Chittenden County RPC
Communities Planning Together

VTrans Working to Get You There
Vermont Agency of Transportation

Transportation Resilience Planning Tool (TRPT)

CCRPC| March 2, 2022

MILONE & MACBROOM

Fitzgerald Environmental Associates, LLC.
Applied Watershed Science & Ecology

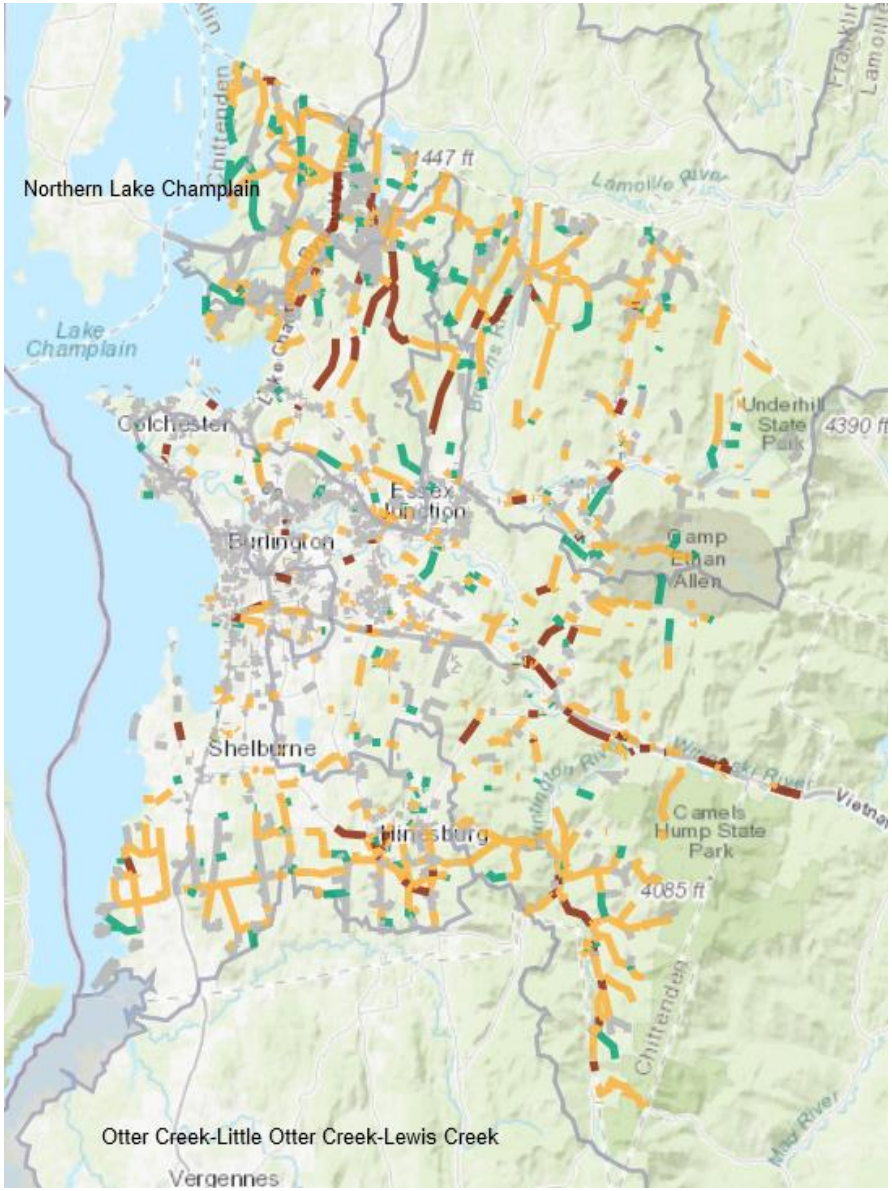
DuBois & King inc.

