



2018 Vermont State Hazard Mitigation Plan

*Making Vermont safer and more resilient in the
face of climate change and natural disasters*



I: EXECUTIVE SUMMARY

Hazard mitigation is any sustained action that reduces or eliminates long-term risk to people and property from natural hazards and their effects.

The impact of anticipated yet unpredictable natural events can be reduced through community planning and implementation of cost effective, preventive mitigation efforts.

The State of Vermont understands that it is not only less costly to reduce vulnerability to disasters than to repeatedly repair damage, but that we can also take proactive steps to protect our economy, environment and most vulnerable citizens from inevitable natural hazard events. This Plan recognizes that communities have the opportunity to identify mitigation strategies during all phases of emergency management (preparedness, mitigation, response, and recovery) to more comprehensively address their vulnerability. Though hazards themselves cannot be eliminated, Vermonters can reduce our vulnerability to hazards by improving our understanding of both the natural hazards we face and their potential impacts.

Mission: to protect life, property, natural resources and quality of life in Vermont by reducing our vulnerability to climate change and natural disasters.

The 2018 Vermont State Hazard Mitigation Plan (SHMP) presents the hazard impacts most likely to affect Vermont and a mitigation strategy to reduce or eliminate our most significant vulnerabilities. This SHMP is a complete rewrite of the 2013 Plan, both in the content of the Plan document and its mitigation actions. Vermont Emergency Management, along with key stakeholders, completed a thorough review of the 2013 SHMP at the beginning of the update process to ensure that nothing developed in previous versions would be lost in this rewrite process.

Audience and Use:

The 2018 Vermont SHMP was developed to help the State of Vermont and local governments identify all natural hazards facing our communities and establish actions that reduce risk. The planning process for this update was much broader than previous mitigation planning efforts in order to better integrate the work of State agencies with those of regional and local governments, as well as nonprofit and private partners. The SHMP will serve as a resource for State agencies and other resilience stakeholders to better understand Vermont's exposure to natural hazards and collectively implement actions that reduce our vulnerability.

While the Vermont Division of Emergency Management (VEM) produced this Plan, a large network of stakeholders across Vermont have worked together to develop the capability inventory and actions. Accordingly, few of the actions in the 2018 SHMP fall solely on VEM to implement; most will require ongoing, concerted engagement by multiple stakeholders over the next five years.

This Plan is also intended to be a valuable resource for Local Hazard Mitigation Plan (LHMP) development. The capabilities list and disaster history spreadsheet are examples of resources that can be pulled directly from the SHMP for use in LHMPs. Further, several of the mitigation actions in this Plan aim to simplify the LHMP development process.

ACKNOWLEDGEMENTS

Though there was a great deal of stakeholder engagement during the planning process, we would like to extend a special thanks to the following individuals for their technical assistance during Plan development:

- **Mike Kline** | Rivers Program Manager | ANR Department of Environmental Conservation
- **Rob Evans** | State Floodplain Manager | ANR Department of Environmental Conservation
- **Jared Ulmer** | Climate and Health Program Coordinator | Vermont Department of Health
- **Rose Paul** | Director of Critical Lands and Conservation Science | The Nature Conservancy
- **Marjorie Gale** | State Geologist | ANR Department of Environmental Conservation
- **Joe Segale** | Policy, Planning & Research Bureau Director | Vermont Agency of Transportation
- **Ben Green** | Dam Safety Engineer | ANR Department of Environmental Conservation

Thank you also to our committee members and the individuals who participated in the Working Groups and Focus Groups.

Photo Credit: Stephanie Smith, VEM



THE PROCESS

In previous iterations of Vermont SHMPs, Plan development was the responsibility of VEM and sister State agencies. Recognizing that resilience efforts in Vermont are far more expansive than the work carried out solely by State government, this SHMP represents a robust, inclusive planning process that better addresses and incorporates statewide mitigation initiatives.

Table 1: State Hazard Mitigation Planning & Policy Committee

Secretary Susanne Young	Agency of Administration
Secretary Julie Moore	Agency of Natural Resources
Secretary Michael Schirling	Agency of Commerce and Community Development
Secretary Joe Flynn	Agency of Transportation
Commissioner Chris Cole	Buildings and General Services
Secretary Anson Tebbetts	Agency of Agriculture, Food and Markets
Director Erica Bornemann	Vermont Emergency Management

In early 2017, the State Hazard Mitigation Planning & Policy Committee (SHMPPC) addressed the need for involving a more diverse group of stakeholders by authorizing the creation of the State Hazard Mitigation Plan Steering Committee to guide the Plan update process and engage a larger audience. The Steering Committee is comprised of members from Federal and State government, as well as the nonprofit and private sectors. Other partners were also involved in SHMP development through Working Group and Focus Group opportunities.

