

REDUCING REPEAT DAMAGE OF VERMONT'S ROADS & STRUCTURES

MAP-21 Part 667 (National Highway System)

*Submitted to FHWA November 19, 2018
Minor revisions December 13, 2019*

Contents

Executive Summary

Introduction to MAP-21 Part 667	1
VTrans Approach to Fulfilling Part 667	1
Summary of Technical Methodology.....	2
Data Notes	2
Result of Analysis	4
<i>Location 1: US 4 in Hartford.....</i>	<i>6</i>
<i>Location 2: US 2 in St. Johnsbury.....</i>	<i>7</i>
<i>Location 3: VT 9 in Brattleboro</i>	<i>8</i>
<i>Location 4: VT 9 in Woodford.....</i>	<i>9</i>
<i>Location 5: VT 15 in Essex</i>	<i>10</i>
Short-Term Next Steps	11
Long-Term Next Steps.....	12
Acknowledgements	13

Appendices

Spreadsheet of District Staff Comments

Detailed Maps by Priority Location with District Needs and DDIR Summaries

Executive Summary

VTrans is working to reduce storm damage impacts on transportation assets to minimize cost, inconvenience to our customers, safety hazards, and impacts on the environment. Staff have taken the MAP-21 Part 667 requirement as opportunity to take this work to a next level. This phase of Part 667 focuses on locations with repeat damage caused by different Governor-declared emergencies. VTrans work for the November 23, 2018 deadline focuses on the national highway system (NHS) but also prepares for the 2020 deadline on the broader transportation network.

VTrans staff conducted analysis of Detailed Damage Inspection Reports (DDIRs) from Governor-declared emergencies from 2004 through the end of 2017. Staff explored “if there are reasonable alternatives to [NHS] roads, highways, and bridges that have required repair and reconstruction activities on two or more occasions due to emergency events.” (*Federal Register*, Volume 81 No. 95 October 24, 2018: Sec 661.1) The understanding from informal discussions with FHWA partners in the Vermont Division Office was that compliance with the federal legislation could include analysis of DDIRs, identifying VTrans actions to stabilize high-risk locations, and also broader strategies VTrans will use to reduce repeat damages to its assets. VTrans is taking a coordinated approach across its bureaus and with existing programs that already increase the resilience of these high-risk locations.

The analysis started with over 1,000 DDIRs and resulted in five locations for further exploration and action. Interestingly, this data-driven process identified one corridor as head-and-shoulders most important: VT 4 in Hartford. The analysis was verified by a range of VTrans bureau and district staff. The other locations with multiple DDIRs from different emergencies in the same location or very nearby are US 2 in St. Johnsbury, VT 9 in Brattleboro, VT 9 in Woodford, and VT 15 in Essex.

Part 667 efforts have been purposefully multi-disciplinary and that will continue. Results include:

- Forming a Risk Management Leadership Team of staff from Asset Management, Emergency Management, Maintenance, and Planning
- Starting field views and next steps on the priority locations that will likely include scoping a substantial US 4 project in the future years of the budget
- Added emphasis on the actions identified in the related Transportation Asset Management Plan (TAMP) to develop a VTrans policy on risk coordinated with asset management and performance management.
- Ongoing coordination within and outside of VTrans to manage risk to Vermont’s assets



Introduction to MAP-21 Part 667

Part 667 requires that state departments of transportation (DOTs) “conduct statewide evaluations to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction activities on two or more occasions due to emergency events.” (*Federal Register* Volume 91, No. 205 (October 24, 2016), p. 73268)

Other key elements of the regulation may be summarized as

- Use data starting as close to 1997 as reasonably available through the end of December of the end of the year of analysis (in this case 2017)
- Emergency event refers to declaration by the governor or president
- Update analysis after additional emergency events or a minimum of every four years
- Similar analysis is due November 23, 2020 for the remainder of roads and bridges open to the public and eligible for financial assistance under Title 23, USC.
- Evaluation includes identification and consideration of alternatives that will mitigate or resolve the root causes of the recurring damage, the costs, and likely duration of the solutions.
- Evaluation shall consider the risk of recurring damage and cost of future repairs under current and future environmental conditions.
- State DOT shall consider the results when developing projects.

VTrans Approach to Fulfilling Part 667

The VTrans approach to fulfilling Part 667 regulations for 2018 is summarized in the following nine steps.

1. **Gather and use DDIRs – Completed.** Over 1,000 DDIRs were gathered going as far back as reasonably possible (2004 through 2017). The initial work was discussed at a multidisciplinary meeting of VTrans staff on 8/7/18, then a summary distributed for review.
2. **Complete and use analysis – Completed.** Finalized DDIR analysis, combined with results from Methods and Tools for Transportation Resilience Planning and other data to identify draft priorities.
3. **Coordinate reviews among statewide staff and with district staff – Completed.** Material distributed, then responses from all involved districts combined into one spreadsheet. This resulted in five priority locations. Added in district needs. Material was distributed several times for reviews.
4. **Review draft priorities and discuss strategies – Completed.** Continued internal discussions. Discussed efforts with FHWA-Vermont Division at meeting held 11/5/18.
5. **Refine next steps – Underway.** Prepare Part 667 submission. Schedule follow-up discussion with FHWA Vermont Division staff and field tour to refine plans to reduce risk at priority repeat damage sites for after submission given timing. Further define broader statewide strategies. Publish analysis as a web map after final discussions.

6. **Establish Risk Management Leadership Team - Completed.** This small group will guide further multidisciplinary efforts. The team is Chad Allen (AMP), Todd Sears (Emergency Management), Joe Segale (Planning, Policy, and Research), and Todd Law (Maintenance Bureau) . Other representatives will be invited into discussions as appropriate or based on requests.
7. **Submit a version of this report to FHWA-VT** after discussions. **Completed on time.**
8. **Engage outside partners - Future.** These partners include DEC Tactical Watershed Planners, Vermont Emergency Management (VEM), and regional planning commissions (RPCs). This will include preparation for full network submission and broader coordination.
9. **Complete documentation of technical and process refinements for 2020 - Future.**

Summary of Technical Methodology

Obtain and analyze DDIRs

- Gather and map data - DDIRs from Tropical Storm Irene had been gathered for the resilience project. The rest of the available DDIRs before and through 2017 were gathered and summarized with more detailed location information. Chad Allen contacted district staff to check if data earlier than 2004 was reasonably available through them without success. All the GIS files were combined, assigned full and consistent geographic information, and reports without adequate information to map were set aside for future work.
- Convert and prepare data - A .1-mile buffer was created for each point and line to account for minor differences in reporting locations and to convert all items into polygons. A union of polygons from each emergency event was run. This cleaned out instances of multiple reports in a location, such as a retaining wall report and a bridge report from one storm.
- Analyze repeat damages – ArcInfo tools were used to dissolve the remaining polygons and count how many had been dissolved together. All scripts were documented.

Incorporate resilience

- Throughout this analysis, “highly vulnerable” refers to a rating of 10 in the 1-10 scale developed in Methods and Tools for Resilience Planning. The focus was the analysis of roads, though vulnerability of bridges and culverts was also considered. There are additional elements of the Resilience work that may be used in the future. VTrans and Vermont Department of Public Safety staff met to discuss implementation through the FEMA Mitigation Program.
- Exploration of locations also used Vermont Agency of Natural Resources stream corridor analysis that defines how a water body is likely to meander in the future.

Data Notes

The main source of data for the analysis in this report was DDIRs prepared by VTrans for the FHWA Emergency Relief (ER) Program. There was some further exploration of the events from postings for FEMA Major Disaster Declarations and counties eligible for Public Assistance (PA) funding. The research across programs is summarized in the table that follows. FEMA and other sources will be explored in future reports.

