National and State Perspectives: Considering Climate is Responsible Asset Management

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2017 Resiliency Peer Exchange on Extreme Weather and Climate Impacts
Washington, DC
November 6, 2017
Key Questions

- What resources are out there for transportation agencies?
- How have national pilot projects helped shape our path forward?
  - Examples from WA State
  - Inspiration from other states
- Is partnering important?
- What are WSDOT’s next steps to integrating climate resilience into decision making?
**FHWA Snapshot – Lots of Resources Available**

<table>
<thead>
<tr>
<th>Research</th>
<th>Resources</th>
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<tbody>
<tr>
<td>Gulf Coast 2 Study</td>
<td>Vulnerability Assessment Framework (HEC-25 &amp; 17)</td>
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<tr>
<td>Vulnerability Pilots</td>
<td>Guidance for Addressing Resilience in Project Development</td>
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<tr>
<td>Hurricane Sandy Project</td>
<td>Synthesis of Approaches for Addressing Resilience in Project Development</td>
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<tr>
<td>Engineering Assessments Study</td>
<td>Green Infrastructure Techniques for Coastal Highway Resilience</td>
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<tr>
<td>Green Infrastructure Pilots</td>
<td>2017 Synthesis is a must read!</td>
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</table>
1. Addressing Resilience in Project Development (Sept 28)
2. Lessons Learned in Transportation Engineering Related to Coastal and Riverine Flooding (Oct 5)
3. Lessons Learned in Transportation Engineering Related to Pavement/Soils & Mechanical/Electrical Vulnerabilities (Oct 12)
4. Post-Hurricane Sandy Transportation Resilience Study in NY, NJ, and CT (Oct 26)
5. Green Infrastructure Pilots I (Nov 2)
6. Green Infrastructure Pilots II (Nov 9)
7. FHWA’s Climate Change & Extreme Weather Vulnerability Assessment Framework (Nov 16)

Resilient and Sustainable Transportation Systems Program

Products & Programs

- State-by-State Interactive Map
- Extreme Weather 101 Briefs
- Extreme Weather Sessions
- Extreme Weather Events Symposium 2013
- Workshop on Adapting Infrastructure to Extreme Weather Events, 5/20/12
- National Climate Change Symposium (2010)
- Climate Change Adaptation Strategies Workshop, 11/17/10
- State DOT Climate Change Workshops
- Webinar Series

Related Resources

- Federal Agencies
- State Agencies
Observed Changes in the Climate

Global Observations

Observations of global temperatures spanning longer than a century indicate that the Earth has warmed by 1.5°F on average between 1880 and 2012 (Figure 1). Warmer temperatures are not limited to the atmosphere; ocean surface waters (top 250 ft.) warmed by +0.6 to +0.9°F from 1971 to 2009 (global
FEDERAL HIGHWAYS CLIMATE PILOT PROJECTS

+ 2010-11 Pilot
+ 2013-15 Pilot
+ 2016-2017 Nature-based Coastal Solutions
FHWA's FRAMEWORK (updated following pilots)

Define Scope
- Identify Key Climate Variables
  - Climate Impacts of concern
  - Sensitive assets & thresholds for impacts
- Articulate Objectives
  - Actions motivated by assessment
  - Target audience
  - Products needed
  - Level of detail required
- Select & Characterize Relevant Assets
  - Asset type
  - Existing vs. planned
  - Data availability
  - Further delineate

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

Integrate into Decision Making
- Incorporate into Asset Management
- Integrate into Emergency & Risk Management
- Contribute to Long Range Transportation Plan
- Assist in Project Prioritization
- Identify Opportunities for Improving Data Collection, Operations or Designs
- Build Public Support for Adaptation Investment
- Educate & Engage Staff & Decision Makers

Monitor and Revisit

Develop New Objectives

Develop New Objectives
WSDOT’s CLIMATE VULNERABILITY ASSESSMENT: KEY FACTS

• Only statewide test of FHWA’s framework
• Qualitative rankings for all state-owned assets
  – State highway & interstate routes, ferry terminals, freight rail lines, state-managed airports
• Relied on:
  – Climate change science from UW Climate Impacts Group (CIG)
  – WSDOT’s Asset Management approach
  – Field personnel intimate knowledge
• 14 Workshops, 200 people were asked:
  • What keeps you up at night?
  • What if it gets worse?
  • How resilient are your assets?
What did we find?

- Climate change will intensify known threats to all transportation assets
- Reinforces value of our current maintenance and retrofit programs
  - Fish passage barrier corrections
  - Slope stability projects
  - Stormwater retrofits
- New awareness of combinations of climate risks / extreme events
- Considering climate *is* responsible asset management
STATEWIDE RESULTS
(map shows results with 2 foot sea-rise & all other threats)
Incorporating climate into WSDOT plans and projects

- Agency commitment to use the results of the vulnerability assessment
- Design and Environmental guidance for project teams
  - I-5 JBLM
  - Mukilteo Multimodal
  - SR 167 Completion
- Corridor plan guidance
- Emergency management
- Communicate & educate
- Collaborate
- Track best available climate science

http://www.wsdot.wa.gov/planning/community/WSDOTCommunityPlanningPortal.htm
Co-Benefits: Highlight current practices that are effective adaptation strategies

Before: old culverts obstruct fish passage

Also:
- Habitat connectivity
- Slope Stabilization
- Stormwater Flow Control
- Roadside Vegetation Management

