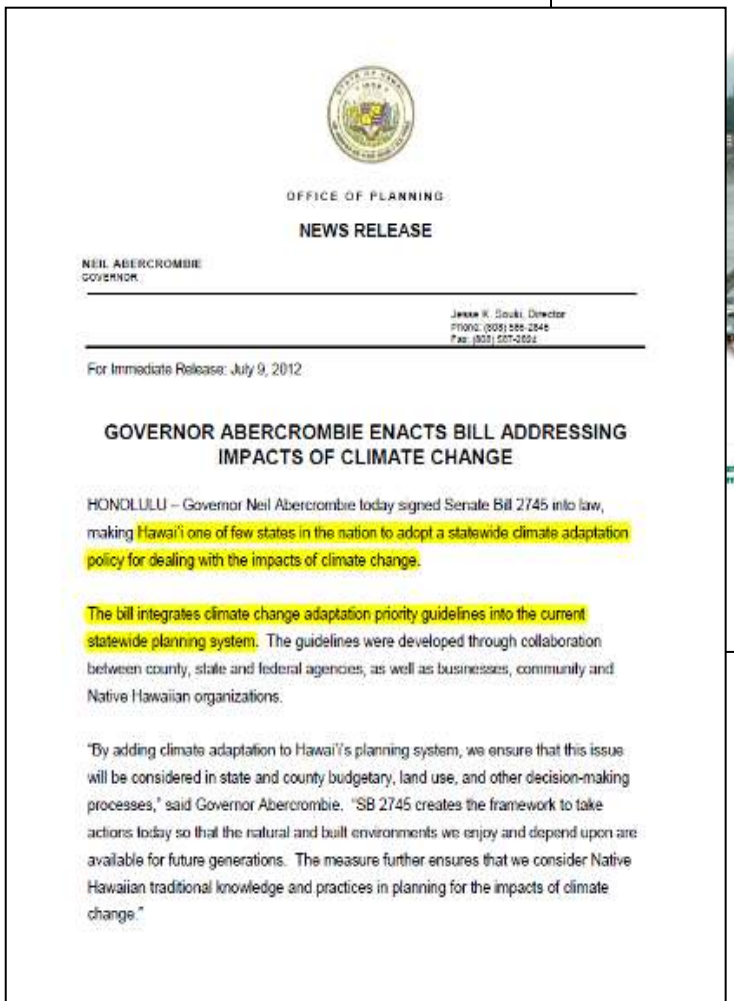
- 2100 Coastal area inundation:
  - 48 miles roadway (43 on major roads)
  - 3 miles NJ Transit tracks
  - 31 total rail miles impacted
  - Ocean city municipal airport



SLR 1 Meter, 2100, Coastal Study Area (Roadways). Source NJTPA

Integrate Results into Decision Making

- **WSDOT**
  Pilot results incorporated into project level environmental guidance
- **Oahu MPO**
  Pilot findings used in developing legislation on incorporating adaptation into statewide planning



OFFICE OF PLANNING

NEWS RELEASE

NEIL ABERCROMBIE
GOVERNOR

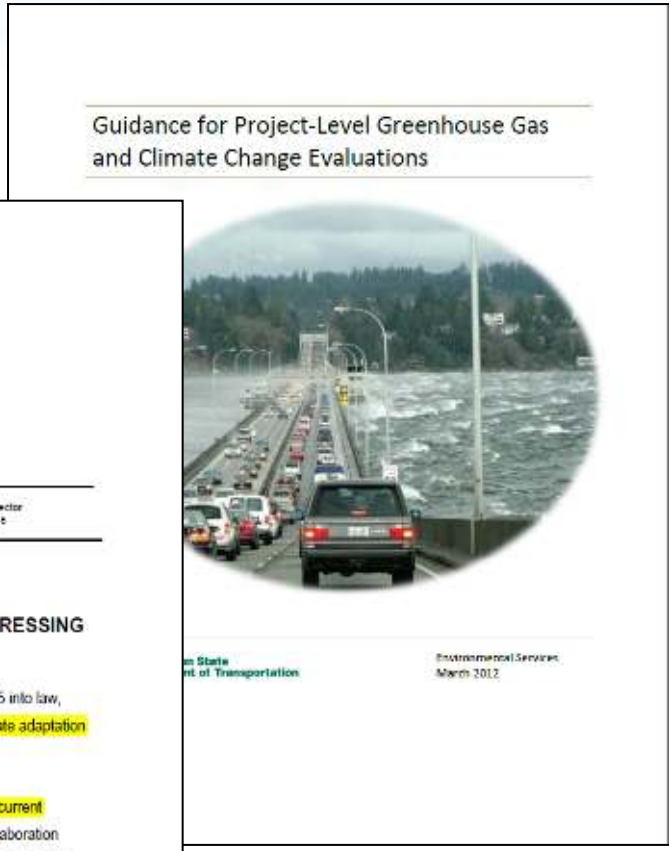
For Immediate Release: July 9, 2012

GOVERNOR ABERCROMBIE ENACTS BILL ADDRESSING IMPACTS OF CLIMATE CHANGE

HONOLULU – Governor Neil Abercrombie today signed Senate Bill 2745 into law, making Hawai'i one of few states in the nation to adopt a statewide climate adaptation policy for dealing with the impacts of climate change.