Exploring Correspondence of FHWA ER and FEMA PA Declarations

FHWA Declaration	Event Date	FEMA Declaration	Event Date
19-2	October 31-November 1, 2019	Not online 12/10/19	x
19-1	April 14-15 and 19-20	4445	April 15, 2019
	X	4380	May 4-5, 2018
	X	4356	October 29-30, 2017
17-1	June 29-July 1, 2017	4330	June 29-July 1, 2017
	X	4232	June 9, 2015
	X	4207	December 9-14, 2015
	X	4178	April 15-19, 2014
	X	4163	December 20-26, 2013
14-1*	July 8, 2014	x	x

*Example of a major storm that was evaluated but didn't qualify for FHWA or FEMA funding

One element that complicated analysis is the multiple heavy storm events in 2011. The 2011 data includes records for the severe April through May storms that are documented as VT 11-01 (also entered as Irene_Spring) and Tropical Storm Irene in August (VT 11-02). There were a variety of ways data was entered in this complicated period that make analysis of repeat damage separating those events difficult. The description in a Weather.gov article gives a sense of the intensity of weather events in that period, and how declared and undeclared events can mix:

From devastating flooding to record breaking snows, 2011 was a year of particularly active and tragic weather across Vermont and northern New York. At Burlington International Airport, it was the wettest year on record with 50.92" of precipitation. Burlington also had its 3rd snowiest winter on record with 128.4". In addition, Burlington experienced 11 out of 12 months of above normal average monthly temperatures with the months of November and December as much as 5 degrees above normal. The greatest snowstorm occurred on March 6-7th when 25.8" fell at Burlington, which was 3rd greatest snowstorm in history. The greatest 24-hour single day rainfall was 3.38" associated with Tropical Storm Irene on 28 August 2011. The combination of above normal snowpack and record breaking rainfall caused several historical flooding events across our region. They include the heavy convective rainfall and flooding event on April 26th-27th, followed by a record Lake Champlain stage of 103.27 feet on 6 May 2011 breaking the previous record by over a foot. Another heavy convective rainfall episode on May 26th- 27th brought more flooding, followed by the historic and devastating flooding from Tropical Storm Irene on August 28th.

-Source: https://www.weather.gov/media/btv/events/Top5_2011.pdf

The major events in this analysis are listed below. The counties listed as eligible for FEMA PA funding are included.

- VT 07-1: four counties were damaged by severe storms, flash flooding, and flooding July 9 through 11, 2007 (Washington, Windsor, Orange, Caledonia and Orleans) – FEMA 1715-DR as amended
- VT 08-1: three counties were damaged by statewide damages as a result of tornado, severe thunderstorms, heavy rain on July 18, 2008 (Caledonia, Grand Isle, and Lamoille) – FEMA-1784-DR
- VT 11-1 (also documented as 11_Spring): Seven counties experienced severe storms and flooding during the period of April 23 to May 9, 2011 (Addison, Chittenden, Essex, Franklin, Grand Isle, Lamoille, and Orleans) – FEMA 1995-DR
- VT 11-2: 13 counties were damaged by Tropical Storm Irene during the period of August 27 to September 2, 2011 -FEMA-4022-DR
- VT 13-1: Extreme runoff and flooding following the heavy rains which fell during the periods of May 22 through 26, and June 25 through July 11, 2013.

- Three counties damaged in severe storms and flooding during the period of May 22-26, 2013 (Chittenden, Essex, and Lamoille) – FEMA 4120
- Seven counties damaged in severe storms and flooding during the period of June 25 to July 11, 2013 (Caledonia, Chittenden, Orange, Orleans, Rutland, Washington, and Windsor) – FEMA-4140-DR
- VT 14-1 (evaluated and numbered but didn't end up qualifying for FHWA or FEMA funding): Wind and rainstorms on July 14, 2014 caused damage to transportation facilities in Andover (Windsor), Chester (Windsor), and Londonderry (Windham),
- VT 17-1: Seven counties suffered substantial damage by flooding between June 29 and July 1, 2017 (Addison, Bennington, Caledonia, Orange, Rutland, Washington, and Windsor) – FEMA DR-4330

The following events occurred after the analysis and will be included in the 2020 Part 667 report.

- VT 19-1: Heavy rains and snowmelt from storms April 14-15 and April 19-20 caused serious damage in eight counties (Windham, Bennington, Windsor, Rutland, Orange, Washington, Caledonia, and Essex) – FEMA
- VT 19-2: Flooding and runoff as a result of extremely heavy rain and high winds from October 31 - November 1, 2019 caused serious damage in six counties (Addison, Chittenden, Franklin, Lamoille, Orleans, and Washington) –

Result of Analysis

This analysis was an impressive example of the power of a data-driven approach. Analysis of over 1,000 DDIRs on the Federal Aid System identified 20 locations on the NHS with damage in two or more different Governor-declared emergencies. Of these, eight have already been fixed to the satisfaction of knowledgeable district staff and are being monitored. This is significant accomplishment.

This analysis started with “messy” data—records in many places, in different formats, and not all with adequate information to map. It took a lot of effort to clean it, an issue that has been largely resolved for the future. One of the 20 locations seems to just be a data problem. Review of the remaining 11 locations with vulnerability and other analysis resolved them down to five priority areas as several were close and likely related to each other. They are listed in the table below and shown in the map on the next page. Staff discussion of next steps for the five priority areas is summarized in a page for each.

These pages follow and will be revised after the field views to become a resource for each location.

Priority Areas to Reduce Repeat Damages

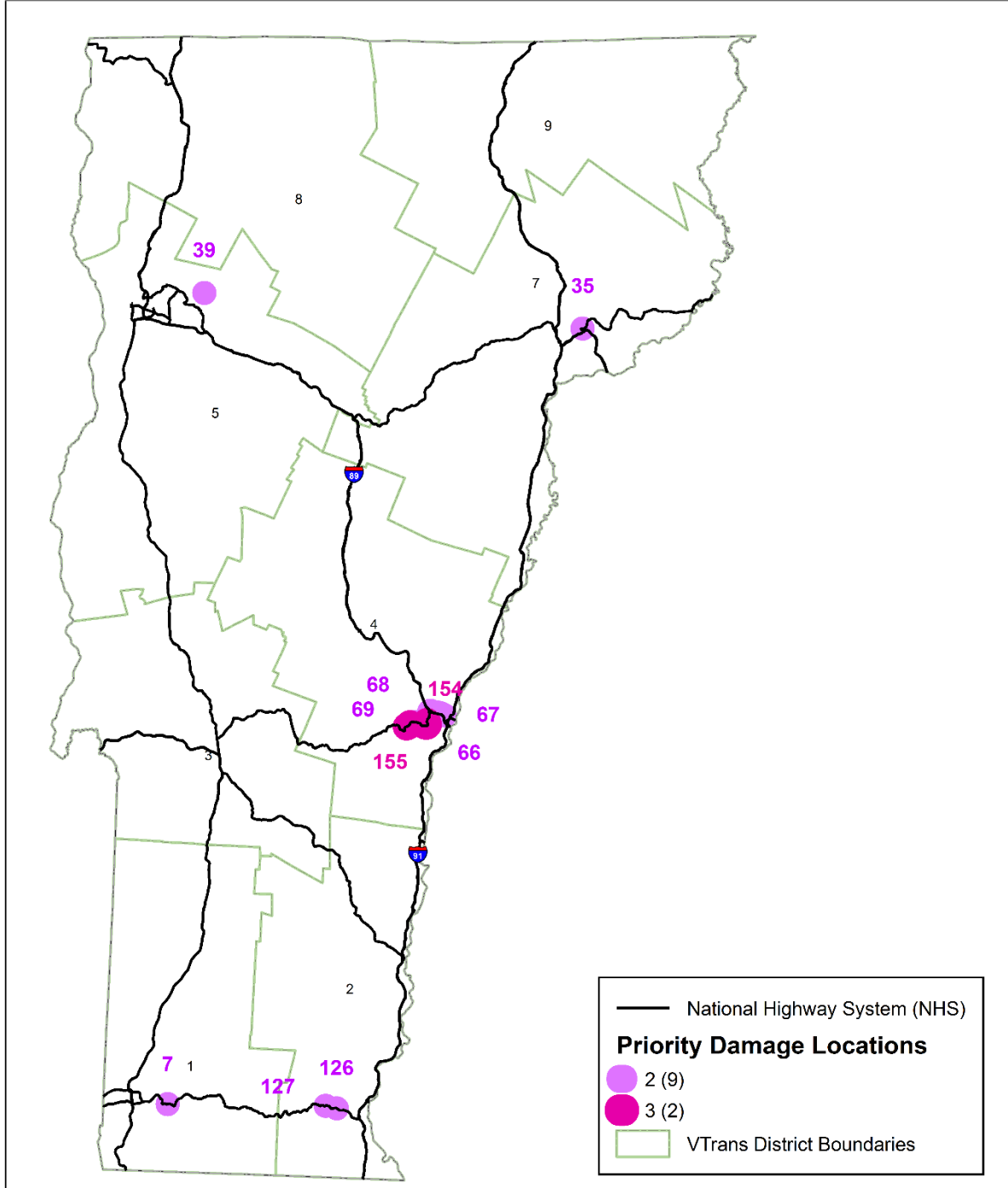
Road	Primary Town	County	VTrans District	RPC
US 4	Hartford	Windsor	4	Two Rivers-Ottawaquechee Regional Planning Commission
US 2	St. Johnsbury	Caledonia	7	Northeast Vermont Development Association
VT 9	Brattleboro	Windham	2	Windham Regional Commission
VT 9	Woodford	Bennington	1	Bennington County Regional Commission
VT 15	Essex	Chittenden	5	Chittenden County Regional Planning Commission

In addition to the statewide map and one-page summaries that follow, the appendices include the following items

1. Spreadsheet of District staff comments
2. For each location, a map with District needs and a spreadsheet with DDIR summaries.