STONE ENVIRONMENTAL

smart mobility

Agenda

- TRPT
- Key Components & Definitions
- TRPT as a resource
- Current Progress
- TRPT app demo



Transportation Resilience Planning Tool

The Transportation Resilience Planning Tool (TRPT) is a web-based application that aims to improve the resilience of Vermont's road network against flood events by:

1. Assessing vulnerability of roads and structures
2. Determining critical locations on the transportation network
3. Assessing flood risk to roads and structures and determining mitigation strategies

Project partners/architects:

- State of Vermont agencies
- Regional Planning Commissions
- Project Consultants:
  - Fitzgerald Environmental, Stone Environmental, Dubois & King, Smart Mobility, SLR Consulting, UVM

https://vtrans.vermont.gov/planning/transportation-resilience

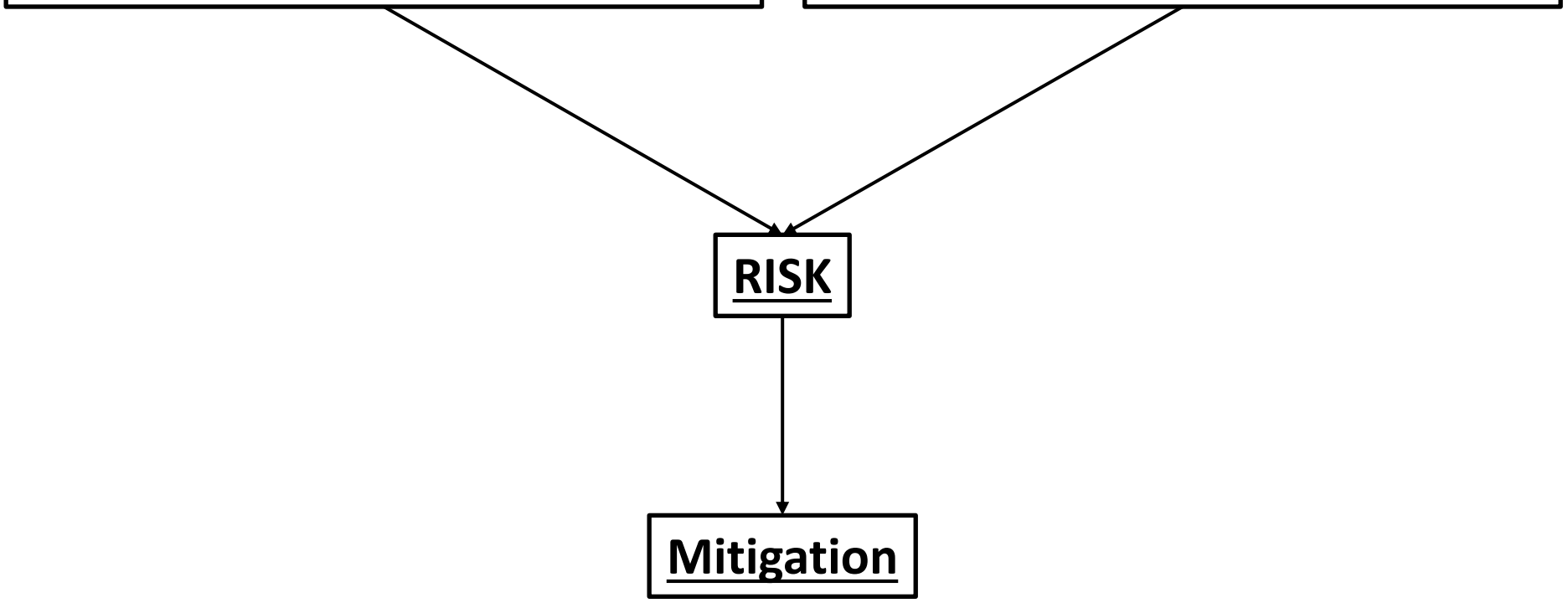
Key Components & Definitions

VULNERABILITY

- Watershed and River Corridor Analysis
- 10-year, 50-year, and 100-year floods
- Road, Bridges, and Culverts
- Failure Mode

CRITICALITY

- State and Local Roads
- Novel Consideration of Vulnerability
- 1,000 Simulations of Network Disruption
- Failures and Delays



