

Adopted by the Town of Hardwick Selectboard on 12/18/17

Town of Hardwick



All-Hazards Mitigation Plan Update

**P.O. Box 523, 20 Church St.
Hardwick, VT 05843
(802) 472-6120**

PA Applicant Number: 005-31825-00 (Town) 005-UQA0M-00 (HEC)

Prepared by:

Town of Hardwick , Vermont

CERTIFICATE OF LOCAL ADOPTION

Town of Hardwick, Vermont

A Resolution Adopting the Town of Hardwick, All-Hazards Mitigation Plan Update

WHEREAS, the Town of Hardwick has worked with its residents and stakeholders to identify its hazards and vulnerabilities, analyze past and potential future losses due to natural and human-caused hazards, and identify strategies for mitigating future losses; and ...

WHEREAS, the Town of Hardwick All-Hazards Mitigation Plan contains recommendations, potential actions and future projects to mitigate damage from disasters in Hardwick; and

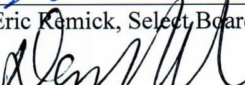
WHEREAS, the Town of Hardwick and the respective officials will pursue implementation of the strategy and follow the maintenance process described in this plan to assure that the plan stays up to date and compliant; and...


WHEREAS, a meeting was held by the Town of Hardwick Select Board to formally approve and adopt the Town of Hardwick All Hazards Mitigation Plan.

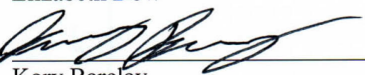
NOW, THEREFORE BE IT RESOLVED that the Town of Hardwick adopts this All-Hazards Mitigation Plan for the Town this 18th day of December, 2017.

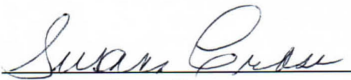
Hardwick Select Board Approval


Eric Kemick, Select Board Chair


Danny Hale, Vice Chair


Shari Cornish

Elizabeth Dow

Kory Barclay


Attest by Susan Cross,
Assistant Town Clerk, Town of Hardwick

Executive Summary

In 2015, the Town of Hardwick began to update the Town of Hardwick’s Local All-Hazard Mitigation Plan. The results of this work are contained herein and represent the collaborative efforts of the Town of Hardwick Hazard Mitigation Planning Team and associated residents, towns and agencies that contributed to the development of this plan update. As hazard mitigation is a sustained effort to permanently reduce or eliminate long-term risks to people and property from the effects of reasonably predictable hazards, the town has communicated its efforts related to developing this plan to its residents and surrounding municipalities, providing a formal opportunity to provide input and review relevant sections of the plan. Along these lines, the town has documented the planning process so that future updates can follow an efficient pattern in addition to capturing this important component as means of establishing institutional memory. In realization that eligibility to receive federal hazard mitigation grants and optimize state-level reimburse or “match” dollars during a federally declared disaster is dependent on a federally approved plan, the town remains committed to sustaining its mitigation efforts and by developing this plan, will have a guide for action that will foster enhanced emphasis on mitigation in the years to come. The town realizes the importance of mitigation inherent to its own resilience as well as means to establishing strong partnerships with regional support agencies and associations, state government and FEMA. As the town moves towards formally adopting this Local All-Hazards Mitigation Plan, the purpose of this plan is to:

- Identify specific natural, technological and societal hazards that impact the Town of Hardwick
- Prioritize hazards for mitigation planning
- Recommend town-level goals and strategies to reduce losses from those hazards
- Establish a coordinated process to implement goals and their associated strategies by taking advantage of available resources and creating achievable action steps

This plan is organized into 5 Sections:

Section 1: Introduction and Purpose explains the purpose, benefits, implications and goals of this plan. This section also describes demographics and characteristics specific to Hardwick and describes the planning process used to develop this plan.

Section 2: Hazard Identification expands on the hazard identification in the Town Plan *with* specific municipal-level details on selected hazards.