VEM mitigation staff (Lauren Oates, State Hazard Mitigation Officer, and Stephanie Smith, Hazard Mitigation Planner) coordinated the overall planning process and Plan development. Community Workshop facilitated and designed the stakeholder engagement process. For more information on Plan development, see: [Planning Process](#).

Table 2: State Hazard Mitigation Plan Steering Committee

Ben Rose	Vermont Emergency Management
Bob Costantino	Vermont Agency of Human Services
Catherine Dimitruk	Northwest Regional Planning Commission <i>Appointed by VAPDA to represent Regional Planning Commissions</i>
Chris Cochran	Vermont Agency of Commerce and Community Development
Gaye Symington	High Meadows Fund
Greg Hanson	National Weather Service
Jen Hollar	Vermont Housing and Conservation Board
Jenna Koloski	Vermont Council on Rural Development
Joe Segale	Vermont Agency of Transportation
Karen Horn	Vermont League of Cities and Towns
Mike Kline	Vermont Agency of Natural Resources
Richard Kehne	Vermont Buildings and General Services
Rose Paul	The Nature Conservancy
Steve Libby	Vermont River Conservancy
Tara Kulkarni	Norwich University
Tim Schmalz	Vermont Agency of Agriculture, Food and Markets

Figure 1: 2018 Vermont SHMP - Stakeholder Engagement Process



KEY CAPABILITY IMPROVEMENTS

This Plan conveys an array of mitigation capabilities that exist within Vermont. The capabilities section and its extensive inventory address both the improvements of existing capabilities, as well as new capabilities that have been developed since the 2013 SHMP. The most significant improvements or additions to Vermont's mitigation efforts are identified below. For information on all capabilities identified through this process, see: [State & Local Capabilities](#).

2018 SHMP Planning Projects:

VEM was awarded funding through FEMA's Hazard Mitigation Grant Program (HMGP) to develop the 2018 Vermont SHMP. As part of this planning grant, VEM received funding for three planning efforts to be carried out by the Agency of Natural Resources (ANR), the Agency of Transportation (VTrans) and Buildings & General Services (BGS), each of which significantly enhances the State's mitigation capabilities. These planning tasks represent a new level of proactive coordination and program integration among State agencies, which are part of an effort to institutionalize hazard mitigation and resilience efforts within State government and expand ownership of the 2018 State Hazard Mitigation Plan.

ANR Project | Statewide River Corridors Risk Analysis and Hazard Mitigation Prioritization

Tool: ANR modified Vermont's Statewide River Corridor Base Map to develop the map as a risk analysis, mitigation and conservation prioritization tool for use by State, regional and local governments. ANR aimed to increase understanding of the risks of fluvial erosion and to identify specific mitigation actions for reducing vulnerability. Using the template project table developed as part of this project, ANR, Regional Planning Commissions and VEM will endeavor to increase the use of project tables in municipal planning and capital improvement efforts Statewide.

VTrans Project | Methods and Tools for Transportation Resilience Planning:

VTrans developed a Methods and Tools for Transportation Resilience Planning (TRPT) application that identifies the specific road infrastructure sites most vulnerable to damage from flooding in three pilot watersheds. The tool also estimates risk based on both the vulnerability and criticality of road segments and identifies a list of potential mitigation measures that can be taken to reduce infrastructural vulnerability. Though currently only available for three watersheds, this Plan's mitigation actions include expanding the tool to all watersheds across Vermont and including other critical infrastructure, such as utilities.

BGS Project | State Facility Inventory and Assessment: BGS completed a vulnerability assessment of all State buildings in order to better understand their respective risks from flooding. The resulting building inventory tool will serve State planners in prioritizing the most cost-effective flood mitigation needs and opportunities to reduce future damages and increase resilience for existing State facilities.