The bill integrates climate change adaptation priority guidelines into the current statewide planning system. The guidelines were developed through collaboration between county, state and federal agencies, as well as businesses, community and Native Hawaiian organizations.

"By adding climate adaptation to Hawai'i's planning system, we ensure that this issue will be considered in state and county budgetary, land use, and other decision-making processes," said Governor Abercrombie. "SB 2745 creates the framework to take actions today so that the natural and built environments we enjoy and depend upon are available for future generations. The measure further ensures that we consider Native Hawaiian traditional knowledge and practices in planning for the impacts of climate change."



2013-2014 Pilot Program
Vulnerability Assessments and Adaptation Options

FHWA is soliciting descriptions of proposed pilot projects from transportation agencies in two areas:

- assessments of transportation vulnerability to climate change and extreme weather events
- options for improving resiliency of transportation facilities or systems to climate changes and/or extreme weather events.

2013-2014 Pilot Program (cont.)

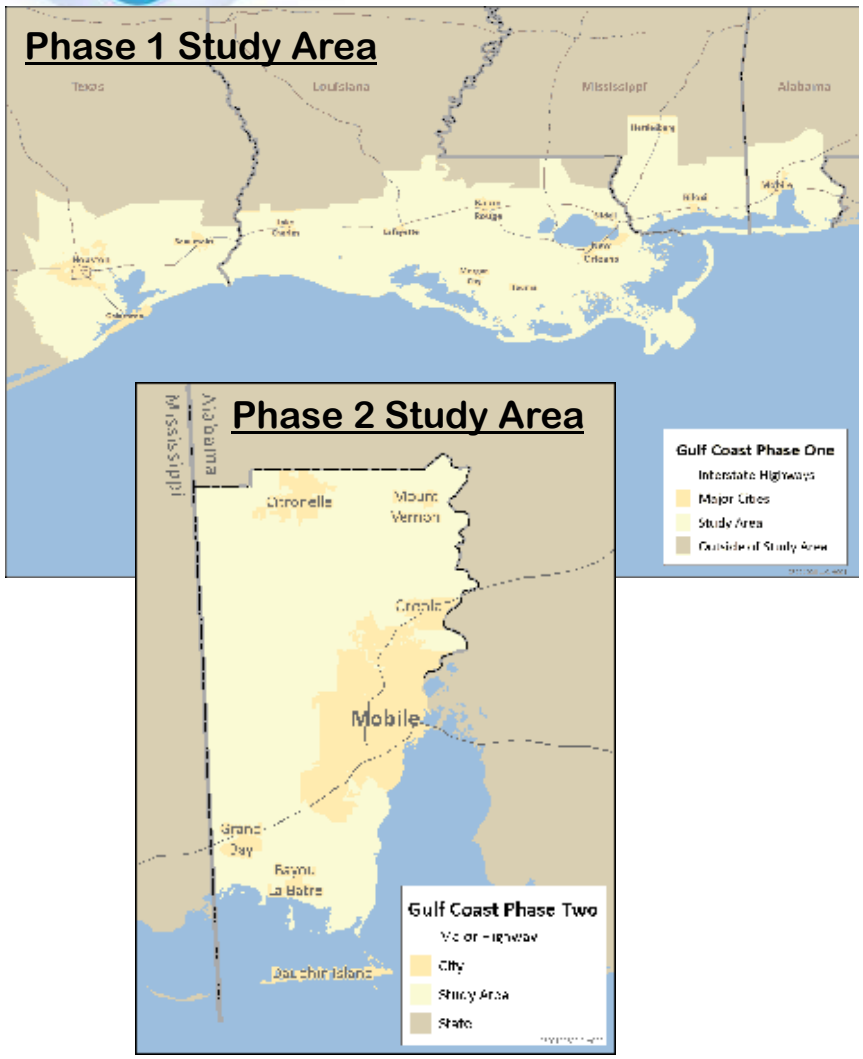
Timeline

- November 2012: Call for Pilots Released
  - Informational webinars on December 6th and December 18th (register on FHWA website)
- January 22, 2013: Proposed project descriptions due to FHWA Division Offices
- February 19, 2012: FHWA HQ announces selected pilot projects

FHWA Climate Change Adaptation Activities and Resources

- **Vulnerability and risk assessment conceptual model (2010), update (2012)**
- **Pilots of vulnerability / risk assessment conceptual model (2011, 2013)**
- Gulf Coast Study: Impacts of Climate Variability and Change on Transportation Systems and Infrastructure (U.S. DOT)
  - Phase 1 – Gulf-wide (2008) [SAP 4.7]
  - **Phase 2 – Mobile, AL (ongoing)**
- Regional Climate Change Effects: Useful Information for Transportation Agencies [Climate Effects Typology] (2010)
- Potential Impacts of Global Sea Level Rise on Transportation Infrastructure: Mid-Atlantic Focus (2008) (U.S. DOT)
- **Adaptation Funding Eligibility Memo (2012)**