Section 3: Risk Assessment discusses identified hazard areas in the town and reviews previous federally-declared disasters to identify what risks are likely in the future. This section presents a hazard risk assessment for the municipality, identifying the most significant and most likely hazards which merit mitigation activity. The most significant hazards for Hardwick have been profiled and are introduced in the grid below:

Severe winter/Ice storm	Hazardous Materials Incident	Flooding/dam breach/flash flood
High Winds		Extreme Cold

Section 4: Vulnerability Assessment discusses buildings, critical facilities and infrastructure in designated hazard areas and estimates potential losses.

Section 5: Mitigation Strategies begins with an overview of goals and policies in the most recent Town Plan that support hazard mitigation and utilizes a current road inventory to formulate a work plan around major infrastructure projects. An analysis of existing municipal actions that support hazard mitigation, such as planning, emergency services and actions of the highway department are also included. The following all-hazards mitigation goals are summarized below:

- 1) Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
- 2) Mitigate financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
- 3) Maintain and increase awareness amongst the town's residents and businesses of the damages caused by previous and potential future hazard events as identified specifically in this Local All-Hazards Mitigation Plan.
- 4) Recognize the relationship between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and storm water management.
- 5) Maintain existing municipal plans and programs, adherence to state standards and ordinances that directly or indirectly support hazard mitigation.
- 6) Consider formal incorporation of this Local All-Hazards Mitigation Plan into the municipal comprehensive plan as described in 24 VSA, Section 4403(5), as well as incorporation of proposed new mitigation actions into the town's operating procedures.
- 7) Consider formal incorporation of this Local All-Hazards Mitigation Plan, particularly the recommended mitigation actions, into the town operating plans and infrastructure, utilities, highways and emergency services.

Section 5 also identifies and provides a detailed discussion on the following mitigation actions:

Action #1: Improve road infrastructure and municipal systems protection programs

Action #2: Improve resilience to severe winter storms

Action #3: Reduce impact of extreme cold durations

Action #4: Raise public awareness of hazards and hazard mitigation actions

Action #5: Increase resilience of mobile homes through accepted structural modifications and resident awareness of programs and opportunities

Action #6: Continue fluvial geomorphology assessments in collaboration with DEC and develop strategies and regulatory actions in response to identified risk

Action #7: Reduce risk and impact of hazardous materials incident

Action #8: Reduce impact of high wind events

In conclusion, Section 5 provides an Implementation Matrix to aid the municipality in implementing the outlined mitigation actions with an annual evaluation process to be coordinated and administered by the Hardwick Planning Commission.

Table of Contents

SECTION 1: INTRODUCTION AND PURPOSE	1
1.1 Purpose and Scope of this Plan	1
1.2 Hazard Mitigation	1
1.3 Hazard Mitigation Planning Required by the Disaster Mitigation Act of 2000	1
1.4 Benefits	2
1.5 All-Hazards Mitigation Plan Goals.....	2
1.6 Town of Hardwick Population and Characteristics	3
1.7 Summary of Planning Process	8
SECTION 2: HAZARD IDENTIFICATION.....	11
2.1 County and Town Declared Disaster History:	12
Table 2-1: Summary of Vermont Emergency Declarations	12
Table 2-2: Summary of Vermont Major Disaster Declarations since 1998 (Caledonia County in Bold with events that resulted in PA funding for the town with an “(*)”)	13
Table 2-3: Hardwick PA Funding by Disaster.....	13
2.2 Profiled Hazards:	14
An Introduction to Climate Change:.....	14
High Winds	14
Table 2-3: Beaufort Scale and HARDWICK Windspeed vs. U.S. Average	15
Severe Winter Storm.....	16
Table 2-4: NOAA’s Regional Snowfall Index (RSI) and HARDWICK Snowfall vs. U.S. Average	16
Hardwick Snowfall vs. U.S. Average	17
Ice Storm.....	18
Extreme Temperatures	18
Flooding	19
Table 2-7: HARDWICK Precipitation vs. U.S. Average	21
Inundation and Floodplains.....	21
Fluvial Erosion.....	22
Ice Jams.....	24
High Hazard Dams.....	24
Hazardous Material Storage and Release:	25
SECTION 3: RISK ASSESSMENT	29
3.1 Designated Hazard Areas.....	29