Emergency Relief & Assistance Fund:

Vermont's Emergency Relief & Assistance Fund (ERAF) provides State funding to match FEMA Public Assistance grants following a federally-declared disaster. In 2014, the ERAF criteria were revised to incentivize communities to be more proactive prior to disasters. The default rate for State contribution towards non-federal Public Assistance match following a declared disaster dropped to 7.5%, requiring municipalities to cover the other 17.5% for Public Assistance projects. However, municipalities that take the following proactive measures are awarded 12.5% State match:

1. Participate in the National Flood Insurance Program (NFIP),
2. Adopt Town Road and Bridge Standards that meet or exceed the VTrans 2013 template,
3. Adopt a Local Emergency Operations Plan annually, and
4. Submit a Local Hazard Mitigation Plan to VEM for review

Municipalities that wish to further decrease their cost share to 7.5%, with a 17.5% State match, must also meet one of the following criteria:

5. Adoption of ANR's River Corridor bylaws, or
6. Enrollment in the Community Rating System (CRS), whereby the community must earn credit under Activity 430

A priority mitigation action in the 2018 SHMP is to assess the effectiveness of the current iteration of the ERAF rule in incentivizing proactive mitigation measures, and to revise the rule to improve it, if needed.

Vermont Stream Alteration General Permit (SAGP) Revision:

A notable advancement in hazard mitigation initiatives during the past few years has been the revision of Vermont's Stream Alteration General Permit (SAGP), and FEMA's subsequent recognition of the new general permit as "codes and standards" for purposes of future Public Assistance repairs. For several disasters following Tropical Storm Irene in 2011, VEM, ANR and VTrans worked with FEMA Region I on a case-by-case basis to have upsized drainage structures deemed fully-eligible for Public Assistance funding under Section 406 hazard mitigation of the Stafford Act. Beginning with DR-4330, which was declared in 2017, structure replacements that fall under the jurisdiction of the SAGP, and are required to meet the standards of the SAGP, are presumed to be PA-eligible and do not require approval by FEMA prior to construction, though certain projects may require environmental planning and historic preservation (EHP) review before breaking ground. This significant improvement allows Vermont to more quickly and appropriately address vulnerable infrastructure in a more sustainable way than has typically been implemented during the immediate response and recovery phase following a disaster.

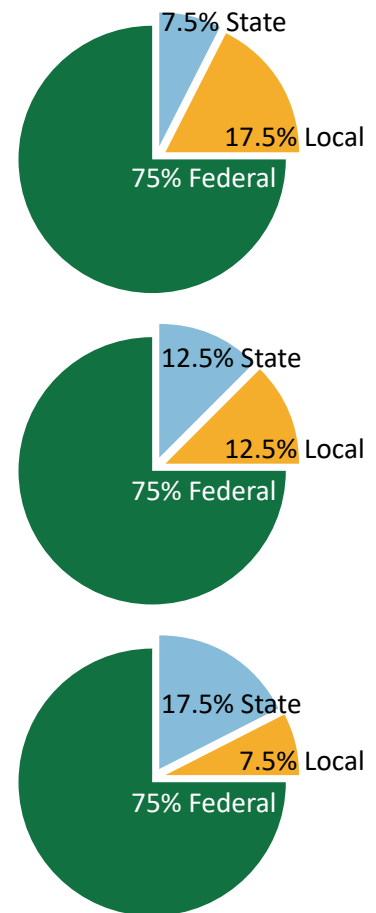


Figure 2: Vermont Emergency Relief & Assistance Fund rates

Hazard Mitigation Assistance Projects:

Since Tropical Storm Irene, Vermont has been proactive in addressing its vulnerability to natural hazards. Through various funding sources, primarily the Hazard Mitigation Assistance (HMA) grant programs, we have acquired and demolished nearly 150 flood-vulnerable properties, completed approximately 70 infrastructure improvement projects, developed LHMPs for 142 municipalities and carried out a handful of 5% Initiative projects. Since the 2013 SHMP, VEM mitigation staff have been more aggressive in applying for Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) funding as a supplement to Hazard Mitigation Grant Program (HMGP) disaster funding. Most notably, through coordinated efforts with State, regional and local project developers, Vermont has been prioritizing larger mitigation initiatives that more comprehensively address vulnerability, like floodplain restoration efforts in Middlebury, Cambridge, Brattleboro and Waterbury.



Greenway Trail Bridge in Cambridge, VT was replaced and the floodplain restored to reduce future flooding in historic downtown Jeffersonville
Photo Credit: Seth Jensen, LCPC

HAZARD ASSESSMENT

VEM staff used several methods to identify risks in Vermont, including the evaluation of historical data, consideration of our changing climate trends, and feedback from stakeholders during the hazard assessment process. The most significant change from the 2013 SHMP to the 2018 SHMP is the way hazards are assessed. Instead of continuing to view hazards as events (e.g. hurricanes), this Plan assesses the impacts of events (e.g. inundation flooding, fluvial erosion, and wind as impacts of a hurricane event), as it is the impacts, not the events, that can be mitigated.