Key Components & Definitions

Vulnerability Process	Other Names	Definition	Photograph
Inundation *Example: Flooding of an Elm Street parking lot in Brattleboro along Whetstone Brook (Photo courtesy Town of Brattleboro)*	Flooding Submergence Ponding	Submergence of a crossing or low spot in the road due to rising floodwaters where road closures take place, yet the facility is typically not damaged or is operating shortly or immediately after the floodwaters recede.	
Erosion *Example: Washout of U.S. Route 4 in Mendon (Photo courtesy of J. Louisos)*	Undercutting Scour Washout Downcutting	Erosion of the banks, channel bed, road embankment, and structure abutments/footings due to high-velocity moving material downstream. Undercutting results in high-impact events such as bank erosion, structure failure, and road embankment washout that requires immediate repairs prior to reopening roads. Widespread road embankment failure can take weeks to restore.	
Deposition *Example: Deposition along Route 100 from Money Brook in Plymouth, VT (Photo courtesy of M. Tucker)*	Debris buildup Clogging Accumulation	The deposition of sediment or large wood that can clog structures and reduce the space in a channel to carry floodwaters. Deposition typically leads to washout of the road fill near a structure, bank erosion and channel widening, or rapid channel relocation (i.e., avulsion).	

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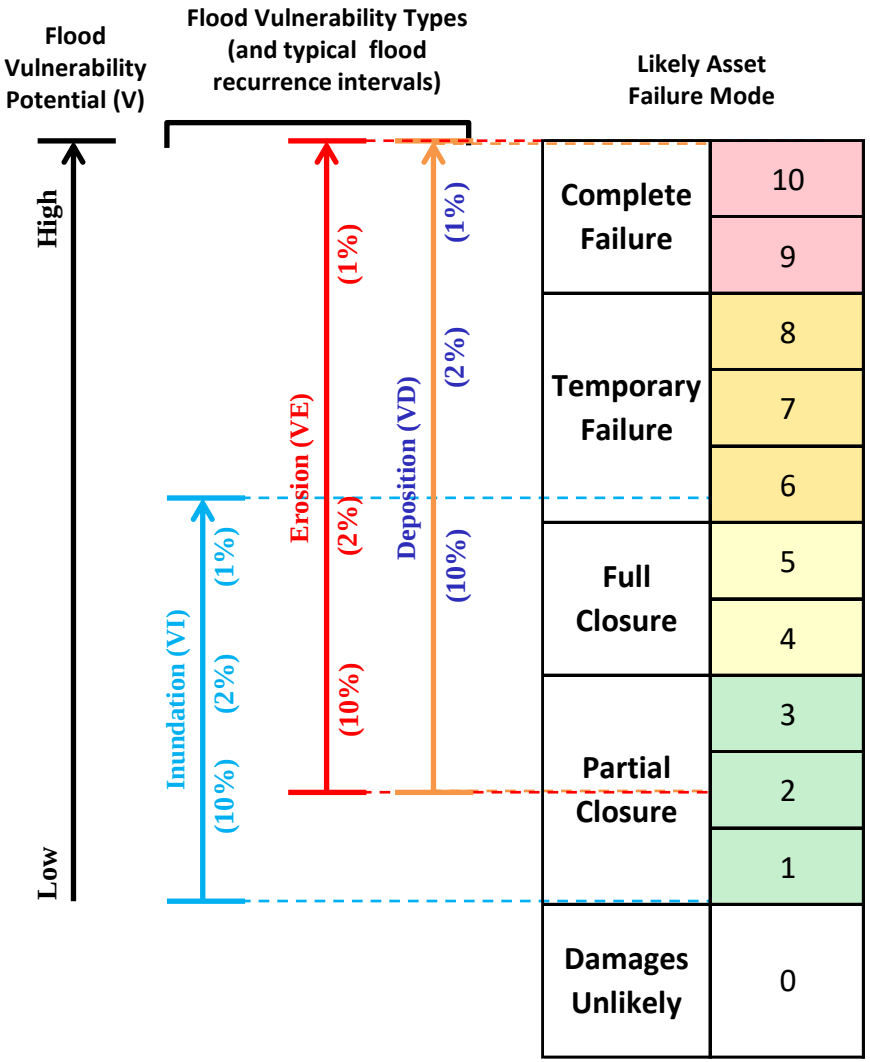
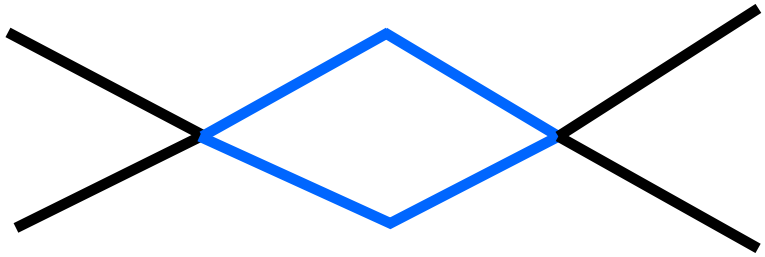
Key Components & Definitions

- Vulnerability estimated at road embankments, bridges, and culverts.
- Assigned maximum from inundation, erosion, and deposition.