3.1.1. Flood Hazard Areas	29
3.1.2. Fluvial Erosion Hazard Areas	30
3.2 Non-designated Hazard Areas	30
Ice Storm Damage.....	30
High Winds and Lightning.....	31
3.3 Previous FEMA-Declared Natural Disasters and Non-Declared Disasters.....	31
Table 3-1: KEY:.....	31
Table 1-2: Town of Hardwick, FEMA-declared disasters and snow emergencies, 1999- Current:	Error! Bookmark not defined.
3.4 Hazard Assessment and Risk Analysis.....	33
3.3.1. Natural Hazards and Hazardous Material Incident.....	33
3.5 Hazard Summary	35
SECTION 4: VULNERABILITY ASSESSMENT.....	35
4.1 Critical Facilities.....	40
4.2 Infrastructure.....	40
4.2.1 Town Highways.....	40
4.2.2 Bridges, Culverts, and Dams	41
Bridges	41
4.2.3 Water, Wastewater and Natural Gas Service Areas.....	43
4.2.4 Electric Power Transmission Lines and Telecommunications Land Lines.....	44
4.3 Estimating Potential Losses in Designated Hazard Areas	44
4.4 Land Use and Development Trends Related to Mitigation	45
4.4.1. Proposed Land Use	46
4.4.2. Land Use Goals.....	46
4.4.3. Land Use Strategies	46
4.4.4 Future Development and Housing	46
SECTION 5: MITIGATION STRATEGIES	47
5.1 Town Goals and Policies that support Hazard Mitigation.....	48
5.1.1. Community Goals.....	48
5.1.3. Public Participation Goals.....	49
5.1.4. Regulatory Devices Goals.....	49
5.1.5. Land Use	49
5.1.6 Natural Resources	50

5.1.7. Policies	51
5.1.8. Transportation Plan	51
5.1.9. Utilities and Facilities Goals	52
5.1.9.1. Educational Goals	52
5.2 Existing Town of Hardwick Actions that Support Hazard Mitigation	53
5.2.1. Flood Resilience Goals:	53
5.2.2. Flood Resilience Strategies:.....	53
5.3 Town of Hardwick All-Hazards Mitigation Goals	54
5.4 Mitigation Actions	54
5.4.1. Current Capabilities, Progress since 2005 and Need for Mitigation Actions	55
5.4.2. Specific Mitigation Actions	57
5.4.3. Prioritization of Mitigation Strategies	65
5.5 Implementation and Monitoring of Mitigation Strategies	67
5.5.1. Public Involvement Following Plan Approval	67
5.5.2. Project Lead and Monitoring Process	68
5.5.4. Plan Update Process.....	69
5.5.5. Implementation Matrix for Annual Review of Progress.....	69
Appendix A: Maps.....	81
Appendix B: No Adverse Impact Floodplain Management Fact Sheet (ASFPM).....	81
Appendix C: Farm Structures in Designated Flood Hazard Area Planning Checklist (VAAFMM)	
81	
Appendix C: Community Outreach Form	85

SECTION 1: INTRODUCTION AND PURPOSE

1.1 Purpose and Scope of this Plan

The purpose of this Local All-Hazards Mitigation Plan Update is to assist this municipality in identifying all hazards facing their community and in identifying strategies to begin to reduce the impacts of those hazards. The plan update also seeks to better integrate and consolidate efforts of the municipality with those outlined in the Town Plan as well as efforts of NVDA, Vermont State agencies, FEMA and the State Hazard Mitigation Plan. The town is aware that community planning can aid significantly in reducing the impact of expected, but unpredictable natural and human-caused events. This document constitutes an All-Hazards Mitigation Plan Update for the Town. Community planning can aid significantly in reducing the impact of expected, but unpredictable natural and human-caused events. The goal of this plan is to provide hazard mitigation strategies to aid in creating disaster resistant communities throughout Caledonia County.