The results of the hazard assessment ranking by the Steering Committee are found in Table 3. As with the previous SHMP, fluvial erosion and inundation flooding continue to be the first and second most significant natural hazards in Vermont, respectively. For more information on all hazards addressed, see: [Hazard Assessment](#).

Table 3: Hazard Assessment							
Hazard Impacts	Probability	Potential Impact					Score*:
		Infrastructure	Life	Economy	Environment	Average:	
Fluvial Erosion	4	4	3	4	4	3.75	15
Inundation Flooding	4	4	3	4	2	3.25	13
Ice	3	3	3	3	2	2	8.25
Snow	4	1	3	2	1	1.75	7
Wind	4	2	2	1	1	1.5	6
Heat	3	1	3	2	2	2	6
Cold	3	1	3	2	2	2	6
Drought	3	1	2	2	3	2	6
Landslides	3	3	2	1	2	2	6
Wildfire	2	3	3	3	2	2.75	5.5
Earthquake	2	3	3	3	2	2.75	5.5
Invasive Species	2	1	1	2	3	1.75	3.5
Infectious Disease Outbreak	2	1	3	2	1	1.75	3.5
Hail	3	1	1	1	1	1	3

*Score = Probability x Average Potential Impact



Snowmobile bridge near Waterbury, VT flexes as debris and water rush past following Tropical Storm Irene

Photo Credit: www.mansfieldheliflight.com/flood

Table 4: Hazard Assessment Ranking Criteria

	Frequency of Occurrence: Probability of a plausibly significant event	Potential Impact: Severity and extent of damage and disruption to population, property, environment and the economy
1	Unlikely: <1% probability of occurrence per year	Negligible: isolated occurrences of minor property and environmental damage, potential for minor injuries, no to minimal economic disruption
2	Occasionally: 1–10% probability of occurrence per year, or at least one chance in next 100 years	Minor: isolated occurrences of moderate to severe property and environmental damage, potential for injuries, minor economic disruption
3	Likely: >10% but <75% probability per year, at least 1 chance in next 10 years	Moderate: severe property and environmental damage on a community scale, injuries or fatalities, short-term economic impact
4	Highly Likely: >75% probability in a year	Major: severe property and environmental damage on a community or regional scale, multiple injuries or fatalities, significant economic impact

Climate Change:

Warming temperatures, shrinking winters and increasing incidence of intense storm events are beginning to have a significant impact on Vermont's economy, people and environment and require immediate attention across all planning efforts at the local, regional, state, federal and global levels. Accordingly, and as a guiding principle of this Plan, we have aimed to recognize and include the impacts of climate change throughout Plan development, most notably reflected in the hazard profiles and mitigation actions. Both direct and indirect impacts of climate change are addressed within pertinent hazard profiles, as well as the potential for compounding impacts. An example of a concerning compounding impact of climate change is that warming temperatures (Figure 3) will allow for increased survivability of forest pests, such as the Emerald Ash Borer. This invasive species can decimate Vermont's ash population, not only shifting the composition of our forests, but also creating additional debris that may exacerbate impacts of other hazards, such as flooding or wildfire.

Vermont's Annual Maximum and Minimum Temperatures (1960-2015)