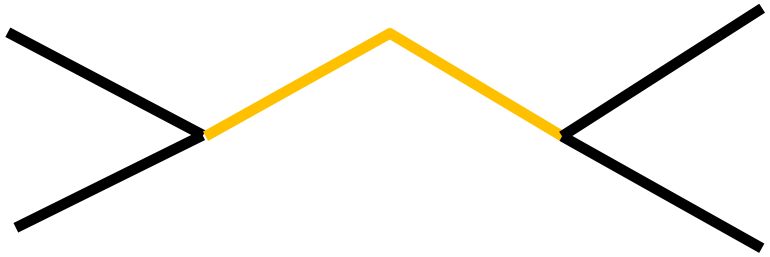


Key Components & Definitions

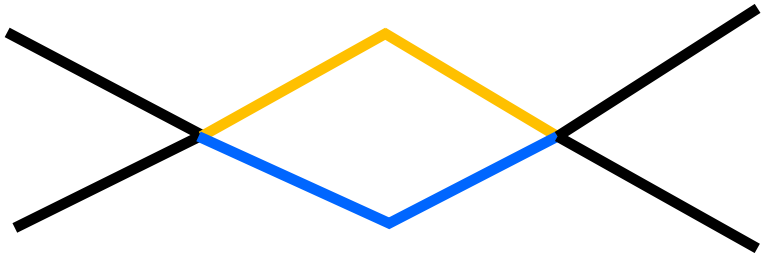
Network Criticality Index



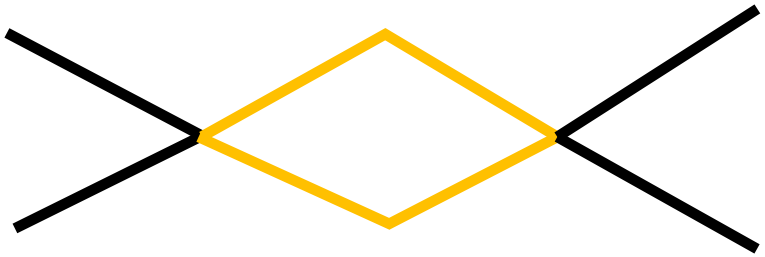
Low criticality – Parallel route



High criticality – No parallel route