1.2 Hazard Mitigation

The Vermont State All-Hazards Mitigation Plan of 2013 defines hazard mitigation as:

“Any sustained action that reduces or eliminates long-term risk to people and property from natural and human-caused hazards and their effects. The Federal Emergency Management Agency (FEMA) and state agencies recognize that it is less expensive to prevent disaster or mitigate its effects than to repeatedly repair damage after a disaster has struck. This plan recognizes that communities have opportunities to identify mitigation strategies and measures during all of the other phases of Emergency Management—Preparedness, Response and Recovery. Hazards cannot be eliminated, but it is possible to determine what the hazards are, where they are, where they are most severe and to identify actions that can reduce the severity of the hazard.”

Hazard mitigation strategies and measures can reduce or eliminate the frequency of a specific hazard, lessen the impact of a hazard, modify standards and structures to adapt to a hazard, or limit development in identified hazardous areas. This plan aligns and/or benefits from the 5 goals accomplished as a State since 2010 and as referenced in Section 5 of the State’s 2013 Hazard Mitigation Plan and as part of the newly created Emergency Relief Assistance Funding (ERAF) requirements. With enhanced emphasis on community resiliency, many state agencies and local organizations have an increased awareness of the importance of mitigation planning and have produced plans and resources that towns can use to support their planning efforts. This plan will reference, when relevant, pertinent tools and resources that can be used to enhance mitigation strategies.

1.3 Hazard Mitigation Planning Required by the Disaster Mitigation Act of 2000

Hazard mitigation planning is the process that analyzes a community’s risk from natural hazards, coordinates available resources, and implements actions to reduce risks. Per *44 CFR Part 201: Hazard Mitigation Planning*, this planning process establishes criteria for State and local hazard mitigation planning authorized by Section 322 of the Stafford Act as amended by Section 104 of the *Disaster Mitigation Act of 2000*. Effective November 1, 2003, local governments now must have an approved local mitigation plan prior to the approval of a local mitigation project funded

through federal Pre-Disaster Mitigation funds. Furthermore, the State of Vermont is required to adopt a State Pre-Disaster Mitigation Plan for Pre-Disaster Mitigation funds or grants to be released for either a state or local mitigation project after November 1, 2004.

There are several implications if the plan is not adopted:

- After November 1, 2004, Flood Mitigation Assistance Grant Program (FMAGP) funds will be available only to communities that have adopted a local Plan
- For disasters declared after November 1, 2004, a community without a plan is not eligible for HMGP project grants but may apply for planning grants under the 7% of HMGP available for planning
- For the Pre-Disaster Mitigation (PDM) program, a community may apply for PDM funding but must have an approved plan to receive a PDM project grant
- For disasters declared after October 14th, 2014, a community without a plan will be required to meet a greater state match when public assistance is awarded under the ERAF requirements (Emergency Relief Assistance Funding)

1.4 Benefits

Adoption and maintenance of this Hazard Mitigation Plan will:

- Make certain funding sources available to complete the identified mitigation initiatives that would not otherwise be available if the plan was not in place
- Lessen the receipt of post-disaster state and federal funding because the list of mitigation initiatives is already identified
- Support effective pre-and post-disaster decision making efforts
- Lessen each local government's vulnerability to disasters by focusing limited financial resources to specifically identified initiatives whose importance have been ranked
- Connect hazard mitigation planning to community planning where possible

1.5 All-Hazards Mitigation Plan Goals

This All-Hazards Mitigation Plan establishes the following general goals for the town and its residents:

- 1) Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
- 2) Mitigate financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
- 3) Maintain and increase awareness amongst the town's residents and businesses of the damages caused by previous and potential future hazard events as identified specifically in this Local All-Hazards Mitigation Plan.
- 4) Recognize the relationship between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and storm water management.

- 5) Maintain existing municipal plans and programs, adherence to state standards and ordinances that directly or indirectly support hazard mitigation.
- 6) Consider formal incorporation of this Local All-Hazards Mitigation Plan into the municipal comprehensive plan as described in 24 VSA, Section 4403(5), as well as incorporation of proposed new mitigation actions into the town's operating procedures.
- 7) Consider formal incorporation of this Local All-Hazards Mitigation Plan, particularly the recommended mitigation actions, into the town operating plans and infrastructure, utilities, highways and emergency services.