Gulf Coast 2 Project – Detailed Study at Metropolitan Scale



- **Primary Phase 2 Tasks**
  - Task 1: Identify critical transportation assets in Mobile (complete)
  - Task 2: Identify climate impacts, assess infrastructure sensitivity (complete)
  - Task 3: Assess vulnerability of critical assets (2012-2013)
  - Task 4: Develop risk management tools for transportation agencies to conduct similar analyses (2012-2013)
- Available from the FHWA website

FHWA Funding for Adaptation Work

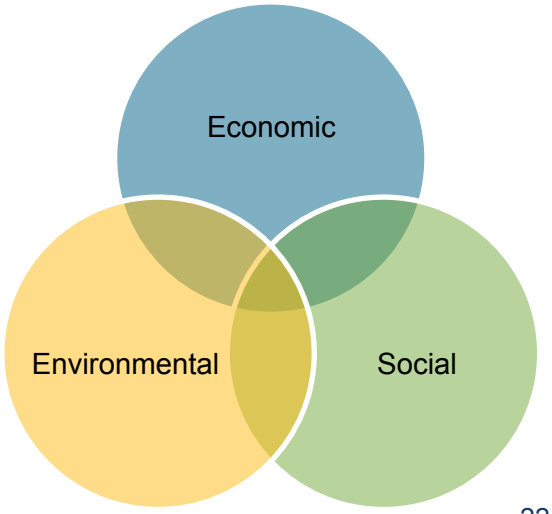
- FHWA released a memo on using Federal-aid and Federal Lands funding for adaptation activities to address
  - Extreme weather events
  - Climate change impacts
- Three sections: Memo, Qs & As, Funding category-specific information
- Clarifies eligibility for various activities
  - Planning (e.g., vulnerability assessments)
  - Design (e.g., designing to handle potential impacts)
  - Construction, etc.
- Memo available at: http://www.fhwa.dot.gov/federalaid/120924.cfm

INVEST

ECONOMIC • SOCIAL • ENVIRONMENTAL

What is a Sustainable Highway System?

- Integral part of sustainable development
- Satisfies functional requirements
  - Fulfills transportation goals and needs
- Addresses development and economic growth
- Avoids, minimizes, reduces impacts
  - Environment
  - Consumption of resources



Sustainability and FHWA

- Stress implementation of sustainable practices: sustainability = action
- Deliver the Federal Aid and Federal Lands Highway Programs in a more sustainable way
- Make wise investment decisions w/limited resources
- Encourage changes in professional practice
- Include sustainability throughout the decision making process
- Go beyond compliance
- Seek Balanced solutions – Not just a GREEN Initiative

Sustainable Highways Initiative

- Promote coordination within FHWA and with other FHWA initiatives
- Strengthen engagement with DOTs and MPOs
- Case Studies to highlight sustainable practices
- Website to serve as portal to access information on activities and available resources: www.sustainablehighways.dot.gov
- Develop tools: INVEST

What is INVEST?

INVEST
ECONOMIC • SOCIAL • ENVIRONMENTAL

INVEST - Infrastructure Voluntary Evaluation Sustainability Tool

A web-based self-evaluation tool for assessing sustainability over the life cycle of a transportation project or program — from system and project planning through design and construction, to operations and maintenance

Built for the Real World

- Voluntary - use it how and where you want
- Private - data belongs to you
- Free - no licenses, no limits
- Tangible & Practical - relates to things you do everyday

Supporting the Entire Lifecycle

INVEST Goals

- Encourage implementation of sustainable practices
- Help agencies assess their level of sustainability implementation and identify areas for internal improvement
  - Assess single or multiple projects
  - Prospective vs. retrospective
  - Planning or O&M programs and processes
- Provide a framework for communicating with stakeholders and decision makers about sustainability
- Establish a method for identifying sustainable best practices in highway systems, projects, programs

Evolution of INVEST

Beta Test Version

- Released Fall 2010
- Over 700 comments from AASHTO, EPA, SMEs, others

Pilot Test Version

- Released Fall 2011
- Over 1200 comments from pilot test participants, SMEs, FTA, others