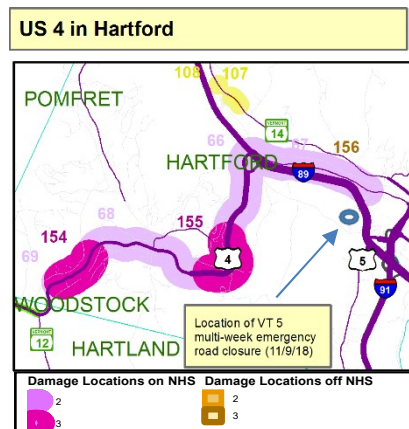
Priority Damage Locations on the NHS with VTrans Districts

HS)



Location 1: US 4 in Hartford

There are only two locations on the Vermont NHS that have been damaged in three different emergencies. These two locations (shown in dark purple), plus others with two DDIRs, are on an approximately 10-mile section of US 4 that is mainly in Hartford but also Woodstock and Hartland. This section also includes a highly vulnerable section of road. A current event that may be of interest is the nearby closure of US 5 for culvert failure. There are also nearby overlapping DDIRs off the NHS on VT 14 (shown in yellow).



Unique ID	Road	Town	County	VTrans District	RPC	How Many DDIRs? Which Events?
154	US 4	Hartford	Windsor	4	TR	3 (Irene-Spring, VT 13-1, VT 17-1)
155	US 4	Hartford	Windsor	4	TR	3 (Irene-Spring, VT 13-1, VT 17-1)
66	US 4	Hartford	Windsor	4	TR	2 (VT 13-1, VT 17-1)
67	US 4	Hartford	Windsor	4	TR	2 (VT 13-1, VT 17-1)
68	US 4	Hartford	Windsor	4	TR	2 (VT 13-1, VT 17-1)
69	US 4	Hartford	Windsor	4	TR	2 (VT 13-1, VT 17-1)

District Comments

District agrees with the assessment of US 4. Some permanent repairs were made to the damaged locations. Many of the US 4 problems are due to the steep slope on the highway. There are locations on US 4 that could become problematic in the future. These have not been funded.

Further Background and Consequences

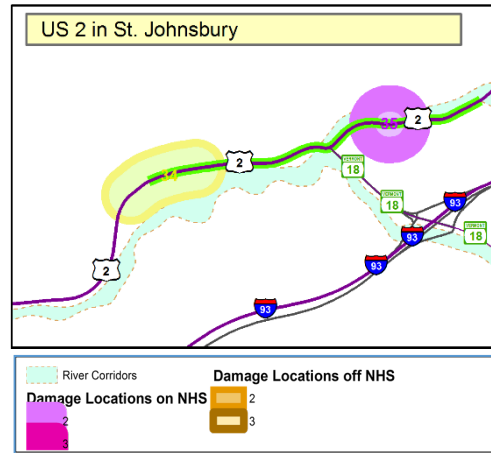
This may be most important corridor to address in Vermont for asset management.

Initial Discussion of Next Steps

- Further review DDIRs and district needs
- Gain understanding of what has been done and what is planned
- Monitor and maintain asset until a project is programmed to make a lasting permanent repair. Make temporary repairs to the extent financially possible for the District's funds (band aids). Most of these are already identified on corridor needs map. Capture the ones not identified.
- Develop a basic description then submit it for ranking as a substantial capital project. If prioritized, follow through with adding to future (referred to as "out") years of the budget. This may involve encompassing some smaller planned project(s) as well as consider addressing existing corridor needs and resiliency concerns. Initial thought is to schedule and budget for a scoping project along US 4 from Hartford to Woodstock to better define project scope and preliminary cost estimates. The time frame to begin this scoping study would at best be FY23.

Location 2: US 2 in St. Johnsbury

There are two overlapping DDIRs on the eastern NHS part of VT 2. Less than a mile away there are also two DDIRs on the non-NHS western part of VT 2 (shown in yellow). The NHS section of VT 2 has relatively high use (close to 5,000 AADT) and is important for its location near the interchange with I-93.



Unique ID	Road	Town	County	VTrans District	RPC	How Many DDIRs? Which Events?
35	US 2	St. Johnsbury	CALEDONIA	7	NV	2 (Irene-Spring, VT 11-1)

District Comments

This location is a continued issue whether there is a storm event or not. Mid-winter and spring thaws cause slope failure and plugs the drainage infrastructure within this section of US 2. District 7 continues to inspect and maintain drainage throughout the year. This section of US 2 has been on our District Needs list and is a high priority.

Further Background and Consequences

On the non-NHS side, the retaining wall on the side of the road away from the river was recognized as deteriorated years ago. Fixing it would take funds but not be difficult. There are likely similar problems now on the eastern (NHS) side. Design has previously been explored but not completed due to other priorities for the funding available. There are issues on the upslope and probably also river side of the road. Implications downstream should be considered in work in this location.

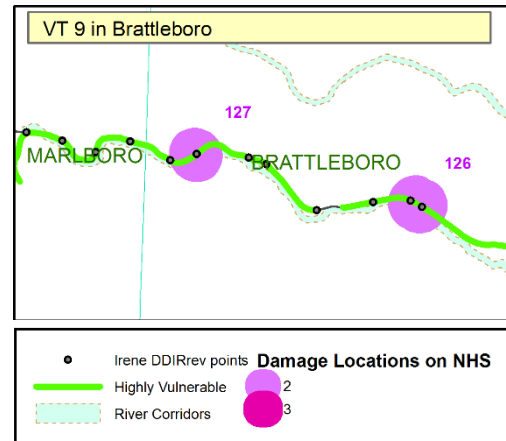
This is confirmed as a high-priority corridor for asset management.

Initial Discussion of Next Steps

- Check previous retaining wall analysis and planning [review was done but not next steps]
- Coordinate with district and other staff to explore a complete approach to protecting assets on both sides of the road on the NHS and Non-NHS side since that will also need to be addressed in the 2020 submittal

Location 3: VT 9 in Brattleboro

Analysis identified two locations on this corridor each with two DDIRs. Further research clarified that the damages were all from the Tropical Storm Irene event. This remains a corridor of concern with 12 DDIRs (available) from that storm within approximately 2 miles. The issues are primarily vulnerable road embankments although there are also moderately vulnerable culverts and bridges based on analysis for a FEMA Pre-Disaster Mitigation (PDM) grant application underway for submittal by January 4, 2019.



Unique ID	Road	Town	County	VTrans District	RPC	How Many DDIRs? Which Events?
126	VT 9	Brattleboro	WINDHAM	2	WR	2 (Irene-Spring)
127	VT 9	Brattleboro	WINDHAM	2	WR	2 (Irene-Spring)

District Comment

This stretch of corridor has had repeated damage both which has qualified for federal relief, and smaller state funded response. Some location in this corridor have been addressed, but this stretch of highway needs to be looked at as a larger project. The geometry of the road generates conflict with the adjacent Whetstone Brooke. These areas need to be addressed or failures will continue.

Further Background and Consequences

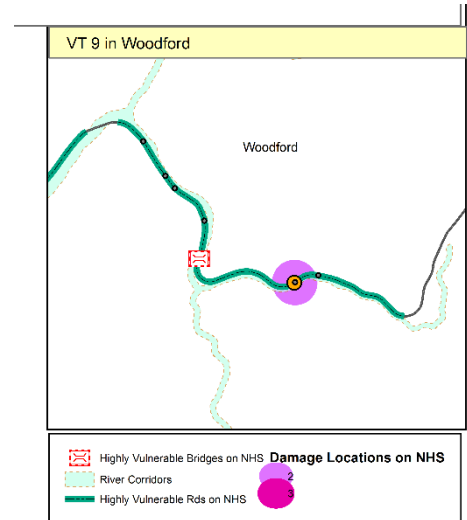
District notes there is a range of potential fixes ranging from small slope repair to creating resilient infrastructure to full scale road realignment and/or stream relocation.

Initial Discussion of Next Steps

- Use of the VTrans Transportation Resilience Planning Tool and discussions with Vermont Emergency Management is resulting in an application for FEMA PDM funding for this corridor. It will include a simple plan that prioritizes the needed improvements, identifies mitigation options, and uses the analysis to identify one or more mitigation projects including costs.
- Coordinate with current construction project in this area scheduled for 2020.

Location 4: VT 9 in Woodford

There are two overlapping DDIRs and approximately a mile away is a highly vulnerable bridge. There are six additional single DDIRs in approximately two miles of the location. River corridors come together in this vicinity and the district notes 60' cliffs with rocks falling from them.