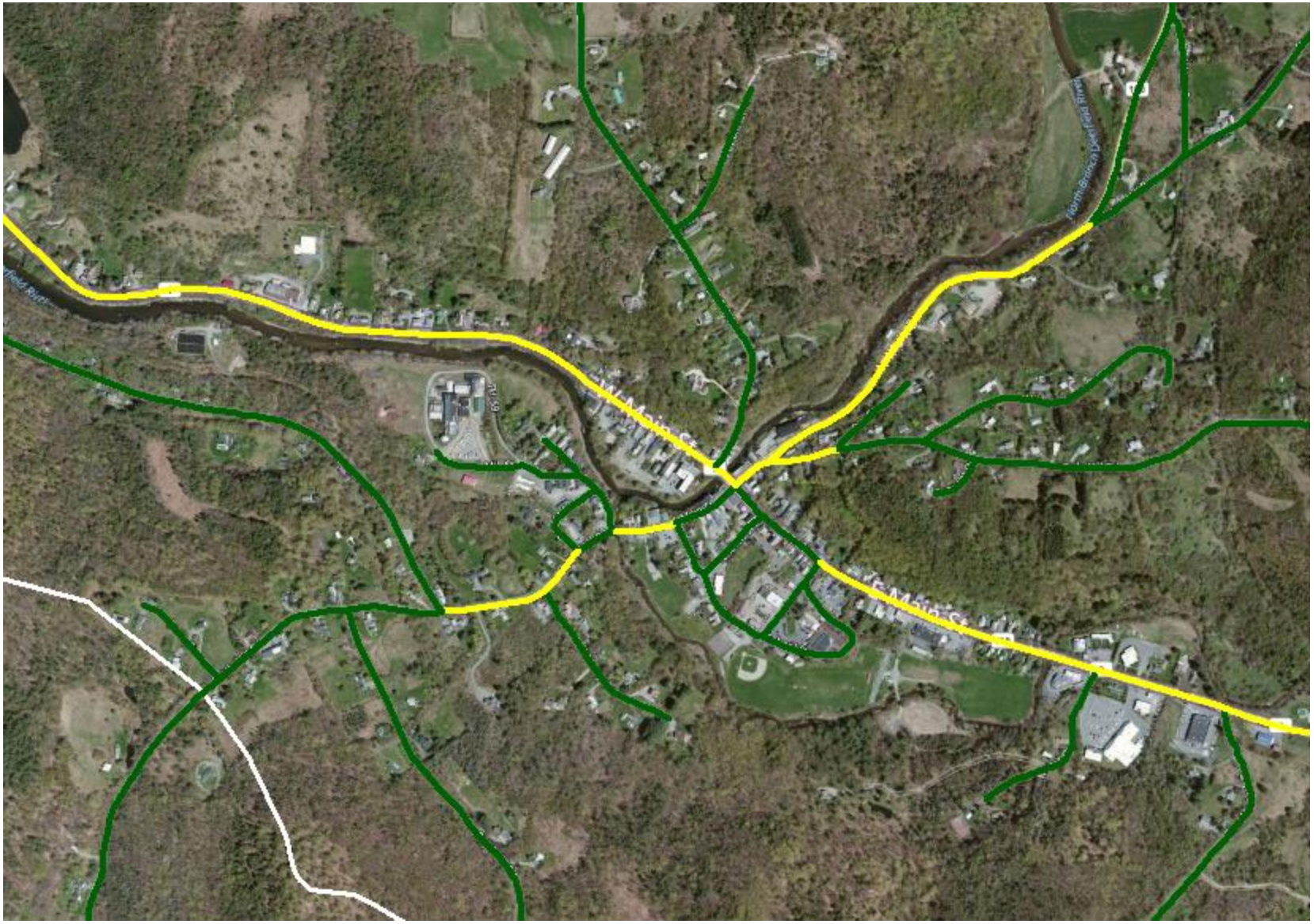


Moderate criticality – Parallel route yet one is vulnerable



High criticality – Both routes vulnerable

Key Definitions: Critical Closeness Accessibility



(Novak and Sullivan, 2014)