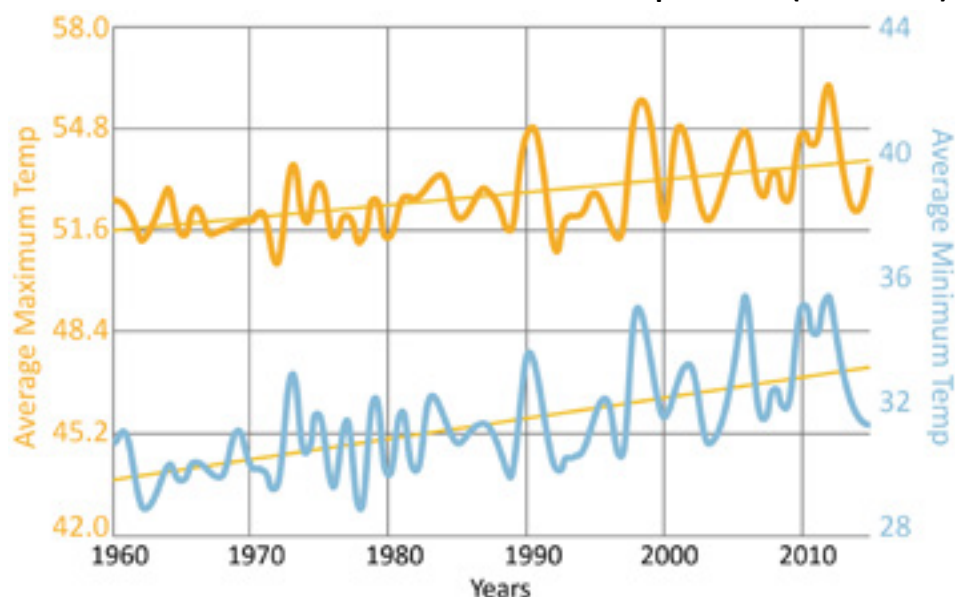


Figure 3: Vermont's annual maximum and minimum temperatures (1960-2015)

Data Source: climatechange.vermont.gov

MITIGATION STRATEGY

At the request of the SHMPPC in early 2017, the Steering Committee worked to develop a mitigation strategy that would be implementable, leverage cross-sector resources and effectively and efficiently reduce Vermont's vulnerability to natural hazards. To do this, the Steering Committee first developed the following four goals of the 2018 SHMP:

Protect, restore and enhance Vermont's natural resources to promote healthy, resilient ecosystems.

Enhance the resilience of our built environment – our communities, infrastructure, buildings, and cultural assets.

Develop and implement plans and policies that create resilient natural systems, built environments, and communities.

Create a common understanding of – and coordinated approach to – mitigation planning and action.

Using these goals, Working Groups and Focus Groups developed a significant list of mitigation actions. These actions were sorted by goal and then further sorted according to similar themes, called “strategies”. The Steering Committee then prioritized the list of 96 mitigation actions based on each individual action's Impact and Feasibility. This prioritization process yielded 24 priority actions, which were then further prioritized into the following top five priorities by the Steering Committee:

- ***Develop a cross-sector buyout program***
- ***Inventory and protect critical headwater and floodplain storage areas***
- ***Collaborate across flood resilience, water quality and habitat connectivity programs and funding***
- ***Audit State programs to assess and improve their support of mitigation goals***
- ***Coordinate State programs to promote development, sharing and maintenance of hazard-related data and mapping***

The majority of the mitigation actions identified in this Plan require collaboration between multiple organizations. Though this will necessitate significant coordination, we believe it also broadens ownership, and therefore improves the implementation potential of the 2018 SHMP. For the full list of mitigation actions, see:

[Mitigation Strategy](#).

Photo Credit: Stephanie Smith, VEM



TABLE OF CONTENTS:

I: EXECUTIVE SUMMARY	ii
Acknowledgements	iii
The Process	iv
Key Capability Improvements	vi
Hazard Assessment	ix
Mitigation Strategy	xi
2: Planning Process	1
State Hazard Mitigation Planning & Policy Committee	1
State Hazard Mitigation Plan Steering Committee	2
Working Groups & Focus Groups	3
Stakeholder Engagement Process & Plan Development	3
Participants & General Outreach	14
Implementation Kick-Off July 2018	15
3: State & Local Capabilities.....	16
State Capabilities.....	16
Hazard Mitigation Assistance Program	16
Public Assistance Program	19
New Capabilities from 2018 SHMP Planning Grant Sub-Projects	22
Local Capabilities	24
Local Hazard Mitigation Planning	25
National Flood Insurance Program (NFIP).....	29
4: Vermont Profile & Hazard Assessment.....	39
Vermont Profile	39
Climate Change	44
Hazard Assessment	46
Hazard Events	46
Hazard Impacts	47
Jurisdictional Vulnerability	49
4-1: Inundation Flooding & Fluvial Erosion.....	55
Inundation Flooding & Fluvial Erosion History	62
Inundation Flooding & Fluvial Erosion Trends & Vulnerability.....	71
Inundation Flooding & Fluvial Erosion Mitigation	79
4-2: Snow Storm & Ice Storm.....	83
Snow Storm & Ice Storm History	84
Snow Storm & Ice Storm Trends & Vulnerability	86
Snow Storm & Ice Storm Mitigation	88
4-3: Wind	89
Wind History	93
Wind Trends & Vulnerability	95
Wind Mitigation	95
4-4: Extreme Cold	97
Extreme Cold History	99
Extreme Cold Trends & Vulnerability	100
Extreme Cold Mitigation	102
4-5: Extreme Heat.....	103
Extreme Heat History	104
Extreme Heat Trends & Vulnerability	105
Extreme Heat Mitigation.....	109
4-6: Drought	111
Drought History	112
Drought Trends & Vulnerability	115
Drought Mitigation	115