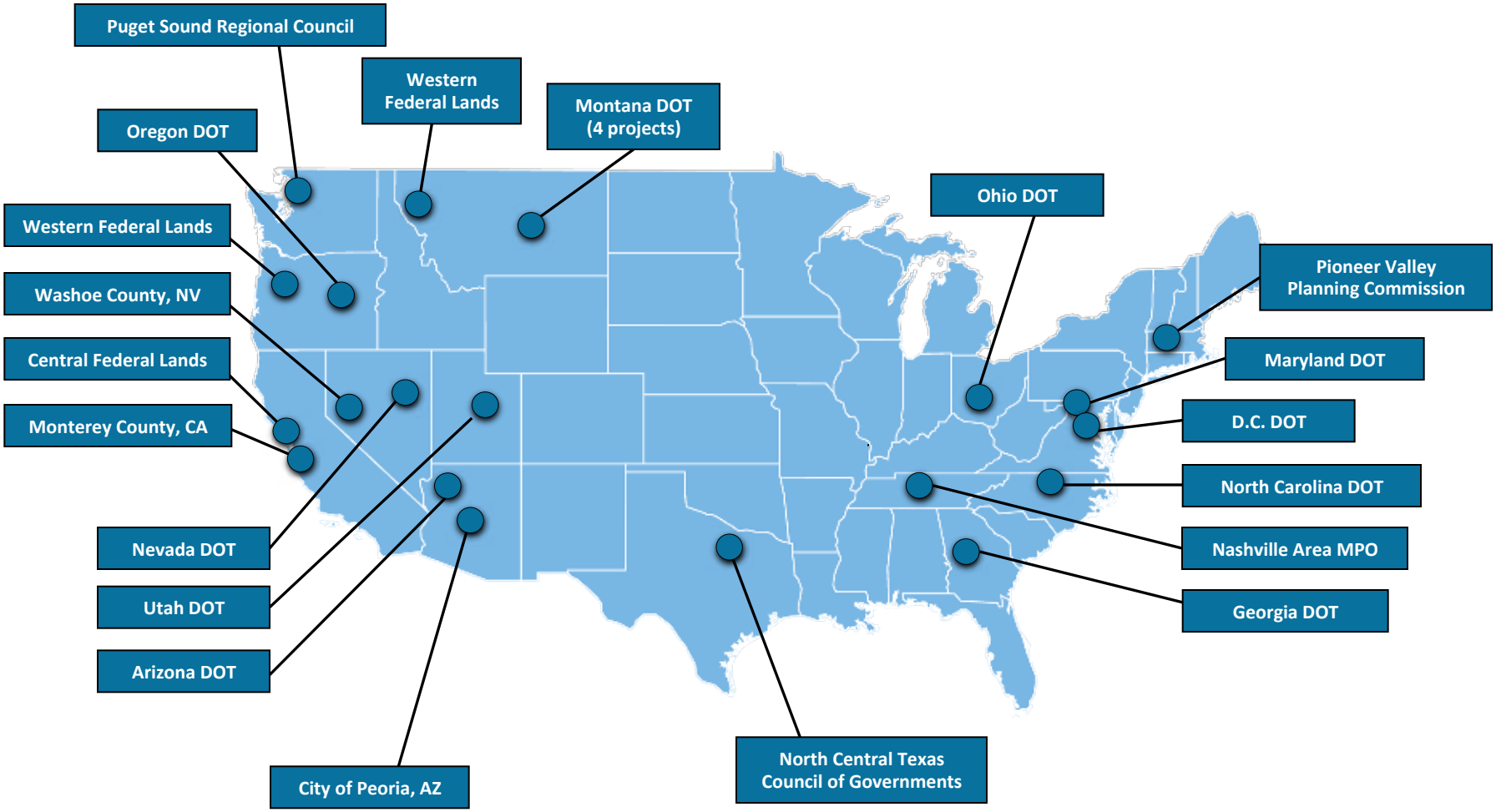
Version 1.0

- Released October 2012

Pilot Testing of INVEST

- Testing done on the Project Development (PD), System Planning (SP) and Operations & Maintenance (OM) criteria from July 2011 – February 2012
- Objectives were to obtain input on:
  - further refinements to the criteria
  - scoring and achievement levels
  - making the tool easier to use
- Process varied across pilot test agencies

INVEST Pilot Sites



Rte 156th W. Corridor Realignment

INVEST Role: Project Development

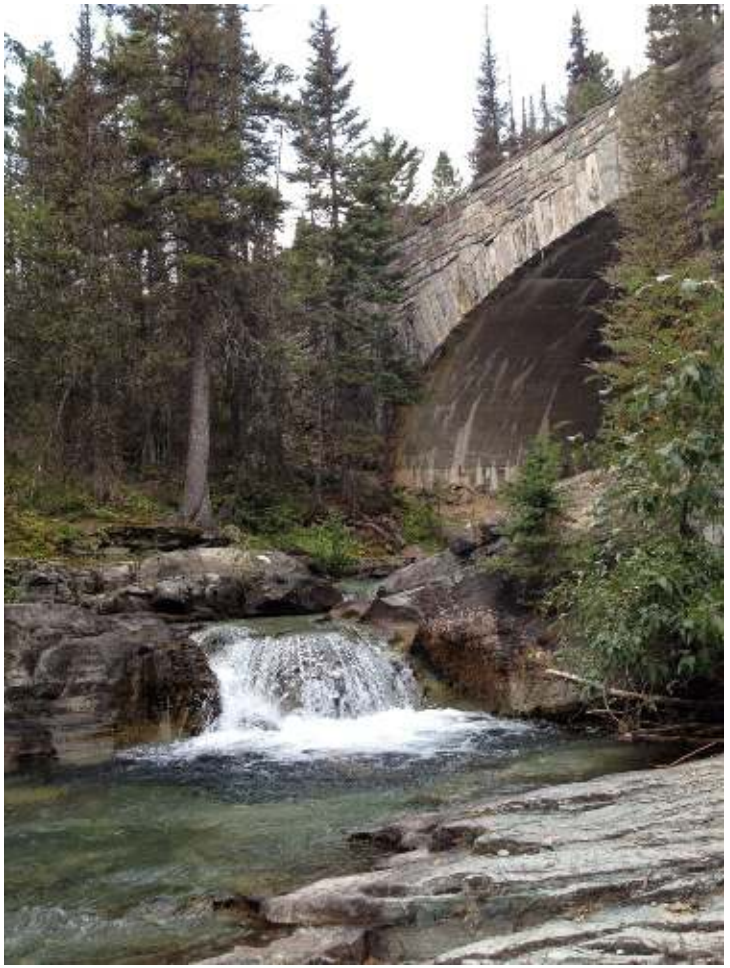
- Environmental document submitted
- Reviewed against current design + standard practices → scored Gold
- Team identified key ideas to incorporate more sustainable features that would get them to Platinum
- Evaluation will influence decisions on this project
- Will evaluate again in design and construction