Key Components & Definitions

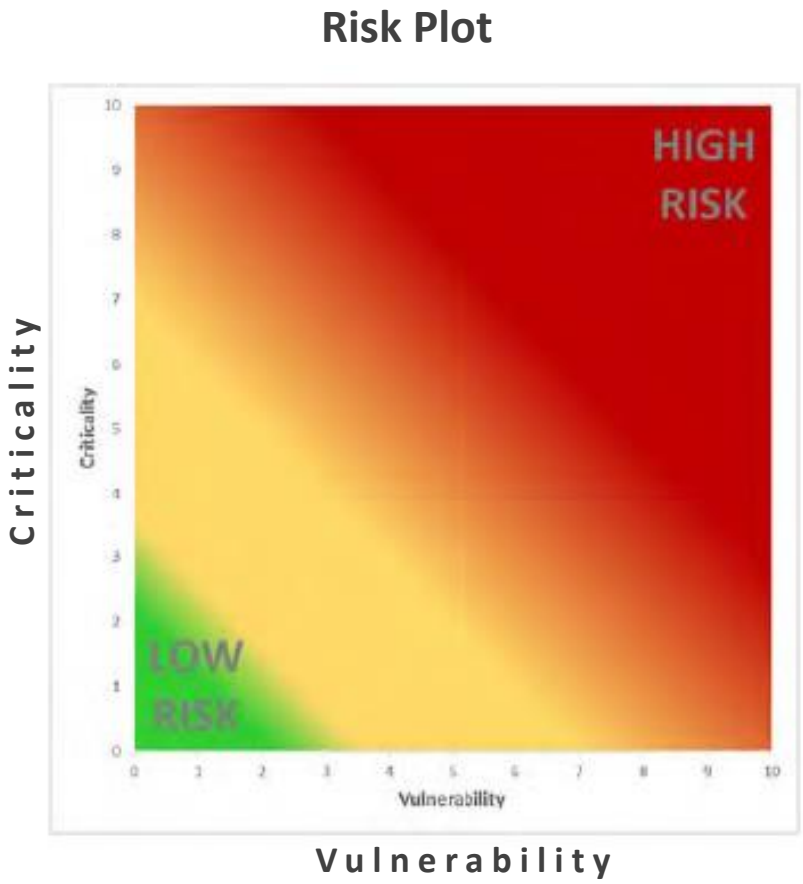
Criticality Scoring and Variables

SCORE	Key Link in Network Criticality Index (High or Medium)		Critical Closeness Accessibility (UVM)		Locally Important for daily regular function or for detour*	Combined Score for Map Display
10=	High or Medium	AND	High	AND	y	HIGH (RED)
9=	High or Medium	AND	Medium	AND	y	
8=	High or Medium	AND	High or Medium	AND	n	
7=	High or Medium	AND	Low	AND	y	
6=	Low	AND	High	AND	y	
5=	Low	AND	Medium	AND	y	
4=	High or Medium	AND	Low	AND	n	MEDIUM (YELLOW)
3=	Low	AND	High or Medium	AND	n	
2=	Low	AND	Low	AND	y	
1=	Low	AND	Low	AND	n	LOW (GREEN)

Key Components & Definitions

Risk Assessment

Risk is the average of Vulnerability and Criticality scores

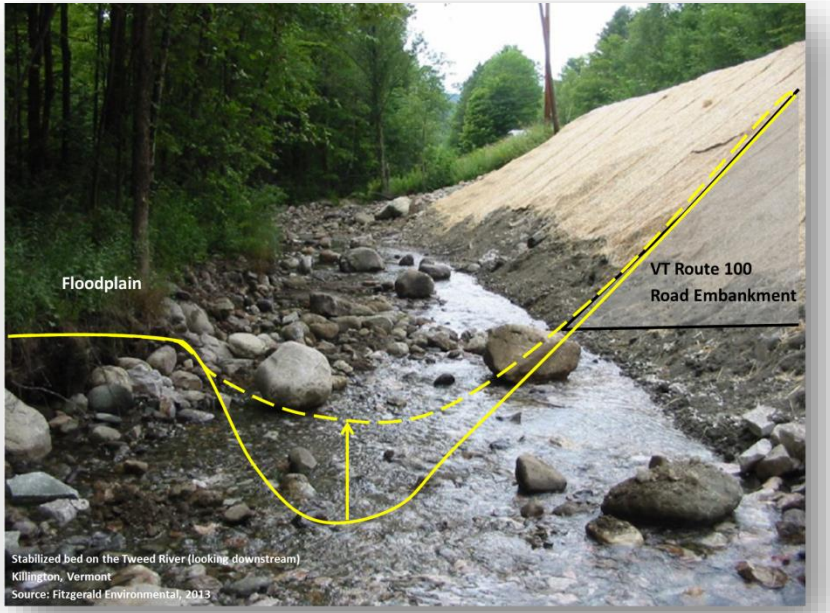


Value	Risk
> 5	High
2-5	Medium
0-2	Low

Key Components & Definitions

Mitigation

- River and Road Stabilization
- Conveyance of Flood Flows
- Floodplain Protection/Relocate Roads
- Improve vegetation