4-7: Landslides.....	117
Landslides History	118
Landslide Trends & Vulnerability	120
Landslides Mitigation	121
4-8: Wildfire	123
Wildfire History	124
Wildfire Trends & Vulnerability	125
Wildfire Mitigation	126
4-9: Earthquake	127
Earthquake History	129
Earthquake Trends & Vulnerability.....	130
Earthquake Mitigation.....	131
4-10: Invasive Species	132
Invasive Species History	134
Invasive Species Trends & Vulnerability	134
Invasive Species Mitigation	136
4-11: Infectious Disease	137
Infectious Disease History	138
Infectious Disease Trends & Vulnerability.....	138
Infectious Disease Mitigation	139
4-12: Hail.....	141
Hail History.....	142
Hail Trends & Vulnerability.....	142
Hail Mitigation.....	142
5: Mitigation Strategy	143
Goals	143
Action Development & Prioritization Process	144
6: Maintenance & Implementation	153
2013 Vermont State Hazard Mitigation Plan Implementation	153
2023 State Hazard Mitigation Plan Update Process	155
Appendix to Section I: Authority & Adoption	158
Adoption by the State of Vermont	158

ATTACHED:

Appendix to Section 3: State & Local Capabilities Supplemental

State of Vermont – Hazard Mitigation Grant Application Review Form
Vermont’s Hazard Mitigation Grant Program Applications (HMGP) Summary - 2011-2018
Emergency Relief and Assistance Fund (ERAF) Updated Criteria
ANR Subgrant - Project Readiness Workbooks Summary
VTrans Subgrant - Methods and Tools for Transportation Resilience Planning Summary
BGS Subgrant - State Building Inventory and Priority Building Assessment

Appendix to Section 4: Hazard Assessment Supplemental

Vermont Disaster History by Events Type
Vermont-Owned Buildings - Replacement Costs

Appendix to Section 5 - Mitigation Strategy Supplemental

2018 Status of 2013 State Hazard Mitigation Plan Actions

TABLES:

Table 1: State Hazard Mitigation Planning & Policy Committee	iv
Table 2: State Hazard Mitigation Plan Steering Committee	iv
Table 3: Hazard Assessment	ix
Table 4: Hazard Assessment Ranking Criteria.....	x
Table 5: State Hazard Mitigation Planning & Policy Committee	2
Table 6: State Hazard Mitigation Plan Steering Committee	2
Table 7: 2018 State Hazard Mitigation Plan Participants	14
Table 8: HMGP Financial Summary: DR-1995 (April-May 2011) through DR-4232 (June 2016).....	18
Table 9: HMGP Project Summary: DR-1995 (April-May 2011) through DR-4232 (June 2016)	19
Table 10: Flood Ready Report Categories	24
Table 11: 2018 State Hazard Mitigation Plan Capabilities	33
Table 12: Changes in Development by Region.....	40
Table 13: 2016 Basic Needs Budget Wages, Per Earner – Vermont’s Basic Needs Budget	43
Table 14: Observed Climate Trends – Vermont’s 2017 Forest Action Plan	45
Table 15: Hazard Events Assessment.....	47
Table 16: 2018 Hazard Assessment	47
Table 17: Hazard Assessment Ranking Criteria.....	47
Table 18: Causal Relationships Between Hazard Impacts.....	48
Table 19: Hazard Assessment Changes from the 2013 SHMP	48
Table 20: Hazard Assessment Ranking by Regional Planning Commission.....	49
Table 21: Hazards Addressed in Local Hazard Mitigation Plans Approved as of December 31, 2017	50
Table 22: Local Vulnerability by Regional Planning Commission	50
Table 23: Economic Centers with Infrastructure and Commercial Buildings at Risk (VERI)	52
Table 24: National Weather Service Stream Gauge Status.....	55
Table 25: Dam Hazard Classification - PUC and DEC Regulated Dams.....	60
Table 26: Dam Inspection Schedule - PUC and DEC Regulated Dams.....	60
Table 27: National Weather Service Lake Champlain Flood Categories	61
Table 28: Winter Storm Severity Index (still under development in 2018).....	84
Table 29: Top 20 Greatest Snowstorms in Burlington (NOAA).....	86
Table 30: Snowfall Extremes by Vermont County — 1-Day, 2-Day and 3-Day Storms.....	87
Table 31: Beaufort Wind Scale.....	89
Table 32: Saffir-Simpson Hurricane Wind Scale	91
Table 33: Enhanced Fujita Scale	92
Table 34: Drought Severity Classification	112
Table 35: Landslide-Vulnerable Properties Purchased With HMGP, CDBG and/or VHCB Funds	119
Table 36: Significant Landslides in Vermont	120
Table 37: Modified Mercalli Intensity (MMI) Scale.....	129
Table 38: Threat Categories of Vector-Borne and Other Infectious Disease	137
Table 39: TORRO Hailstorm Intensity Scale	141
Table 40: Hail Size and Diameter in Relation to TORRO Scale	141
Table 41: Hail Events Summary: 2000-2017	142
Table 42: Action Prioritization Criteria.....	144
Table 43: 2018 State Hazard Mitigation Plan Actions Acronym List:	146
Table 44: 2018 State Hazard Mitigation Plan Actions	147
Table 45: State Entities with Primary Responsibility by Hazard.....	154