Unique ID	Road	Town	County	VTrans District	RPC	How Many DDIRs? Which Events?
7	VT 9	Woodford	BENNINGTON	1	BC	2 (Irene-Spring, VT08-1)

District Comments and Nearby Needs

Generally, a difficult and vulnerable corridor, but need to explore if the specific location of one of the DDIRs was remedied. The biggest repair work in this area is around the larger bridges at the bottom of the hill.

Further Background and Consequences

There are steep slopes and ledge. The Roaring Branch is aptly named. It brought big boulders downstream in Tropical Storm Irene.

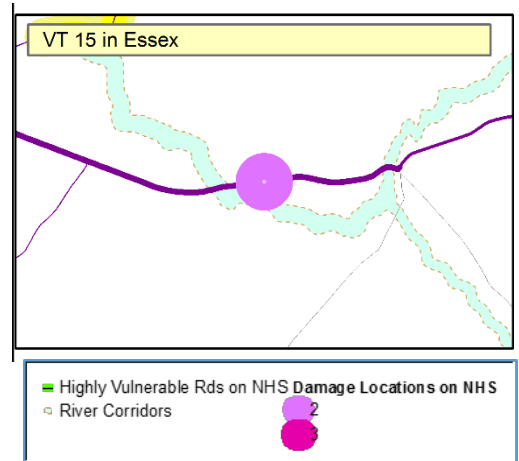
Initial Discussion of Next Steps

- Short-term: With PowerBI and new application of it for dashboards may be able to prioritize tracking and maintaining culverts and bridges.
- Further explore if the issues are more closely related to culvers/bridges, roadways, or both.
- Long-term: Explore options for this vulnerable corridor through hydrologic analysis including whether culverts are sized appropriately and review of base areas of bridges.

Location 5: VT 15 in Essex

DDIR and Vulnerability Analysis

This is Unique ID 39 in analysis. The buffers for the two DDIRs only overlap slightly. Another set of DDIRs was showing just to the east (ID 40) but seems to have been a messy data issue. There is a lot of surface water and a stream corridor connecting VT 15 and the non-NHS VT 128 sections to the north where there have been multiple DDIRs. This may be a lower-priority location than others.



Unique ID	Road	Town	County	VTrans District	RPC	How Many DDIRs? Which Events?
39	VT 15	Essex	CHITTENDEN	5	CC	2 (VT11-1, VT13-1)

District Comments and Nearby Needs

This area was damaged in 2011 and 2013. Explore if there is a problem with slope pipe installed as raised by district staff.

Further Background and Consequences

Fixing the small area with two slightly overlapping DDIRs should be coordinated with surrounding single DDIRs and the stream corridor to avoid future damages.

Initial Discussion of Next Steps

- Explore district comments about potential nearby repair that didn't hold up
- Review road with stream corridor and surface water layers

Short-Term Next Steps

There are a variety of steps underway or planned for November through December, 2018.

1. Hold additional discussion with districts and other staff regarding problems and repairs made or planned. Continue discussions with FHWA Vermont Division staff.
2. Start discussions with RPCs at 11/15/18 Transportation Planning Initiative meeting.
3. Schedule one or more field trips to view the issues first-hand. Potential participants: District team, AMP, PDB Program and PM (Bridge and Roadway – 2 to 4 total), Todd Sears, Joe Segale, Zoe Neaderland, Jesse Devlin or staff, and Performance Management. FHWA Vermont Division staff (Matt DiGiovanni and Larkin Welborn). [Kevin Marshia and Sommer Bucossi visited VT 9 and US 4 areas as part of other tour in Fall, 2019. They will be sharing observations in Winter, 2019 or Spring, 2020]
4. Act on next steps, including submitting scoping study(s) and coordinating on short-term actions with districts. Estimate costs and, as reasonable, do basic benefit-cost analysis. Explore use of FEMA Pre-Disaster Mitigation funding. Clarify the range of strategies eligible for FHWA Emergency Relief funding (e.g. www.fhwa.dot.gov/environment/sustainability/resilience/publications/er_faq/index.cfm). Consider the big picture when there are projects in high- risk corridors and harmonize needs. Manage expectations given limited funding. [meeting being scheduled 2019/2020]
5. Update this document and keep this work visible. Share simple web map on VCGI online.
6. Combine this 2004-2017 Part 667 analysis with the 2011 DDIR analysis in the Methods and Tools for Resilience. It will be used in prioritizing projects in the Vermont Project Selection and Project Prioritization (VPSP2) so Part 667 work will be used in project selection.
7. Update Part 667 after Governor-declared emergencies and every four years. Incorporate this updated work into the resilience tool. [Underway] Incorporate Part 667 analysis and vulnerability into other processes such as corridor management and the TAMP. [Underway]
8. Engage outside partners. These partners include DEC Tactical Watershed Planners, Vermont Emergency Management (VEM), and RPCs. This engagement will include follow-through to reduce risk on NHS and preparation for full network submission/broader coordination.
9. Encourage that Vermont Asset Management Information System (VAMIS) include business processes that make analysis for Part 667 more efficient earlier rather than later.
10. Finalize documentation and note refinements for 2020. These include
 - Figure out how to include all appropriate repairs rather than just from emergencies
 - Include not just FHWA-funded repairs, but also FEMA and other
 - Further and continuously engage districts and other people with on-the-ground knowledge
 - Figure out how to track effectiveness of completed risk management or repair projects
 - Differentiate between patches (replace in kind) or addressing underlying problems, for example through review of locations damaged in Irene.

Long-Term Next Steps

Some of these actions will be completed in 2019 but some require a longer time frame. This list will continue to evolve as VTrans stays with the momentum of the first stage of Part 667 to move toward the broader geography and continued enhancement of risk management. The intent is to have substantial progress to report for the 2020 Part 667 submittal.

1. Prepare an outline of work to stabilize the Hartford corridor and submit into the project prioritization process. Foster short-term actions to keep the corridor functioning safely and explore long-term fixes of the underlying problems.
2. Improve how Agency conducts risk management, which is widespread but not well-coordinated. This would include a standard definition and signed leadership policy statement. This policy could help connect risk, asset, and performance management. [Policy statement included in 2019 TAMP. [Multidisciplinary meeting being scheduled for late 2019/early 2020]
3. Continue to work on risk-related actions from the TAMP Action Plan.

Risk Management TAMP Actions

Risk Focus Area	Issue	Fix
Extreme Weather Impacts	Risk Management Not Yet Embedded into VTrans Culture	Identify a risk management champion for each asset group. Train how to incorporate risk management in VTrans processes emphasizing an integrated approach. Implement strategies from asset risk registers. Monitor new risks. Evaluate strategies.
Extreme Weather Impacts	Bridge System is Not Prepared for Climate Change	Identify bridges at risk due to extreme weather, in part using VTrans Transportation Flood Resilience Planning Tool. Participate in evaluation of facilities repeatedly damaged by major events. Revise standards to become more resilient in the face of climate change and chance of seismic activity.
Extreme Weather Impacts	Lack of Preparedness for Climate Change Effects on Roads	Expand Transportation Flood Resilience Planning Tool from test locations to statewide. [Underway]. Participate in repeatedly damaged facilities task. [TAMP and Part 667 work coordinated in 2019 TAMP]
Information Management	Limited Access and Integration of Risk Data and Information	Improve access to risk management data and information; widely communicate availability and how to use it.
Sustainable Transportation	Ineffective Collaboration in Enterprise-Level Risk Management	Act on enterprise level risk starting with a multidisciplinary VTrans meeting followed up annually; establish communication with traditional and new partners to minimize or mitigate risks.

Source: [VTrans TAMP \(2018\)](#)

Acknowledgements

Thank you to the many people who contributed to the launch of this effort to reduce repeat damage and risk on Vermont's transportation system! People who contributed to this 2018 Part 667 effort are grouped by VTrans bureau. Names of core team members are bolded.

Maintenance and Operations Bureau: Scott Rogers

Maintenance and Operations: Todd Law

Technical Services: Alec Portalupi

Emergency Management: Todd Sears

Project Delivery/Structures: Nick Wark

Project Delivery-Structures & Hydraulics: Kristin Higgins

Asset Management and Performance: Chad Allen

Budget and Programming: Kevin

Marshia Data Management: Stephen

Smith Analytics: Reid Kiniry

NBIS Inspections and Budget: Pam Thurber

Policy, Planning, & Research: Joe Segale

Planning: Zoe Neaderland

Mapping: Johnathan Croft, Kerry Alley

Performance: Kevin Viani

Performance and Risk Monitoring: Mike Pologruto, Jason Tremblay (since moved on to new position)

Additional Thanks

Members of the Transportation Asset Management Plan-Work Group (TAMP-WG)

FHWA Vermont Division staff: Matt DiGiovanni and Larkin Welborn

Appendices

Spreadsheet of District Staff Comments

Detailed Maps by Priority Location with District Needs and DDIR Summaries

Ground Truth Review of Repeat Damage on the NHS Analysis

Analysis uses reasonably available Detailed Damage Inspection Reports (DDIRs) looking back to 1997 but covering 2004 - 2017 locations with adequate information to map. Results were further prioritized by whether location was on a road highly vulnerable to water damage based on 2017 Resilience Methods and Tools analysis and additional data. Analysis was then reviewed by VTrans district staff and others for reasonableness and history, known needs and potential strategies; and any sense of cost. Color of rows indicates grouped problems corridor. High priority corridors are bright colors. These three columns are mainly from VTrans district staff.