Western Federal Lands

Glacier National Park - National Scenic Parkway

INVEST Role: Project Development

- 70 years of traffic, weather, avalanches & rockslides
- Aggressive 20-year seasonal rehab program keeps road open but work moving ahead
- Reusing all existing stonework, re-seeding disturbed roadsides
- INVEST helped validate context sensitivity but also improve their documentation & communications



Utah Department of Transportation (UDOT)

Maintaining a State-Wide Highway System

INVEST Role: Operations & Maintenance

- Traffic monitoring & coordination across 6K+ center-line miles of highways
- Key goals: preserve infrastructure, optimize mobility, improve safety, strengthen the economy
- Budget pressures driving need for more sustainable practices
- Used INVEST to ID inexpensive ways to promote sustainability, like better data about pavement conditions

North Central Texas Council of Governments (NCTCOG)

Large Multi-Modal Transportation Plan

INVEST Role: System Planning & Processes

- Rapid regional growth: 6.5M to 10M
- Projected funding shortfall of $45B
- Need to increase mobility, cut some improvements & reprioritize others
- Influence travel behavior & demand, improve transportation / land use links
- Extend life of existing assets, increase spending on O&M
- Used INVEST to validate assumptions, ID improvements in asset management and infrastructure resiliency

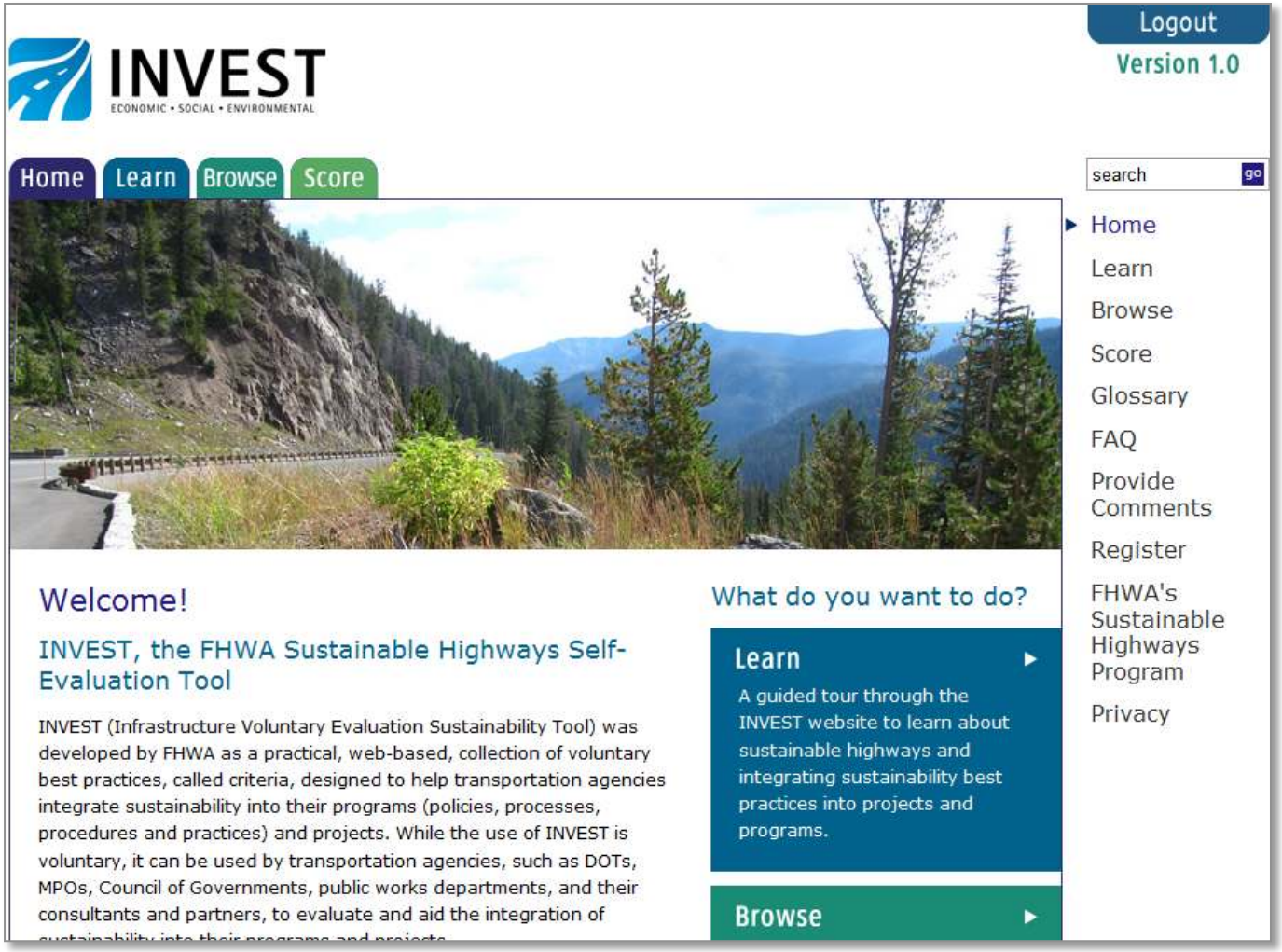
Lessons Learned from Pilots

- Overall pilot agencies were supportive and enthusiastic about INVEST
- Programmatic application most useful
- Pilot agencies suggested many good technical and contextual changes to the criteria and web interface
- Pilot agencies would like to see:
  - More information and a guide for using the tool
  - Additional examples of sustainable practices, case studies, etc.

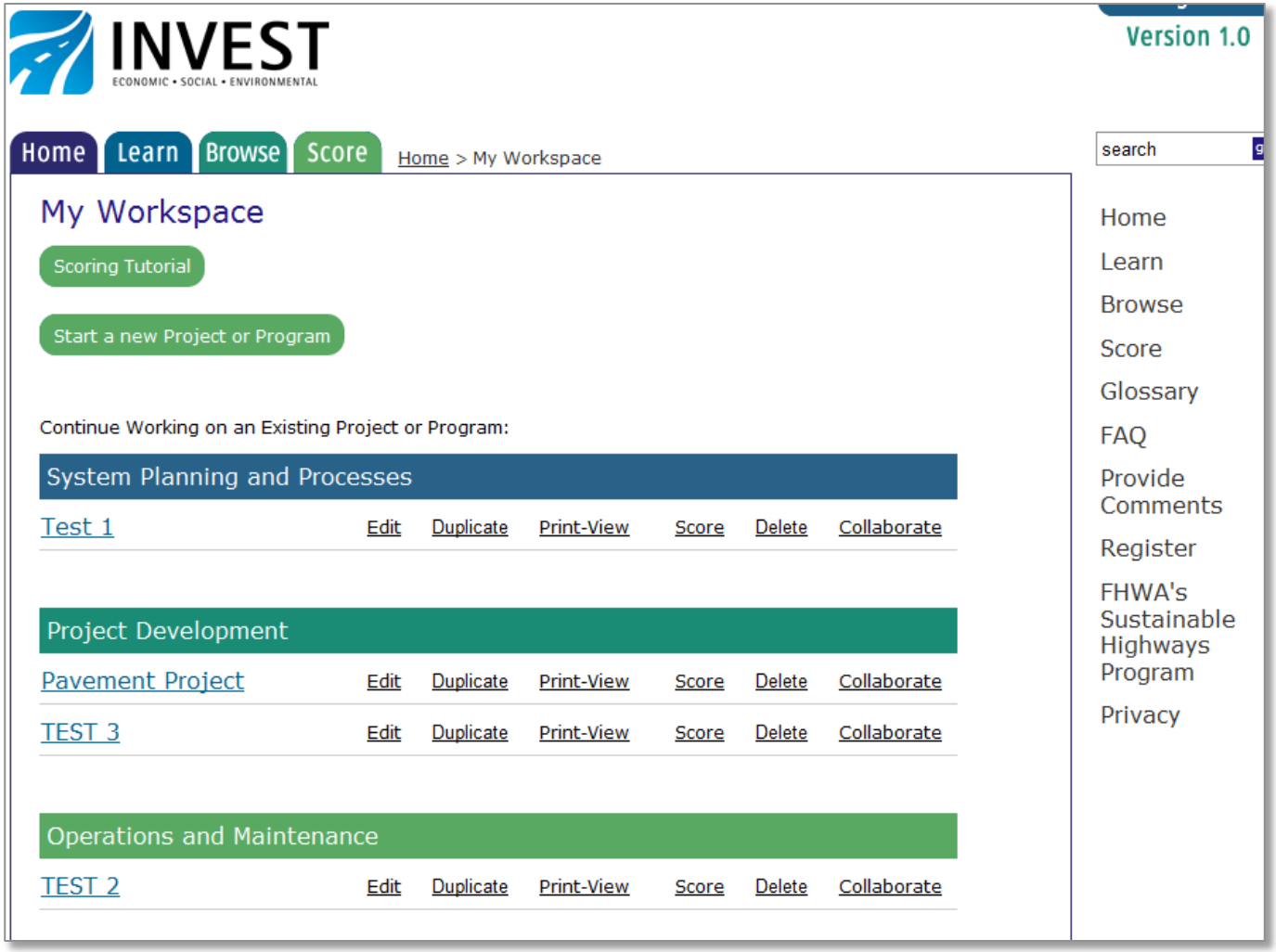
Changes for INVEST 1.0

- Significant changes to the criteria in all three modules
- More flexibility in selecting relevant PD criteria to address project concerns/context
  - urban vs. rural
  - large vs. small
- More opportunities for partial credit (i.e., gradation in point scale within criteria)
- Putting more emphasis on the process of using the tool and learning (not the score!)