1.6 Town of Hardwick Population and Characteristics

Caledonia County

Chartered: August 19, 1781 (Vermont Charter)

Area: 24,741 Acres = 38.66 Square Miles [Size Rank: 150*]

Coordinates (Geographic Center): N 44° 30' W 72°22'

Altitude: 861 feet ASL

Population (US Census, 2010): 3,010 [Population Rank: 54*]

Population Density (persons per square mile): 77.9 [Density Rank: 50*

Community History and Background

Hardwick is a small, rural community located in Northeastern Vermont that was chartered on August 19, 1781, (see Hardwick Base Map). The Town of Hardwick abuts seven towns; Greensboro, along the Northeastern Border, Hardwick along the Southeastern Border, Woodbury along the Southwestern border, Wolcott and Elmore along the Northwestern Border, Stannard touches the Eastern corner and Cabot touches the southern corner. The town also abuts three counties; Orleans, Lamoille and Orange.

The Town of Hardwick has two unincorporated villages, Hardwick Village and East Hardwick. Hardwick Village was once an incorporated village but was disincorporated in 1988. The former Hardwick Village area is characterized by dense development, including single family and multifamily dwellings and various commercial and industrial businesses. The East Hardwick area is much smaller and it is mostly single-family homes, with a few multifamily dwellings and a few commercial buildings.

In the late 1800s, Hardwick was a center of industry, with several factories and productive granite quarries. As time passed, many of the mills closed or changed use and the quarries ceased

operation. In the last decade, there has been a boom in industries involved in the processing of agricultural products. The industrial park is nearly full, mostly with agricultural processing facilities, including Vermont Soy, the Sugar Man, the Vermont Food Venture Center, Vermont Natural Coatings, and Caledonia Spirits. The rest of the town is sparsely populated and except for a few commercial businesses, the lands are used primarily for agriculture and forestry purposes.

The Town of Hardwick is part of the Orleans Southwest Supervisory School District, which provides K-12 public education. The town has two public schools. The Hardwick Elementary School serves grades K - 6 grades. The 2014 enrollment is listed at 243 with a capacity of 360 students. The Hazen Union School serves grades 7 – 12. The 2014 enrollment is listed at 368 students with a capacity of 500 students. There are two preschools in the town, one is located in the Southwest corner of Town off from Route 14 at 49 Winter Street and the other is Head-start located on 67 Church Street.

The Lamoille River runs east to west through the town. Vermont Route 15 and the now defunct Lamoille Valley Railroad bed follow the Lamoille River to the west. Vermont Route 14 runs from north to south through the town as does Route 16. The Town is connected to the rest of Caledonia County via Route 15 to the East where it intersects Route 2 in West Danville.

The median Residential housing unit value for transfers of housing units on less than 6 acres in 2009 was \$70,000. The area of land is 38.66 square miles with a population density of 83 persons per square mile.

The town government is run by the selectboard with a Town Manager and several departments. The Town of Hardwick has been involved in six significant Federal Emergency Management Agency (FEMA) events, all involving flooding and/or ice jams. A series of concrete ice retention blocks have been placed in the Lamoille River to mitigate against future (spring-thaw) flooding by breaking up ice jams before heading south towards the village area. To date they have been successful.

Topography & Climate

The Western portion of the town is characterized by steeper slopes and higher elevations, while the eastern portion of the town is lower rolling hills. Most of the bedrock is covered with glacial deposits of varying depths.

The climate in Hardwick is much the same as in the rest of northern Vermont. The following climate data comes from NOAA's recording station in nearby Morrisville, Vermont. The average coldest winter temperatures occur in January, with an average mean temperature of 13.2 degrees and an average nighttime lows of 24.9 degrees. The warmest part of the year is in July, with an average mean temperature of 65.7 degrees and an average daytime high of 77.8 degrees Fahrenheit.