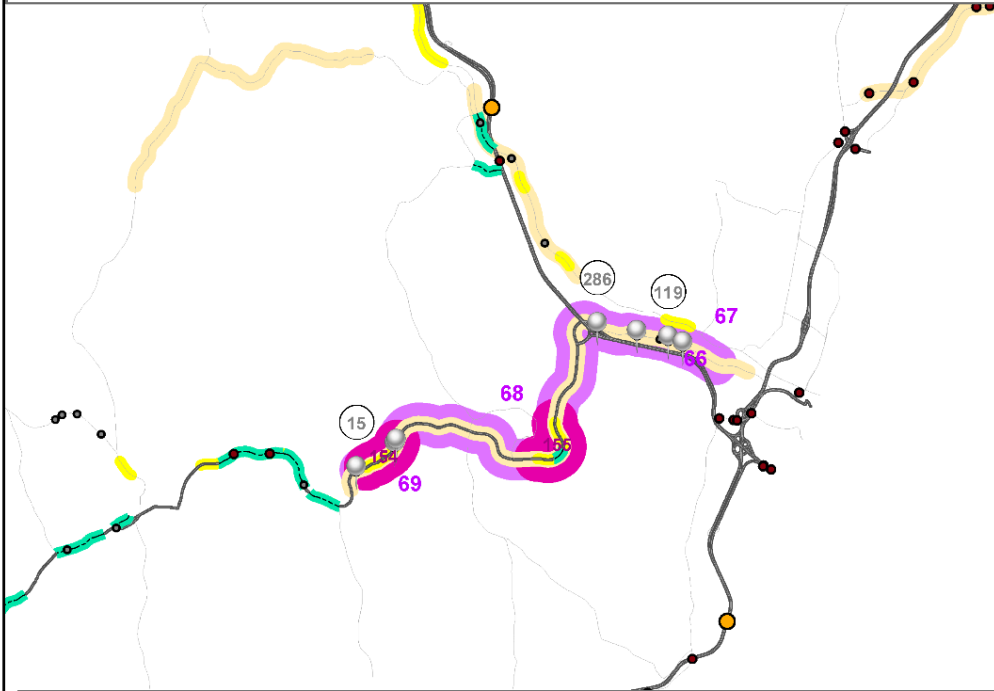
Updated Priority	Unique ID	Road	Town	VTrans District	Ground-Truth/History	Need/Strategy	Sense of Cost	Preliminary Draft - Next Steps	Map
A	154	US 4	Hartford	4	We agree with the assessment of US 4. Some permanent repairs were made to the damaged locations. Many of the US 4 problems are due to the steep slope on the Highway. There are location on US 4 that will become problem in the future. These have not been funded.	Short Term – Identify, monitor and maintain asset until a project is programmed to make a lasting permanent repair. Make temporary repairs to the extent that is financially possible for the Districts limit funds (band aids). Most of these are already identified on our GIS corridor needs map. Capture the ones not identified. Long term- properly engineered repairs, Prepare scoping report for problem locations. Many will Geotechnical analysis as many are slope related. Design the appropriate repair. Many of these sites are not overly complicated	It is the cost of the repair that is the problem. And that is what is holding things back. Some could be \$75,000 projects and some could be \$800,000 projects. Our corridor needs map may have rough cost estimates.	Check if projects are programmed. Explore mix of short- and long-term solutions	1
A	155	US 4	Hartford	4	See 154				
A	66	US 4	Hartford	4	See 154				
A	67	US 4	Hartford	4	See 154				
A	68	US 4	Hartford	4	See 154				
A	69	US 4	Hartford	4	See 154				
C	31	US 2	East Montpelier	7	This project was completed by District 6 prior to District 7 taking over this section/route. Stone slope was constructed. No issues since. Unsure of how project was funded.			Success. Monitor	
C	33	US 2	East Montpelier	7	This project is just east of the slope reconstruction listed above. District 7 had Soils and Foundations design a repair. Keyway at the bottom of the slope, fabric and 3' minus stone was constructed. Work done by district and Mathews & Son Excavating. Work done under ER funding (NH-ERIRN0(002) - \$75,692.07			Success. Monitor	
A	35	US 2	St. Johnsbury	7	This project is a continued issue whether there is a storm event or not. Mid-winter & spring thaws cause slope failure and plugs the drainage infrastructure within this section of US 2. District 7 continues to inspect and maintain drainage throughout the year. This section of US 2 has been on our District Needs list and is a high priority for us. .	The western section of this project does already have a retaining wall design done by Soils and Foundations however there was no funding for construction. The property (field) above US 2 is now owned by Jim Rust and he has approached the District to let us know that he would be willing to work with the state for work needing to be done outside the state right-of-way. This is a project that needs to be design and constructed via PDB	[Can check if retaining wall design has costs]	Check if projects are programmed. Explore mix of short- and long-term solutions. Note these locations are near non-NHS US 2 multiple damage locations	2
Fixed	134	US 4	Killington	3	This was a small washout during the Irene event and all have been repaired via Recovery Funds. To my knowledge, we have not had any further issues with these areas and I feel that further mitigation measures are not needed at this site.			Success.	
C	64	US 4	Mendon	3	The District experienced several small washouts due to Irene and from the 13-1 event due to plugged DIs. The washouts have been repaired and all have been repaired via recovery/FEMA funding. To my knowledge, we have not had any further issues with these areas as we prioritize the DI inspections during heavy rain events. I feel that further mitigation measures are not needed at this site.			Success. Has ongoing monitoring.	
Fixed	65	US 4	Mendon	3	This site was the area of a slope failure/mudslide in the 1980's and during Irene. A construction project was completed in 2016 to repair/armor the slope and included installing a new 55" x 40" squash pipe. I feel that further mitigation measures are not needed at this site.			Success.	
Fixed	105	US 7	Wallingford	3	This site used to have (2) 30" pipes adjacent to each other than ran under U007 and led to a 24" box culvert under the RR. These culverts could not handle heavy rain events. In 2017 new concrete box culverts were constructed under U007 and the RR. The larger box culverts are now handling the water run-off and I feel that further mitigation measures are not needed at this site.			Success.	
A	126	VT 9	Brattleboro	2 in GIS/comments from 1	This stretch of corridor has had repeated damage both which has qualified for federal relief, and smaller state funded response. Some location in this corridor have been addressed, but this stretch of highway needs to be looked at as a larger project. The geometry of the road generates conflict with the adjacent Whetstone Brooke. These areas need to be addressed or failures will continue.	There is a large magnitude of fixes ranging from small slope repair to create a resilient infrastructure to full scale road realignment and/or stream relocation.	With not being a localized problem it's tough to develop an estimate.	Explore mix of short-and long-range solutions.	3

A	127	VT 9	Brattleboro	2/1	See 126			NOTE: data turned out to really all be Irene-Spring. See district notes and explore data further
C	128	VT 9	Searsburg	1	This stretch of highway is a very steep gradient. The damage was caused by ditch water moving too fast and developing erosion. This only happens when we have high intensity rain falls. After TS Irene this stretch of ditch was reconstructed with a stone lined ditch. Recently, we have had no significant erosion. We have had general maintenance in this area from the steep gradient.	General maintenance is the best practice in this area. We are not going to change the steep slope of the road way. If we follow our BMP's for a stone lined ditch we should have minimal problems.		Success. Has ongoing monitoring.
B	7	VT 9	Woodford	1	We have had washouts along this stream/road corridor, but this specific location doesn't immediately come to mind. The biggest repair work in this area is around the larger bridges at the bottom of the hill. The particular location indicated on the map has been corrected after Irene using recovery funds.	The stream is constricted by both the road and steep topography of the area. The crowding of the stream generates deeper water resulting in more erosive power. A stacked stone wall to increase the width of the stream and not compromising road width would be the best solution.	The cost of long-term corridor correction would depend on the length of the project.	Partial success. Explore further. 4
A	39	VT 15	Essex	5	Assumption is that there is something wrong with the slope pipe we installed.	We can probably save the existing DI and connect a new system to the DI outlet pipe. We will have to remove and replace about 60 feet of concrete sidewalk, remove and reset approximately 60 feet of 6" Chainlink fence, remove the existing slope pipe and either reinstall the existing slope pipe or install a new slope pipe. I am assuming a contractor would use a long stick excavator so the could work from the sidewalk/roadway. I estimate the work would take two weeks which includes the restoration of the area and replacement sidewalk.	SWAG is \$50,000 to \$75,000	Confirm problem and strategy, explore funding. This area damaged in 2011 and 2013. 5
Drop	40	VT 15	Jericho Village	5	Not actually near each other, plus problems at two DDIRs fixed			N/A
Fixed	132	VT 103	Shrewsbury	3	This is BR #50 that spans the Mill River. To my knowledge, the only issue we've ever had with this bridge was with Irene when a massive amount of debris came down the river causing a debris jam under the bridge. Irene recovery funds allowed for the armoring of the embankments & wing-walls at all 4 corners of the structure and to remove the debris under the bridge. I feel that further mitigation measures are not needed at this site.			Success