About INVEST 1.0

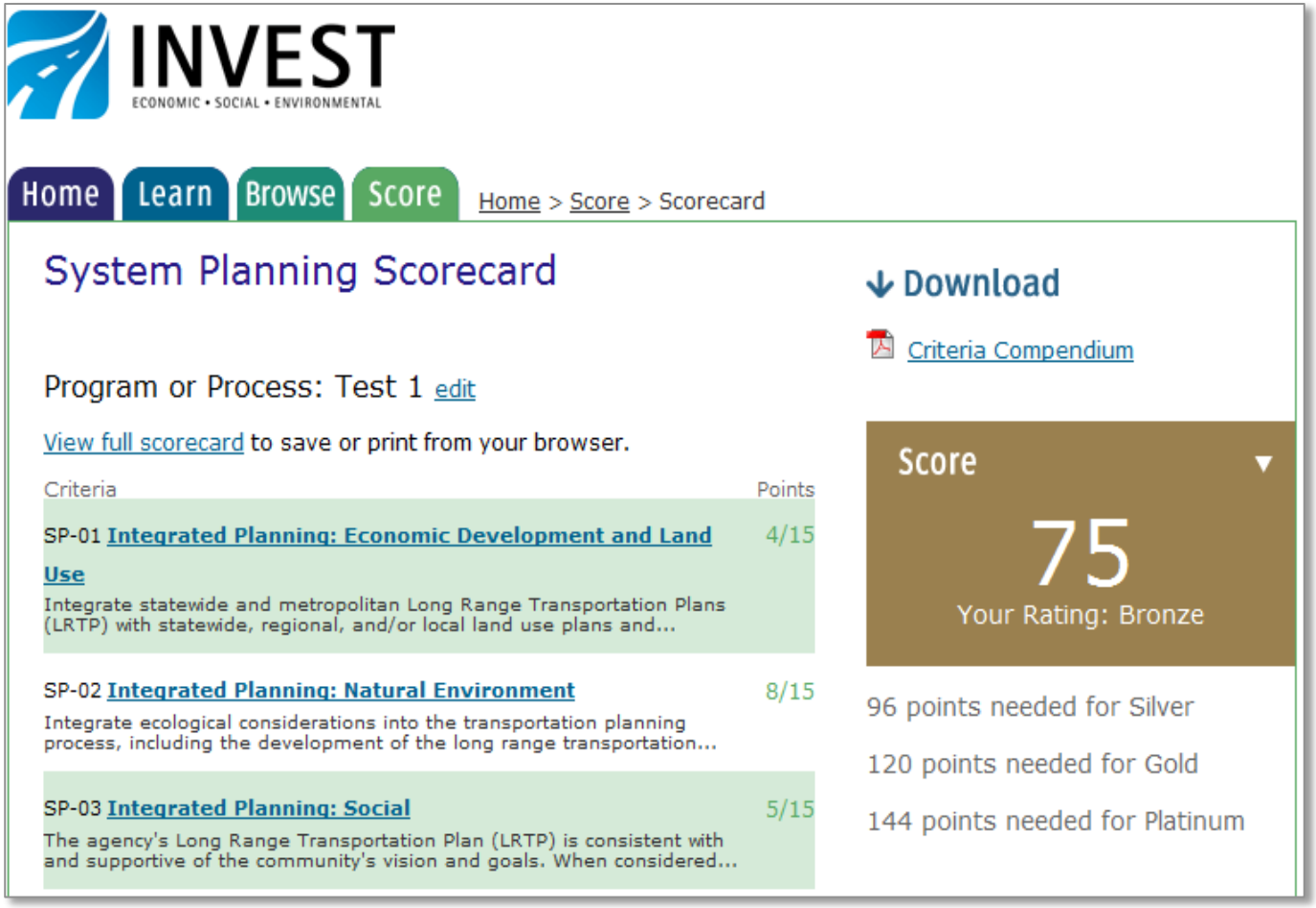


INVEST User Workspace



Scoring in System Planning

How INVEST Measures Sustainability



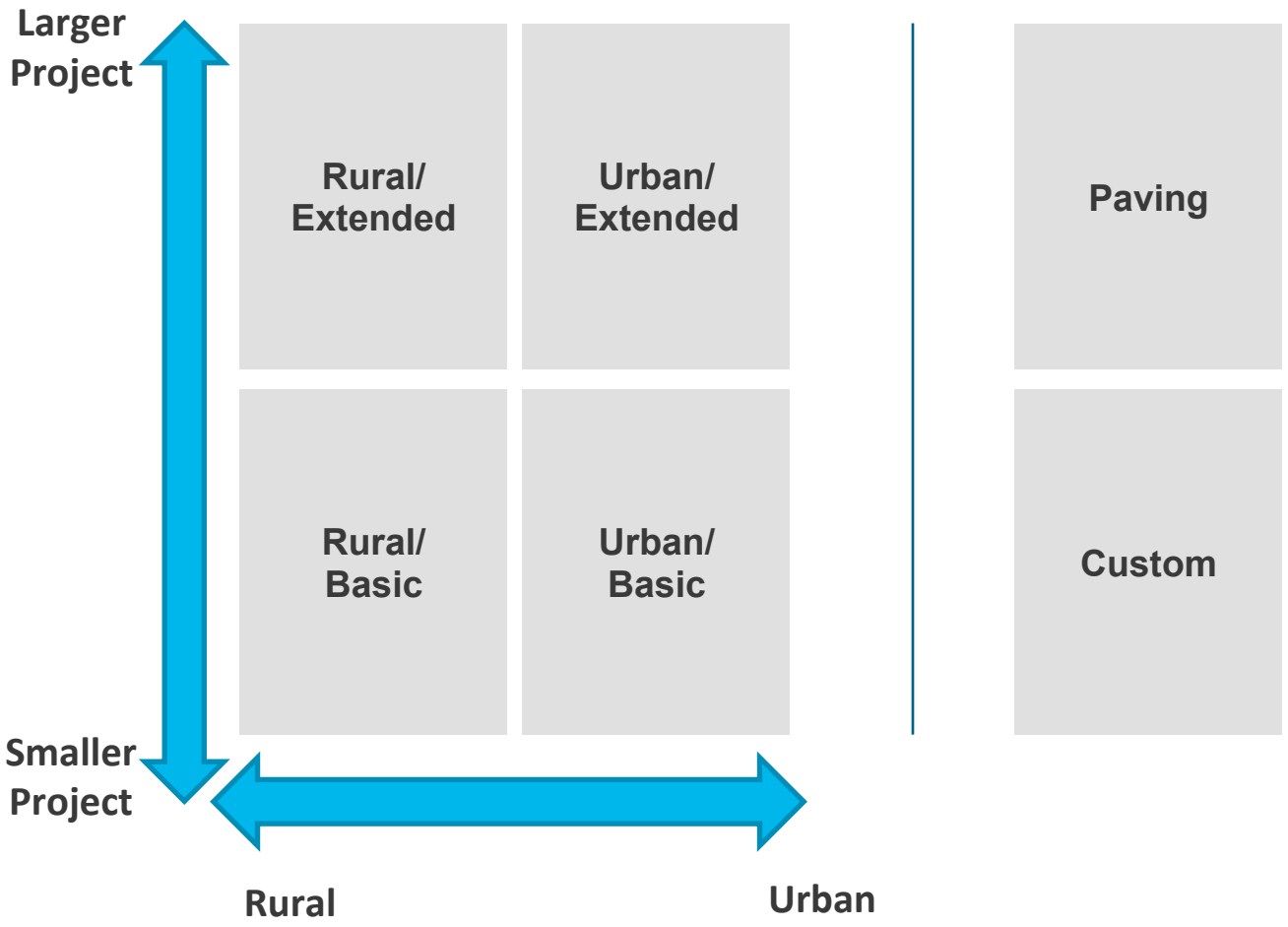
Version 1 Project Development Criteria

PD-1	Economic Analyses
PD-2	Lifecycle Cost Analysis
PD-3	Context Sensitive Project Development
PD-4	Highway and Traffic Safety
PD-5	Educational Outreach
PD-6	Tracking Environmental Commitments
PD-7	Habitat Restoration
PD-8	Stormwater
PD-9	Ecological Connectivity
PD-10	Pedestrian Access
PD-11	Bicycle Access
PD-12	Transit & HOV Access
PD-13	Freight Mobility
PD-14	ITS for System Operations
PD-15	Historical, Archaeological, and Cultural Preservation
PD-16	Scenic, Natural, or Recreational Qualities
PD-17	Energy Efficiency
PD-18	Site Vegetation

Version 1 Project Development Criteria

PD-19	Reduce and Reuse Materials
PD-20	Recycle Materials
PD-21	Earthwork Balance
PD-22	Long-Life Pavement Design
PD-23	Reduced Energy and Emissions in Pavement Materials
PD-24	Contractor Warranty
PD-25	Construction Environmental Training
PD-26	Construction Equipment Emission Reduction
PD-27	Construction Noise Mitigation
PD-28	Construction Quality Control Plan
PD-29	Construction Waste Management

Multiple Scorecards to Fit Your Project



Version 1 Operations & Maintenance Criteria

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OM-1	Internal Sustainability Plan
OM-2	Electrical Energy Efficiency and Use
OM-3	Vehicle Fuel Efficiency and Use
OM-4	Reuse and Recycle
OM-5	Safety Management
OM-6	Environmental Commitments Tracking System
OM-7	Pavement Management System
OM-8	Bridge Management System
OM-9	Maintenance Management System
OM-10	Highway Infrastructure Preservation and Maintenance
OM-11	Traffic Control Infrastructure Maintenance
OM-12	Road Weather Management Program
OM-13	Transportation Management and Operations
OM-14	Work Zone Traffic Control

Next Steps

- INVEST 1.0 was released on October 10th
  - Link to the recorded event @ www.sustainablehighways.org
- Initiation of Deployment Program (PY13)
  - Request for deployment sites released soon
- INVEST Toolkits
- Monitor performance/impact of INVEST 1.0
- INVEST 1.X, 2.0…beyond

Try INVEST at www.sustainablehighways.org

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Thank you

www.fhwa.dot.gov/hep/climate_change