

## VERMONT'S RESILIENCE CONTEXT

Vermont's resilience activities have been focused almost exclusively on the erosion and inundation cause by flooding. Its network of state and local highways, rail lines, and small cities and villages, were built along rivers, often in steep, confined valleys. The 2023 Vermont State Hazard Mitigation Plan, and all its previous versions, identify flooding and fluvial erosion as the highest-ranking hazard in the state. The need to focus on flood resilience was reinforced by statewide damage caused by Tropical Storm Irene in 2011 and the July 2023 storm, both of which were the continuation of an on-going trend. Since the 1927 flood, considered to be the worst in Vermont's history, there has been one major flood every 14 years, and the frequency is increasing. Between 1973 and 2011, Vermont suffered approximately 25 disastrous floods of regional scale, the equivalent of one event every 18 months<sup>1</sup>.

## VTRANS TRANSPORTATION RESILIENCE

The Vermont Agency of Transportation (VTrans) is improving resilience to floods by integrating the Emergency Management life cycle (Prepare, Respond, Recover, Mitigate) with Transportation Planning and Project Design. This provides an efficient approach to continually improving system resilience; understanding the impacts from the past and using those lessons learned to plan and design more resilient infrastructure will minimize the response and recovery efforts needed for the next.

## EMERGENCY RESPONSE AND RECOVERY ACTIVITIES TO IMPROVE FLOOD RESILIENCE

Given the resources and time it takes to rebuild infrastructure, VTrans expects that much of the state and local road network will remain vulnerable to flood damage for years to come. The following activities will improve the Agency's ability to effectively respond to and recover from the impacts of disasters, which is essential to providing a resilient transportation system.

**July 2023 Flood Response:** The July 2023 Flood led to an estimated greater than \$300 million in transportation infrastructure damage. 294 miles of roadway were closed and 832 structures impacted. In the time since, 825 sites have had emergency repairs completed and 49 sites have been identified for permanent projects. Each permanent project site has been visited by a resilience strike team and is being designed with resilience in mind so that these locations are less likely to be damaged again in the future.

**Incident Management System:** VTrans has adopted and implemented an Incident Management System that uses the Incident Command System (ICS) organizational structure. The IMS was deployed most recently in response to the July 2023 Storm and to manage the Agency's role in the COVID-19 State of Emergency.

**Continuity of Operations Plan:** The COOP involves assessing all Agency mission-essential functions and analyzing how to continue these functions safely, efficiently, and effectively in the long term.

**Rivers and Roads Training:** The Rivers and Road Training Program was developed through a partnership between VTrans and the Agency of Natural Resources. Its purpose is to facilitate the durable and resilient repair of flood damaged infrastructure through an understanding of river processes.

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<sup>1</sup> Based on an analysis prepared by the Rivers Management Program, VT Department of Environmental Conservation, Agency of Natural Resources

**Emergency Procurement and Contracting:** These procedures make it possible to quickly hire consultants and contractors if additional support is necessary to repair or reconstruct damaged infrastructure.

**Vermont Emergency Management Coordination:** VTrans is a member of the Steering Committee for the 2023 State Hazard Mitigation Plan (SHMP) that is nearly complete. VTrans is also participating on the review committee for statewide hazard grant applications and in discussions of increasing resilience of ground transportation access to Commodity Points of Distribution (CPODs).

## **DESIGN AND ENGINEERING ACTIVITIES TO IMPROVE FLOOD RESILIENCE**

**Design Standards Update:** In the early 2000's, VTrans began to work with partners at the Agency of Natural Resources to update our design process. As a result, new structures are designed to span the natural bank full width of the channel to account for natural processes such as sediment and debris transport and aquatic organism passage.

**Hydraulics Manual Update:** The Hydraulics Manual and Hydraulic Standard were also updated to incorporate sediment flow data and bank-full width. Establishment of this statewide standard ensures that FEMA's cost share will be based on the cost to re-build a damaged bridge or culvert in a manner that is resilient to future floods.