District 4

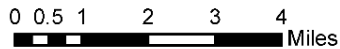
US 4 Area in Hartford

Review Areas 66, 67, 68, 69, 154, 155 with District Needs

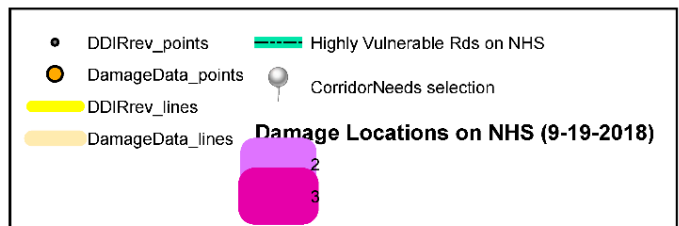


District Needs - Numbers in circles on map

FID	BeginMM	IssueCateg	IssueDescr	EstimatedC	WorkType	FailurePro	FailureImp	RemainingS	AssetID	LastEditDa	Completion	OBJECTID	Top2Prior
15	0.4378	Culvert	pavement edge, slope, culvert issues. very deep old stone culverts drainage failed bottomed out. these issues run the stretch of tafsville to white river junction	0					31504			40	0
119	0	Culvert	70' Deep stone box culvert - stones missing from roof of culvert - beginning to fail	500000						2016-12-16		280	0
253	0	Culvert	3 stone box culverts caving in/outlet failed	1000000	Capital Project					2016-12-29		585	0
286	6.51	Pavement	bump in road from trucks, what can we do to prevent this, has been fixed once	25000						2016-12-28		659	0
423	0	Slope	2 failed stone retaining wall - remove wall, slope bank back and install stone on slope	36000	District Forces					2016-12-29		990	0
1358	0	Culvert	Sinkhole in shoulder	0	District Forces	Very High	Very High	0-1 years		2017-04-28	2017-11-30	39530	0
1403	7.118	Culvert	PID 31647 Bottom culvert rotten, holes thru ribs, road is settling	70000	MRA							48278	2



Work Map 11/2/18



US 4 Hartford
Summary

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Pre- and Post- Irene (DamageData Lines)

OBJECTID	Emergency_ Event	Town	Asset_Type	MM	Description_of_Damage	Estimated_Cost	Report Number	GIS RecordID	DDIRs Folder	Have?
110	VT13-1	Hartford	shoulders	0.1-8.4	Various sites: shoulder washouts, washed under guardrail, repair shoulders, and around culvert	\$ 9,784.92	D4-US4-74	278	R:\FHWAERDeclarations	Y
125	VT17-1	Hartford	Slope, culvert	0.5-8.9	4 sites, several slope failures due to the volume of heavy rain runoff, one pipe failure, and a collapsed headwall. Repair slope failures, replace failed culvert, repair collapsed headwall, clean plugged culverts	\$ 89,708.91	D4-US4-1	211	R:\FHWAERDeclarations	Y

Irene DDIR Lines

OBJECTID	Data_Dicti	TOWN	MM	Description or DescChange	Estimated_Cost	REPORT_NUM	GIS RecordID	Folder-Photos	Have?
16	Irene_Spring	WOODSTOCK	3.7 TO 4.6	125' of embankment washed out causing damage to 75' of pavement		D4-US4-23		R:\UnifiedCommand\Irene_Spring12\Photos\ID4-US4-23	Y
19	Irene_Spring	HARTFORD	7.6 to 8.9	120' of embankment washed out, 70 x 45' x 8' washout along northern embankment		D4-US4-19-Rev	709	R:\UnifiedCommand\Irene_Spring12\Photos\ID4-US4-19-Rev	Y
55	Irene_Spring		0.1 to 0.4	225' x 80' x 8' washout of northern embankment. 180' of embankment washed out. 135' of paved ditch and 90' of pavement damaged		D4-US4-21-Rev	739	R:\UnifiedCommand\Irene_Spring12\Photos\ID4-US4-21-Rev	Y
72	Irene_Spring		0.6 TO 1.2	stone fill slope: repair shoulder, long way down. 2 spots, new		D4-US4-22-Rev		R:\UnifiedCommand\Irene_Spring12\Photos\ID4-US4-22-Rev	Y

Irene-DDIR Points

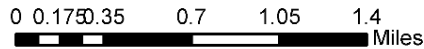
OBJECTID	Data_Dicti	TOWN	ROUTE	MM	Description	Estimated_Cost	REPORT_NUM	GIS RecordID	Folder-Photos	Have?
18	Irene_Spring	Woodstock	U004	9.5	slope evaluation: slope undermining, culvert debris		D4-US4-20-Rev		R:\UnifiedCommand\Irene_Spring12\Photos\ID4-US4-20-Rev	Y
366	Irene_Spring		U004	7.2	100' of embankment washout and 50' of pavement damage		D4-US4-24	440	R:\UnifiedCommand\Irene_Spring12\Photos\ID4-US4-24	Y

District 7 US 2 Area in St. Johnsbury Review Area 35 with District Needs

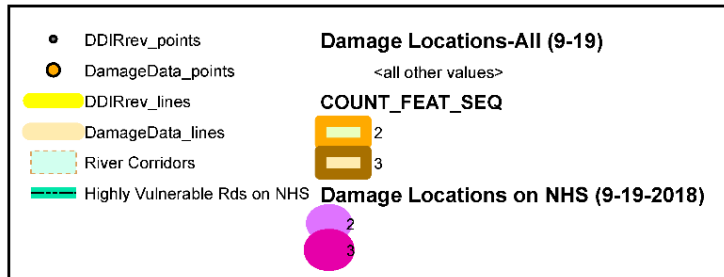


District Needs - Numbers in circles on map

FID	Route	BeginMM	EndMM	ProjectLen	Owner	IssueCateg	IssueDescr	Action'sTak	ActionsNee	EstimatedC	Source	Top2Priori	last_edt_1
756	U002	6.7	7.1	211	HVY MCB Maintenance Lunenburg	Slope	Failed slope, retaining walls, and poor drainage. Drainage gets filled in with sediment from slope and above field constant maintenance issue, ice and sediment. Moose River is located adjacent to route 2 and slope.	Phase 1 - There were plans drawn for this section of wall that were not completed.	Area is not a viable district project, contract out.	3000000	Alex Nicholson 02/01/17	0	2017-07-19
757	V018	0.2259	0.2259	713	HVY MCB Maintenance Lunenburg	Slope	Retaining wall replace part of corridor need ID 44.	None	Issue could be combined into a all encompassing St. J. slope rehabilitation project. Replace 713' of retaining wall and associated under rail grade as necessary.	0	Alex Nicholson 02/07/17	2	2017-07-19



Work Map 11/2/18



US 2 St Johnsbury
DDIR Summary

This is a mix of NHS and Nearby Non-NHS

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Print

Before or After Irene (DamageData) points	Emergency Town	Asset_Type	Road	MM	Estimated_Cost	Description_of_Damage	Report Number	RecordID_2018	DDIRs Folder	Have?
101	St. Johnsbury	Road and ditch	Concord Ave		\$ 23,459.23	About 0.3 miles of road and ditch washout		65		N