FIGURES:

Figure 1: 2018 SHMP Stakeholder Engagement Process	v
Figure 2: Vermont Emergency Relief & Assistance Fund rates	vii
Figure 3: Vermont’s annual maximum and minimum temperatures (1960-2015)	x
Figure 4: 2018 Vermont State Hazard Mitigation Plan process timeline	1
Figure 5: Stakeholder Diagram	4
Figure 6: Engagement Framework Diagram	5
Figure 7: Action cards reviewed and categorized during the August Working Group meetings	9
Figure 8: Example of posters used for additional input on actions	10
Figure 9: Vermont Emergency Relief & Assistance Fund rates	20

Figure 10: ERAF rate map by municipality (September 10, 2018)	21
Figure 11: Map of Vermont municipalities with current and interim River Corridor Protections (May 31, 2018)	21
Figure 12: Vermont's 11 Regional Planning Commissions map	24
Figure 13: Local Hazard Mitigation Plan status by municipality map (September 10, 2018)	25
Figure 14: Browns River in Underhill demonstrates the true vulnerability (i.e. River Corridor area) versus the FEMA-mapped vulnerability (DFIRM Flood Hazard Area)	29
Figure 15: NFIP participation by municipality map (May 31, 2018)	31
Figure 16: Risk Map status by municipality map (May 31, 2018)	31
Figure 17: Vermont population by county map (2016)	39
Figure 18: Vermont population change by county map (2010-2016)	39
Figure 19: Housing units by county map (2016)	40
Figure 20: Housing unit change by county map (2010-2016)	40
Figure 21: Vermont's state highway system map	42
Figure 22: Vermont public transportation service areas map	42
Figure 23: Social Vulnerability Index map (2016)	43
Figure 24: Vermont population over 65 map (2016)	43
Figure 25: Vermont's annual maximum and minimum temperatures (1960-2015)	44
Figure 26: Vermont's annual precipitation (1960-2015)	45
Figure 27: Vermont river corridor map (2015)	57
Figure 28: Vermont high-risk dam inundation areas for which there is full or partial* inundation mapping available (*Little River and Wrightsville)	60
Figure 29: Lake Champlain water level—2011 level and summary level through 2017	61
Figure 30: Lake Champlain sub-basins & major tributaries map	62
Figure 31: Tropical Storm Irene total rainfall in inches map (August 27-28, 2011)	65
Figure 32: Federally declared flooding disaster public assistance expenditure by municipality (2000-2016)	70
Figure 33: Observed U.S. percent increases in the amount of precipitation falling during very heavy events (defined as the heaviest 1% of all daily events) (1958 to 2012)	71
Figure 34: Observed U.S. precipitation change map (1991-2012)	71
Figure 35: Projected U.S. precipitation change by season, higher emissions scenario (A2)	72
Figure 36: Vermont's annual precipitation (1960-2015)	73
Figure 37: Federally-declared ice and snow disaster public assistance expenditure by municipality (2000-2016)	86
Figure 38: Number of days in Vermont with greater than 1-Inch snow cover (1960-2015)	87
Figure 39: Peak Hurricane Season in the Atlantic Basin	90
Figure 40: North Country Maximum Wind Gusts, Monday, October 30, 2017 (DR-4356)	93
Figure 41: Federally declared wind disaster public assistance expenditure by municipality (2000-2016)	94
Figure 42: Electric Utility Service territory map from Vermont Public Utility Commission	95
Figure 43: Wind chill temperature index	97
Figure 44: Wavy polar vortex configuration (left) versus more typical, compact configuration (right)	98
Figure 45: Average mean temperature trends in the U.S. map, February 1895-2016 (95% confidence interval)	101
Figure 46: Number of days in Vermont with greater than 1-Inch snow cover (1960-2015)	102
Figure 47: Heat index	104
Figure 48: Vermont's average annual maximum & minimum temperatures (1960-2015)	106
Figure 49: Projected temperature increase under lower emissions scenario, B1 (left) versus under higher emissions scenario, B2 (right)	106
Figure 50: Vermont heat emergencies map by municipality	107
Figure 51: Vermont Heat Illness Vulnerability	108
Figure 52: U.S. drought monitor – history of drought in Vermont percent area in drought (2000-2018)	113
Figure 53: Map of abnormally dry (D0) to severe drought (D2) during significant drought periods in Vermont in late 2001 (left) and late 2016 (right)	114
Figure 54: ANR's Drinking Water Drought Reporter Map	116
Figure 55: Town of Highgate landslide map	121
Figure 56: 2010 Wildland Urban Interface (WUI) map for Vermont	126
Figure 57: Peak acceleration expressed as a percent of gravity (%)	130
Figure 58: U.S. Earthquake Responses in 2017 (top) and Cumulative (1991-2017)	131
Figure 59: Model Predictions of Habitat Suitability - Japanese Knotweed	135
Figure 60: Yearly cases of lyme disease reported in Vermont (2000-2016)	139
Figure 61: Reported lyme disease cases map 1996 (left) and 2014 (right)	140