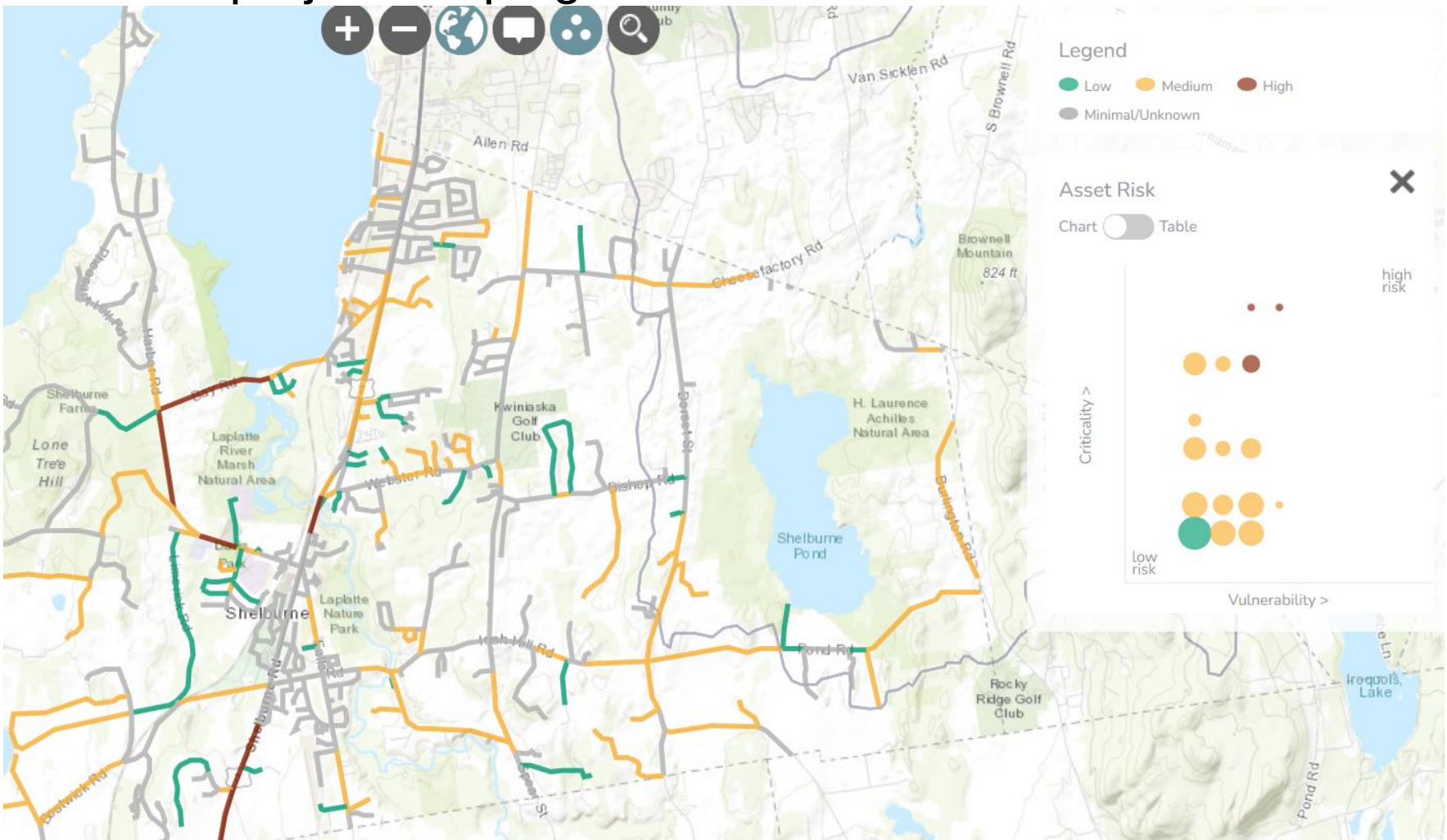
Key Components & Definitions

Mitigation

Filter (TRPT Name)	Options (Listed in Order of Presentation)	Definition
Initial River Impact	Low (L)	None/Low impacts, return to nature
(Initial River Impact)	Moderate (M)	Moderate intensity and impacts
	High (H)	High intensity and impacts
Transportation Network Impact	Low (L)	None to small footprint change
(Network Impact)	Moderate (M)	Some changes to network
	High (H)	Large changes to network such as relocations and ROW issues
Implementation Time Frame	Short-term (S)	Short-term repair to get/keep road open
(Short or Long Term)	Long-term (L)	Permanent change to setting, > 5-year implementation time
Project Application Scale	Point (P)	
(Application Scale)	Road segment (RS)	Less than 0.5 miles long
	River reach (RR)	0.5 to 1 mile long
	Watershed (W)	

TRPT as a Resource

- Highlight vulnerable infrastructure
- Inform project scoping
- Capital programming
- Hazard mitigation planning



TRPT as a Resource

- Identify/prioritize vulnerable locations, create list of potential solutions based on “strategies” outlined in TRPT tool
- Municipal budgeting, grant applications- focus on most vulnerable locations. Are there culverts or projects on specific roads that should be prioritized?