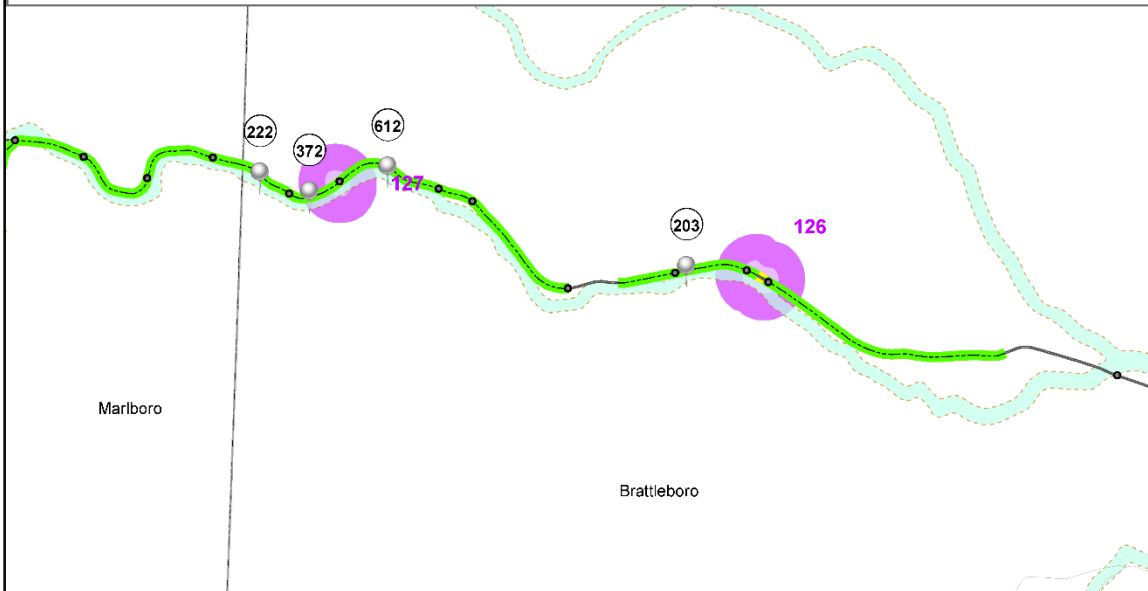
Have "Request for Opening New EA"

Before or After Irene (DamageData lines)

Emergency Town	Asset_Type	Road	MM	Estimated_Cost	Description_of_Damage	Report Number	RecordID_2018	DDIRs Folder	Have?
24	St. Johnsbury	Slope	5.0-6.0	\$ 23,264.20	Slope failure	D7 US2-3	82	R:\FHWA\ERDeclarations\VT11-1\07\STATE ROUTE DDIR's - see US2-3	Y
26	St. Johnsbury- Kirby	Slope and bridge	6.74-0.25	\$ 200,180.35	Slope failure and BR 109 substructure scour	D7 US2-4	83	R:\FHWA\ERDeclarations\VT11-1\07\STATE ROUTE DDIR's - see US2-4	Y
106	St. Johnsbury	Culvert, ditch, shoulders	5.72-6.81	\$ 8,822.75	Box culvert inlet washout, ditch and shoulder erosion. Clean culvert and reestablish ditch	D7 US2-1	227	R:\FHWA\ERDeclarations\VT17-1 (Updated Folder)\District 7\State System\St. Johnsbury US2	Y

Have Request for Authorization for Eastern Ave (U002-1) VT 11-1 but not more

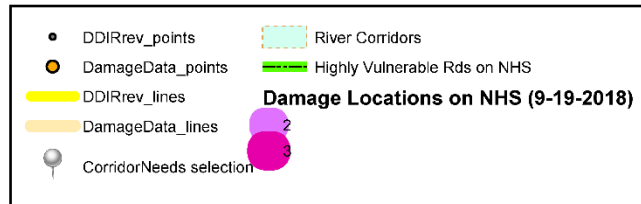
District 1/2 Area VT 9 Area in Brattleboro Review Areas 126 and 127 with District Needs



District Needs - Numbers in circles on map

FID	BeginMM	District	Owner	IssueCateg	IssueDescr	ActionsNee	EstimatedC	WorkType	FailurePro	FailureImp	RemainingS	LastEditDa	OBJECTID
203	1.809	1	HWY MOB Maintenance Wilmington	Culvert	Place new culvert and new DI	Place new culvert and new DI	0	District Forces	Low	Low	5-10 years	2016-07-21	464
222	0.09	1	HWY MOB Maintenance Wilmington	Slope	Irene Site never repaired (river work)	river work	0					2016-07-21	519
372	0.281	1	HWY MOB Maintenance Wilmington	Ledge			0						870
612	0.6	1	HWY MOB Maintenance Wilmington	Other	Stream Bed armory	Stream Bed armory	30,000		Med	Med		2016-07-21	1405

0 0.15 0.3 0.6 0.9 1.2
Miles



Work Map 11/2/18

VT 9 Brattleboro
Summary

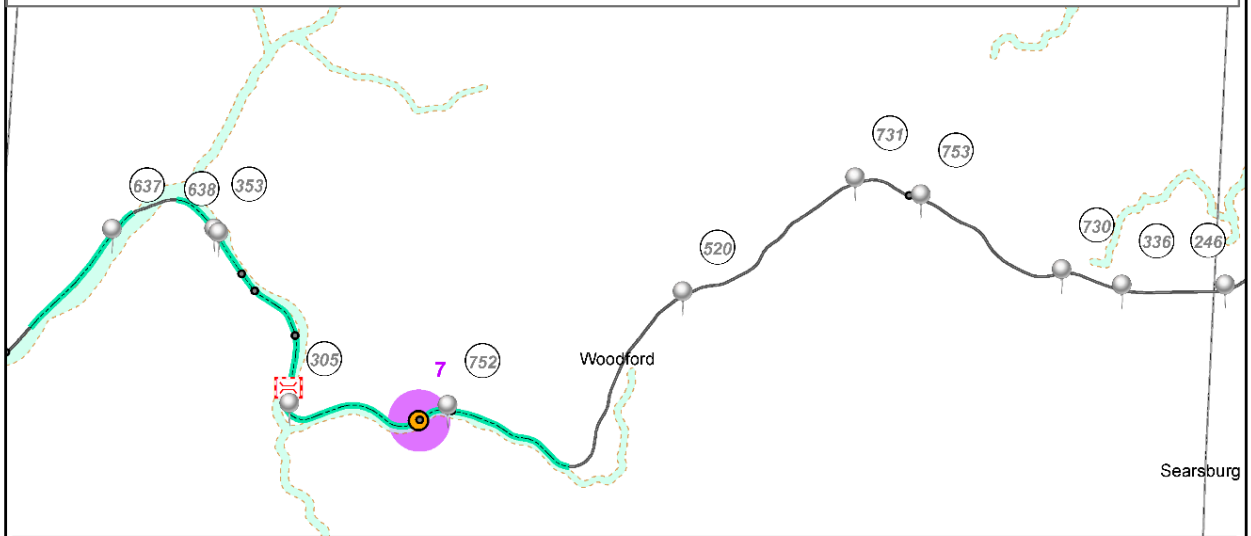
Irene-DDIR Points		Sorted by MM		R:\UnifiedCommand\CompletedDDIRS - then by town				File & print	
OBJECTID	Data_Dicti	TOWN	MM	DESC_CHANG	MAGNITUDE	REPORT NUM	RecordID	Folder	Have?
423	Irene_Spring	MARLBORO	7.33			D1-084	2018 795	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-084	Y
490	Irene_Spring	MARLBORO	7.6			D1-085	794	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-085	Y
46	Irene_Spring	MARLBORO	7.92	fix cut slope across from autobody shop	0-50,000	D1-086	502	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-086	Y
132	Irene_Spring	MARLBORO	8.2	pull back toe of slope and armor at berm	0-50,000	D1-087	501	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-087	Y
102		BRATTLEBORO	0.2	rebuild slopes with larger fill material	0-50,000	D1-088	550	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-088	Y
354	Irene_Spring	BRATTLEBORO	0.4			D1-090	793	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-090	Y
71	Irene_Spring	BRATTLEBORO	0.8	pull back slope and rebuild slopes with larger material	50,000-250,000	D1-091	500	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-091	Y
242	Irene_Spring	BRATTLEBORO	0.93			D1-092	792	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-092	Y
62	Irene_Spring	BRATTLEBORO	1.41	add fill material to slope	0-50,000	D1-093	499	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-093	Y
307	Irene_Spring	BRATTLEBORO	1.8			D1-095	791	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-095	Y
166	Irene_Spring	BRATTLEBORO	2.1	pull back slope	50,000-250,000	D1-096	498	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-096	Y
391	Irene_Spring	BRATTLEBORO	2.15			D1-097	790	R:\UnifiedCommand\ScanTour\Spring 12\Photos\ID1-097	Y

Apprx 3 miles

Blank in data dictionary is what made this come through as a different event in analysis