State of Vermont
Agency of Administration
Office of the Secretary
Pavilion Office Building
109 State Street, 5th Floor
Montpelier, VT 05609-0201
www.aoa.vermont.gov

[phone] 802-828-3322
[fax] 802-828-3320

Susanne R. Young, Secretary

October 18, 2018

Mr. Douglas F. Wolcott, Jr., Acting Deputy Regional Administrator
Department of Homeland Security/FEMA Region I, 99 High Street, Sixth Floor
Boston, MA 02110-2132

Dear Mr. Wolcott:

I am pleased to submit the newly updated 2018 State Hazard Mitigation Plan (SHMP) on behalf of the State of Vermont. This 2018 SHMP has been developed in accordance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended by the Disaster Mitigation Act of 2000 (Public Law 106-390) and the planning requirements of the Final Rule Title 44 Code of Federal Regulations (CFR) Parts 201 and 206. Also, pursuant to the National Flood Insurance Act of 1968, as amended.

Director Erica Bornemann of Vermont Emergency Management (VEM) and the partner agencies of the State Hazard Mitigation Planning and Policy Committee (SHMPPC) have endorsed the 2018 SHMP submitted to FEMA. Upon having received conditional approval by FEMA, this letter constitutes formal adoption of the Standard SHMP by the State of Vermont. Given formal approval of the 2018 SHMP by FEMA, the State of Vermont will be considered eligible for the 15% level of Hazard Mitigation Grant Program (HMGP) funding in the aftermath of a federally declared disaster. With State adoption of our 2018 SHMP, Vermont will also be eligible for grant funds through Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), Fire Mitigation Assistance Grants (FMAG), and Public Assistance Categories C-G (PA C-G).

The State of Vermont will comply with all applicable Federal laws, regulations and statutes regarding hazard mitigation grant funding requirements, as outlined in 44 CFR § 201.4 (c) 7, in compliance with § 13.11 (c). The State will also comply with all provisions of § 201.4 (c) 7 in accordance with all applicable Federal laws, statutes and regulations in effect with respect to periods for which it received grant funding, in compliance with 44 CFR 13.11 (c) and 2 CFR 200. The State will also amend the 2018 SHMP whenever necessary to reflect changes in State and Federal statutes as required in accordance with 44 CFR § 13.11 (d).

The State of Vermont 2018 SHMP has been approved for release by the office of the Secretary of Administration, based upon the endorsement of the Vermont Emergency Management (VEM) Director and member agencies of the State Hazard Mitigation Planning and Policy Committee (SHMPPC). As the Governor's Authorized Representative (GAR), I am authorized to adopt the 2018 SHMP on behalf of the State of Vermont. With my signature below, I am adopting the 2018 Vermont State Hazard Mitigation Plan.

Sincerely,

Susanne R. Young, Secretary of Administration
Governor's Authorized Representative