Climate Change Resilience and the Vermont Agency of Transportation

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“Flooding, Vulnerability and Risk Oh My!”
AASHTO’s 21st Century Mobility for Freight and Passenger Transportation Conference
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Why is VTrans taking action

What data & information are we using

What action is resulting
The Problem for Vermont:

Climate change in the northeast means more intense and frequent storm events and the associated flooding of inland waterways.
Climate Change Preparedness Framing:

1. Response – emergency preparedness

2. Recovery – put back in order after the event

3. Resilience – build and act in such a way as to mitigate the problem in the future – The outcome: No disruptions to transportation needs
Transportation infrastructure typically bears the greatest proportion of economic costs from flood disasters in Vermont.
Major Disaster Declarations in Vermont

Source: Federal Emergency Management Agency

Only part way through the 5 year period
National Weather Service Record Reports for June 2015

RECORD REPORT NATIONAL WEATHER SERVICE BURLINGTON VT 217 AM EDT WED JUN 10 2015 ...RECORD DAILY MAXIMUM RAINFALL SET AT BURLINGTON VERMONT... A RECORD DAILY RAINFALL OF 1.52 INCHES WAS SET AT BURLINGTON VERMONT YESTERDAY JUNE 9TH. THIS BREAKS THE OLD RECORD OF 1.22 SET IN 1889.

RECORD REPORT NATIONAL WEATHER SERVICE BURLINGTON VT 527 PM EDT MON JUN 29 2015 ...RECORD MONTHLY RAINFALL FOR JUNE SET AT MOUNT MANSFIELD VERMONT... AS OF 4 PM MONDAY JUNE 29TH...MOUNT MANSFIELD`S (ELEVATION 3950 FEET) TOTAL RAINFALL FOR THE MONTH OF JUNE 2015 HAS REACHED 15.54 INCHES. THIS BREAKS THE PREVIOUS RECORD FOR JUNE OF 15.28 INCHES SET IN JUNE 1998. WITH ADDITIONAL RAINFALL POSSIBLE...AN UPDATED STATEMENT WILL BE ISSUED AT THE END OF THE MONTH.
The problem and solution as articulated by UVM scientists speaking before the VT Legislature in 2012:

1. Climate change means more intense and frequent storm events and thus big changes in the timing and amount of stream flow
2. Confined and straightened rivers have greater power and erosive force while access to flood plains dissipates energy
3. Imperviousness of the landscape increases discharge

The Basic Approach:

• Give rivers more room to move
• Elevate bridges and take abutments and roadway fill out of the active river belt width
• Slow stormwater flow and allow for infiltration
Inter-agency love
What we thought was true is no longer true.
New VTrans Hydraulics Manual
Site of a culvert destroyed by Tropical Storm Irene in Rochester, VT on a tributary of the White River.

Design for a flood resilient box culvert that was built at the site in 2013. Note outline of temporary culvert put in place as part of the emergency response.
8 of 11 damage sites in Rt. 100 corridor are associated with highest levels of river shear stress (i.e., erosion potential).

Legend

- Irene Damage Sites
- Q100 Shear Stress (lb/sqft)
  - 0 - 33 percentile
  - 34 - 66 percentile
  - 67 - 100 percentile

Q100 Shear Stress - developed using HEC-RAS model for the South Branch Tweed River based on LiDAR elevation data.

HEC-RAS cross-section.
Aerial Imagery and LiDAR obtained by VTRANS - April 2012.
Known damage site

Unknown erosion site

Previously armored site

Legend
- ODOT Irene Damage Sites
- Rte. 100 Mileposts
- Potential Erosion Areas
- HEC-RAS Cross-Sections
- 1 ft Contours (LiDAR)
- Q100 Shear Stress (lbf/ft²)
- Slope (LiDAR)
- Road to River Differential (ft)
- Town Boundaries
- Q100 Shear Stress - developed using HEC-RAS model for the South Branch T上述河岸
- Road to River Differential - difference in elevation between channel bottom and flood surface per LiDAR data along reach
- FEMA imagery and LiDAR data by VTRANS - Apr 27, 2012
Side Slope Design

Before

After
ANR/VTrans Roads and Rivers Training:
http://wsmd.vt.gov/rivers/roadstraining/
Vulnerability Assessment
State and Local Roads

Road locations within High Sensitive River Corridor Reaches

– 3,200 locations on State Highways
– 7,500 locations on Local Roads

Based on preliminary statewide river corridor GIS data by the ANR Rivers Program
Vulnerability Assessment
State Short Structures (6-20 ft. span)

Unknown, 98, 8%

Less Than 80% BFW, 666, 54%

81-94% BFW, 71, 6%

Greater Than 95% BFW, 405, 32%
Tools & Methods for Transportation Resilience Planning

- Software tools to assess vulnerability, probability, consequence, and risk.
- Technical documentation and training materials
- Training workshops
- Transportation System Resilience Plans for three study watersheds. Proposals now being reviewed
- A recommended update to the VTrans Project Prioritization Process
Final Observations

• Focus on Risk

• Incorporate into existing planning & project development

• Use available data

• Understand limitations

• Support innovation

• Collaborate
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