After: WSDOT project removes barrier and restores access to fish and wildlife habitat
WSDOT Update

2017 – 2019 Work Plan Items

• Hydraulics & Environmental Offices guidance
  – Studied implications of WDFW 2016 research report “Incorporating Climate Change into design of Water Crossing Structures”
  – Continue to expand use of WSDOT’s statewide Climate Impacts Vulnerability Assessment (CIVA)
    • Hydraulics Office updated design approach to include a step for “highly vulnerable”
    • Issued climate guidance for WSDOT planners (new for corridor sketches and plans)
    • Updated NEPA/SEPA project guidance (required for EIS and EA's)

• Environmental Office and Olympic Region’s SR 167 Project team collaborating with FHWA and The Netherlands
  – Pilot project funded by FHWA to:
    • Test climate assessment tools and review new guidance (HEC-17)
    • Exchange info on innovations, use of nature-based solutions (SR 167’s riparian restoration)

• Asset Management Planning (23 CFR 667) & State Hazard Reduction Planning
Pacific Northwest Climate Science 2009 & 2013

Changes Relative to the 20th Century

- Temperature (°F)
  - Historical variability
  - 2020s shift in mean
  - 2040s shift in mean
  - 2080s shift in mean

- Precipitation (inches)
  - Historical variability

Source: Climate Impacts Group, University of Washington

But, expect heavier rain events
How resilient are our current fish passage designs?

Tributary to Tawes Creek
12 foot box culvert design using WSDOT’s 5 steps compared to calculations using WDFW’s approach (*)

<table>
<thead>
<tr>
<th>Actual BFW measured</th>
<th>7.1 feet</th>
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<tbody>
<tr>
<td>2040 predicted BFW*</td>
<td>7.6 feet</td>
</tr>
<tr>
<td>2080 predicted BFW*</td>
<td>7.8 feet</td>
</tr>
<tr>
<td>100-year flow</td>
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<td>Stream-sim</td>
<td>12 feet</td>
</tr>
<tr>
<td>2040 Stream-sim*</td>
<td>11.1 feet</td>
</tr>
<tr>
<td>2080 Stream-sim*</td>
<td>11.4 feet</td>
</tr>
<tr>
<td>Final Structure Size</td>
<td>12 ft culvert</td>
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</table>
# Results for 4 fish passage project designs

<table>
<thead>
<tr>
<th></th>
<th>Trib to Tawes Creek</th>
<th>Grovers Creek</th>
<th>Olsen Creek</th>
<th>Gribble Creek</th>
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<tbody>
<tr>
<td>Measured BFW (FT)</td>
<td>7.1</td>
<td>8.8</td>
<td>24</td>
<td>11</td>
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<tr>
<td>2040 predicted BWF (FT)</td>
<td>7.6</td>
<td>9.4</td>
<td>26.3</td>
<td>11.8</td>
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<td>7.8</td>
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<td>27</td>
<td>12.9</td>
</tr>
<tr>
<td>100-yr flow (CFS)</td>
<td>115</td>
<td>58.9</td>
<td>306</td>
<td>130</td>
</tr>
<tr>
<td>500 -yr flow (cfs)</td>
<td>145</td>
<td>76.5</td>
<td>410</td>
<td>177</td>
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<tr>
<td>2040 predicted flow (CFS)</td>
<td>136</td>
<td>73.8</td>
<td>351</td>
<td>129</td>
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<tr>
<td>2080 predicted flow (CFS)</td>
<td>145</td>
<td>82.5</td>
<td>379</td>
<td>141</td>
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<tr>
<td>Stream-sim/bridge design (FT)</td>
<td>12</td>
<td>12.6</td>
<td>32</td>
<td>16</td>
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<td>2040 Stream-sim/bridge design (FT)</td>
<td>11.1</td>
<td>13.3</td>
<td>34.7</td>
<td>17</td>
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<td>2080 Stream-sim/bridge design (FT)</td>
<td>11.4</td>
<td>13.5</td>
<td>36</td>
<td>18</td>
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<tr>
<td>Final Structure Size (5 steps)</td>
<td>12-foot box culvert</td>
<td>13-foot box culvert</td>
<td>45-foot bridge</td>
<td>19-foot box culvert</td>
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Resilience of barrier corrections: before and after

WSDOT’s new culvert (right) on State Route 129 allows fish to access habitat upstream of the old barrier (left) on Rattlesnake Creek.
The Netherlands

Population:
17 Million
[7 Million]

Area:
16,000 sq mi
[71,000 sq mi]

Public Roads:
86,000 miles
[82,000 miles]

[WA State Comparison]
FHWA/RWS Pilot Project

Compare and Contrast EU’s ROADAPT and FHWA’s Climate Change and Extreme Weather Vulnerability Assessment Frameworks

Test scalable approaches that allow analysis of transportation systems

Risk Management for Roads in a Changing Climate (above); FHWA’s Framework (right)

Two highway projects:
SR 167 in Fife, WA and InnovA58, Holland
Projects on both sides

SR167 Tacoma, Washington State

InnovA58, South Netherlands

Credit: Angel Vlar, RWS
Draft paper shows value of green infrastructure approach
Next Steps

- Update our manuals
- Collaborate with partners & researchers
- AASHTO & FHWA
- Pursue actionable science - like research on coastal and tidal projections
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