**Town Highway Road and Bridge Standards:** To encourage flood resilient local roads, VTrans developed Town Highway Road and Bridge Standards in partnership with ANR for voluntary adoption by municipalities.

## **PLANNING AND PROGRAMMING ACTIVITIES TO IMPROVE FLOOD RESILIENCE**

**Resilience Improvement Plan:** VTrans has developed a [Resilience Improvement Plan](#) to prioritize its investments related to the 2021 IIJA PROTECT program. Resilience locations were identified and prioritized based on flood vulnerability (TRPT risk score), repeat damage locations, social vulnerability, transit access, emergency freight access, and opportunities for interagency coordination.

**Reducing Repeat Damage to Vermont's Roads and Structures (MAP-21 Part 667):** VTrans is working to reduce repeat storm damage to transportation assets and has taken the Federal MAP-21 Part 667 requirement as an opportunity to advance existing risk and resilience efforts. The [2022 Report](#) covers the Vermont Federal Aid System (FAS). A tool for exploring and discussing the analysis is the Reducing Repeat Damage Webtool ([https://bit.ly/Repeat\\_Damage](https://bit.ly/Repeat_Damage)).

**Transportation Resilience Planning Tool (TRPT):** The TRPT is a web-based application that identifies bridges, culverts, and road embankments that are vulnerable to damage from floods, estimates risk based on the vulnerability and criticality of roadway segments, and identifies potential mitigation measures based on the factors driving the vulnerability.

The TRPT's web application and its User Manual can be accessed here:

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

**Incorporating Flood Resilience into Project Selection and Prioritization:** AOT's Vermont Project Selection and Prioritization Process (VPSP2) is the method in which the Agency selects and prioritizes projects across the state. This method includes eight different criteria by which projects are evaluated –

Safety, Asset Condition, Mobility/Connectivity, Community, Economic Access, Environment, Health Access and **Resiliency**.

Figure 1: Transportation Project Prioritization Criteria and Weights

Asset Condition	Safety	Mobility / Connectivity	Economic Access	Community	Resilience	Environment	Health Access
20	20	15	10	10	10	10	5

**2040 Vermont Long-Range Transportation Plan:** To address the challenges presented by increasingly frequent and severe extreme weather events, the LRTP includes a specific directive to “Improve the resilience of the transportation system.” The LRTP includes a goal and strategies to improve safety and security across all transportation modes.

**Transportation Asset Management Plan:** The Agency’s 2022 Transportation Asset Management Plan includes a strong theme of resilience throughout to tie together the Transportation Resilience Planning Tool with asset needs across the state to mitigate risk in the investments we make.

**INFRASTRUCTURE INVESTMENTS TO IMPROVE FLOOD RESILIENCE**

**Updated infrastructure:** In response to Irene, VTrans constructed 130 permanent projects with a cost of \$229.4 million. The Agency reviewed these project locations following the July 2023 Flood to find that they held up considerably well. Most sites were not impacted and the ones that were received very minimal damage, demonstrating that new standards and knowledge are paying off.

**VT Route 9-Brattleboro Flood Mitigation Project:** VTrans received a FEMA Pre-Disaster Mitigation Grant in 2019 for a \$4.5 Million project to improve the resilience of VT 9 to flood and erosion damage in West Brattleboro and into Marlboro.

**PROTECT Program Funding:** The Bipartisan Infrastructure Law (also known as Infrastructure Investment and Jobs Act or IIJA) created the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) Formula Program to help make surface transportation more resilient to natural hazards through the support of planning activities and resilience improvements. Between 2022 and 2026, Vermont is programmed to receive \$37.3 million dollars as part of the PROTECT program. The VTrans RIP will reduce the non-federal match for PROTECT-funded resilience improvement projects. The resilience plan and supporting PROTECT funding provide a significant opportunity for VTrans to proactively implement projects, including those that use natural infrastructure, to address highly vulnerable components of the transportation system.