Mitigation Strategies	
River/Road Stabilization	Armor riverbanks (riprap) or road embankment
Conveyance of Flood Flows	Restore flood benches, floodplains
Floodplain Protection/Relocate Roads	Adjust road alignment, conserve river corridors, buyout flood prone properties
Improve Vegetation	Install bank vegetation Riparian buffer plantings

Current Status

Pilot and Phase 2 watersheds covered 20% of state

- Pilot completed April, 2018
- Phase 2 completed Sept, 2020

Phase 3 –

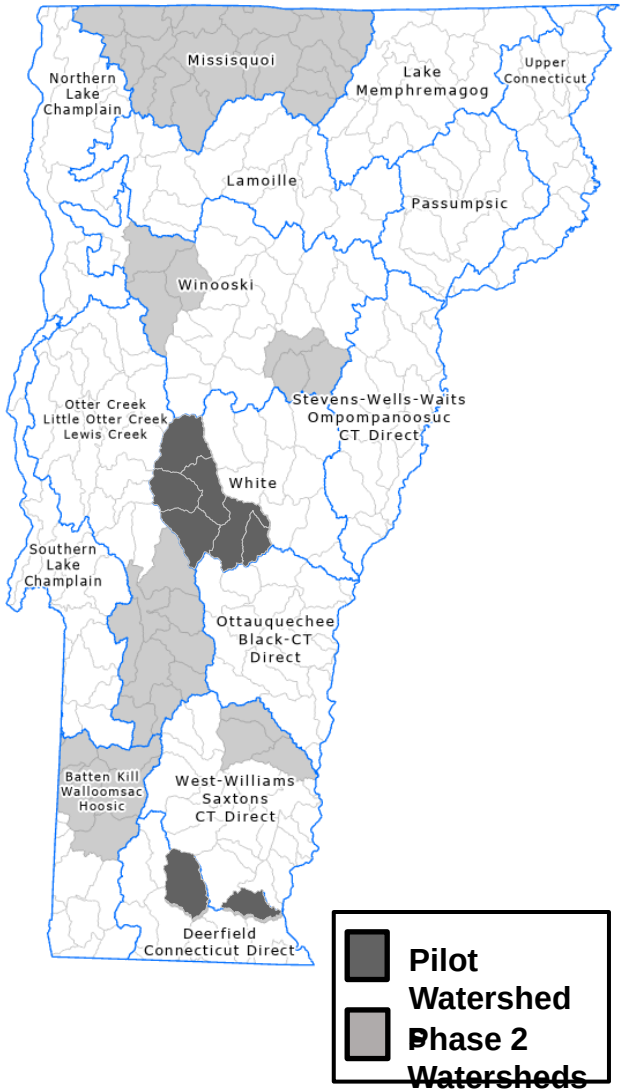
VERMONT Vermont Transportation Flood Resilience Planning Tool

Basin List

Search by town, basin, location

Basin ID	Basin Name	% Complete	Date Updated
3	Lake Memphremagog	100%	2/10/22
4	Lamoille	100%	2/9/22
13	Northern Lake Champlain	100%	2/9/22
6	Otter Creek-Little Otter Creek-Lewis Creek	26%	10/25/21
11	Winooski	100%	9/27/21
12	Missisquoi	100%	11/20/20
9	West-Williams-Saxtons-CT Direct	11%	9/22/20

TRPT Completed Areas – Pilot and Phase 2 Watersheds



Links to TRPT Websites

- Direct link to TRPT

https://roadfloodresilience.vermont.gov/#/map

Link to VTrans TRPT Website

https://vtrans.vermont.gov/planning/transportation-resilience

- Link to statewide Vulnerability, Criticality and Risk Assessment

https://vtrans.vermont.gov/planning/transportation-resilience/statewide