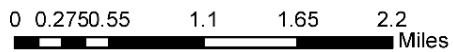
12 DDIRS

District 1 VT 9 Area in Woodford Review Areas 7 with District Needs



District Needs - Numbers in circles on map

FID	Route	BeginMM	EndMM	Owner	IssueCateg	IssueDescr	ActionsTak	ActionsNee	EstimatedC	FailurePro	FailureImp	RemainingS	LastEditDa	Completion	OBJECTID
305	V009	2.86	2.95	HWY MOB Maintenance Bennington	Ledge	60ft cliff, rocks failing		secure cliff ledge	300,000	Med	High	3-5 years	2016-07-20		715
353	V009	1.74	0	HWY MOB Maintenance Bennington	Slope	Unstable slope, erosion		stabilize slope	0	Low	Med	5-10 years	2016-07-20		815
637	V009	0.975	0	HWY MOB Maintenance Bennington	Culvert	PID 10007 - 18' Metal culvert in critical condition		new culvert	5,000	Very High	Low	0-1 years	2017-03-27	2015-09-30	5442
638	V009	1.789	0	HWY MOB Maintenance Bennington	Culvert	PID 10013 - 30' metal culvert in critical condition		replace culvert	10,000				2017-03-27	2016-10-03	5443
752	V009	3.878	0	HWY MOB Maintenance Bennington	Culvert	PID 10049 - 24' metal pipe - Critical at barrel and outlet	Full replacement. 24" HDPE with underdrain		15,000				2017-06-07	2017-06-02	5446



Work Map 11/2/18

Damage Locations on NHS (9-19-2018)

- DDIRRev_points
- DamageData_points
- DDIRRev_lines
- DamageData_lines
- ⊠ Highly Vulnerable Bridges on NHS
- Highly Vulnerable Rds on NHS
- ▨ River Corridors
- CorridorNeeds

Map legend showing symbols for DDIRRev_points, DamageData_points, DDIRRev_lines, DamageData_lines, Highly Vulnerable Bridges on NHS, Highly Vulnerable Rds on NHS, River Corridors, and CorridorNeeds. A purple circle with the number 7 is highlighted, corresponding to the review area on the map.

VT 9 Woodford
Summary

File &
Print

Pre- and Post Irene (Damage Data Points)

OBJECTID	Emergency Event	Town	Asset_Type	MM	Description	Estimated_Cost	Description_of_Damage	Folder	Report Number	RecordID_2018	RecordID_Have?
155	VT08-1	Woodford	Rock slope	3.7	On VT Route 9 in Woodford at MM 3.7	\$ 248,979.32	Heavy rain caused a fractured rock cut slope to break loose and fall onto the shoulder. Additionally the falling rock weakened the remainder of the slope creating an unstable situation/threat for future rock falls	R:\HWAER\Declarations	D1-VT9-1-241		Y

Irene DDJR Lines

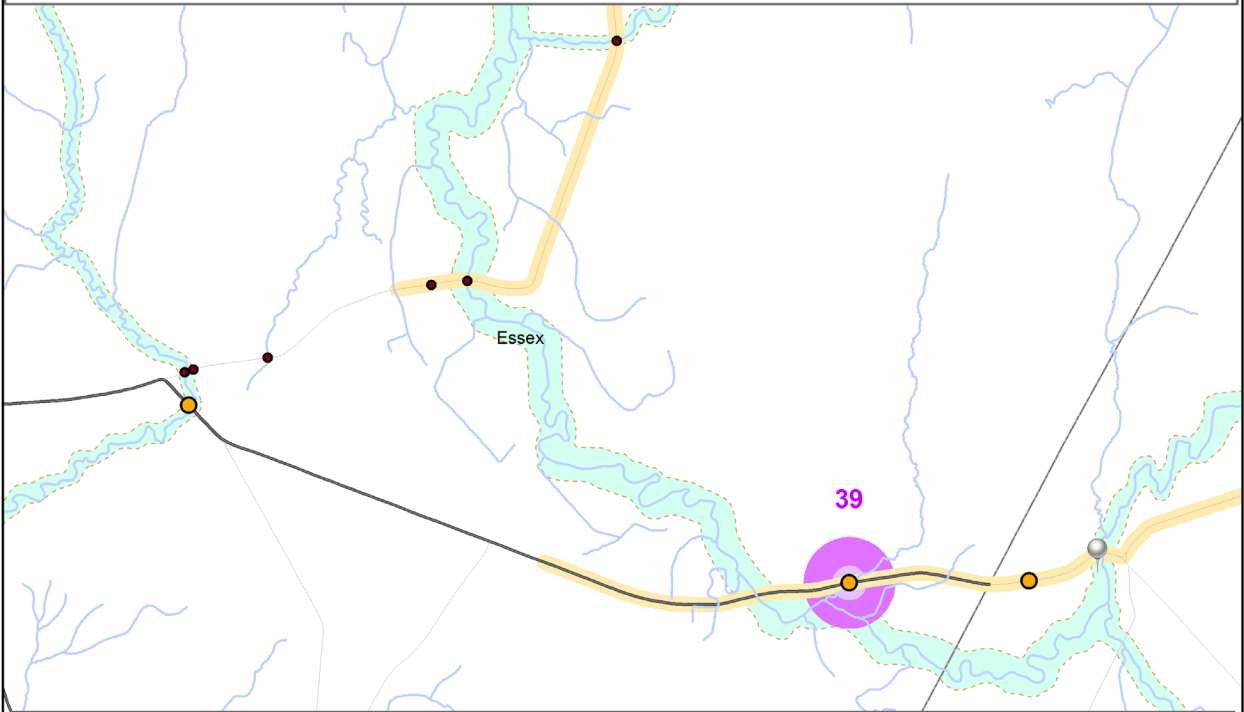
OBJECTID	Data_Dicti	TOWN	MM	Description or DescChange	Estimated_Cost	SOW_with_I	Folder-Photos	REPORT_NUM	RecordID_2018	RecordID_Have?
131	Irene_Spring	Woodford	3.707	guardrail debris and culvert shortend pull slope toe back extend slope repair	250,000-500,000	guardrail debris and culvert shortend pull slope toe back extend slope repair	R:\UnifiedCommand\ScanTour\Spring12\Photos\D1-047	D1-047	386	Y
172	Irene_Spring	Woodford	3.902	Multiple locations of slope/shoulder failure			R:\UnifiedCommand\ScanTour\Spring12\Photos\D1-062	D1-062	650	Y

Note: 172 is 2/10th miles away but seemed worth including.

R:\UnifiedCommand\Completed\DDIRS

this folder doesn't seem to be there

District 5 VT 15 Area in Essex/Jericho Review Areas 39 with District Needs



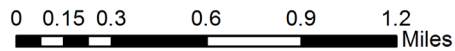
District Needs - Numbers in circles on map

FID	Route	BeginMM	Owner	IssueCateg	IssueDescr	ActionsTak	EstimatedC	WorkType	FailurePro	FailureImp	Remainings	Detour	AssetID	OBJECTID	last_edt_1
1082	V015	0.3905	HWY MOB Maintenance Colchester	Culvert	Culvert PID 1836. Culvert is located between two Dis cannot see through culvert but there is a drop within the pipe.	None	20,000	Capital Project	Med	Med	1-3 years	20-30 miles	1836	917	2017-12-06

- CorridorNeeds
- DDIRRev_points
- DamageData_points
- DDIRRev_lines
- DamageData_lines
- River Corridors
- Highly Vulnerable Rds on NHS
- CorridorNeeds selection 2

Priority Damage Locations

2



VT 15 Essex Area
Summary

These are locations over approximately half a mile. RecordID 298 and 17 are the focus on the map. RecordID 303 is just off NHS section Pre- and Post-Irene (DamageData Points)

File &
Print

OBJECTID	Emergency_ Event	Town	Asset_Type	MM	Description_of_Damage	Estimated_Cost	Report Number	GIS RecordID_2018	DDIRs Folder	Have?
142	VT13-1	Jericho	Roadway	0.13	Road edge washed out, repair slope and debris removal	\$ 25,000.00	D5-VT15-12	303	R:\FHWAERDeclaration s\VT13-1\District 5	Y
160	VT13-1	Essex	Slope, sidewalk	5.45	Slope failure, sidewalk undermined	\$ 50,681.00	D5-VT15-62	299	R:\FHWAERDeclaration s\VT13-1\District 5	Y
173	VT13-1	Essex	Roadway, culvert, slope	7.7	Washed out road. Repair pavement, rail, slope, box culvert, debris removal	\$ 25,000.00	D5-VT15-10	298	R:\FHWAERDeclaration s\VT13-1\District 5	Y

Pre- and Post-Irene (DamageData Lines)

OBJECTID	Emergency_ Event	Town	Asset_Type	MM	Description_of_Damage	Estimated_Cost	Report Number	GIS RecordID_2018	DDIRs Folder	Have?
50	VT11-1	Essex-Underhill	Ditch, roadway, shoulder, pavement	6.70-1.10	Ditch, roadway, shoulder, and pavement washouts	\$ 12,990.60	D5 VT15-1	17	R:\FHWAERDeclaration s\VT11-1\ID5\STATE ROUTE DDIR\s\D5 Sitefile.xlsx - tab VT15-1	Y