The wettest time of the year occurs during July and August with averages of 4.61 inches and 4.38 inches of rain, respectively. The driest period is January through March with average melted precipitation amounts of 2.66 inches in January, 2.59 inches in February and 2.79 inches in March. The bulk of the snow falls in December, January, February and March with 25.0 inches, 21.9 inches, 21.6 inches and 21.8 inches respectively. The average total snowfall for the year is 104.2 inches. October and November average 0.8 inches and 8.4 inches of snow, respectively, with April receiving 4.7 inches.

Town Infrastructure

The Town of Hardwick has 1.5 miles of Class 1 roads, 11.3 miles of Class 2 Roads, 52.5 miles of Class 3 Roads, 5.7 miles of Class 4 Roads, and 16.1 miles of State Highway. Much of Main Street was repaved in 2012 and 2014. The Town has a 5-year road plan that includes yearly paving projects. Additionally, the Town of Hardwick has developed a long-range plan and a line item allocation in its Capital Budget to refurbish troublesome portions of the Town's Class 3 or dirt roads, which make up the majority of Hardwick's roads. All major bridges located in Hardwick are reviewed by the Agency of Transportation regarding their structural needs and the Town makes improvements to these bridges annually as necessary. The Town also maintains a culvert record system that tracks the location, condition and installation date of all Town road culverts.

The Town of Hardwick owns its own power company, the Hardwick Electric Department, which provides power to 5 communities in 3 different counties. There are two dams located in the Town. The Mackville dam is located on Nichols Brook on the southeast side of town and was rebuilt in 2004. The Jackson dam is located on the Lamoille River on the southwest side of town downstream of downtown and the industrial park. Neither of these dams provide electrical generation. There is no electrical generation in the Town of Hardwick aside from solar voltaic panels and wind generators which are all owned by private individuals.

There are two cell towers located in Hardwick, one on Hopkin Hill on the Claire and Rod Mayo farm and one located off from Bridgman Hill on the Wendell and Beverly Shepard Farm.

The Hardwick Community Water Supply system has two wells that supply all of the water used by the village of Hardwick. The municipal wells are located near the Hardwick Industrial Park adjacent to Wolcott Street. The East Hardwick Fire District #1 supplies water to the village of East Hardwick from springs located on Ward Hill to the south. The Town has well head protection areas and plans for providing water in case of a shortage due to unexpected circumstances. Private wells are not permitted within the water distribution area of the Urban Compact.

The Urban Compact of the Village of Hardwick, now the Town of Hardwick, is served by a tertiary wastewater treatment facility built in 1978. The facility has been upgraded three times since its initial construction to increase capacity and to provide a higher level of wastewater treatment. Private septic tanks and leach fields are allowed outside of the collection area of the Hardwick Urban Compact.





Town Emergency Services

EMS Services - Town emergency medical services are provided by a local nonprofit organization known as the Hardwick Rescue Squad (HRS). HRS serves the towns of Hardwick, Craftsbury, Greensboro, Wolcott, and Woodbury. The HRS has its headquarters collocated on Creamery Street with the Hardwick Town Garage.

Town Fire Department - The Town has a well-trained volunteer fire department with up-to-date equipment including a ladder truck, a tanker truck and a brand new rescue pumper truck. South Main Street in Hardwick Village has seen four significant downtown fires in the last 20 years, one of which resulted from an automobile crashing into a building. Much of the new construction on this street now includes new sprinkler systems and firewalls between structures.

Town Police Department - The Hardwick Police Department consists of seven full-time officers and two part-time officers. The Town has four police cruisers and a K9 officer. The

Police Department moved into new quarters in 2013 located on 54 High Street in Hardwick. The Hardwick Police Department provides services to the Town of Greensboro and to the Town of Hardwick.

Additionally, there are two main hospitals located outside of town that provide services for Hardwick residents; Copley Hospital in Morrisville, approximately 20 minutes away to the east, and the Central Vermont Hospital in Berlin about 25-30 minutes to the south. There is a health clinic in the village that serves the residents for most minor needs.

1.7 Summary of Planning Process

The last approved plan for the town was in 2005. This approval came after formal adoption of the Hardwick Annex of the NVDA-developed, 2005 Northeast Kingdom Multi-Jurisdictional Hazard Mitigation Plan. The 2005 plan was all-but forgotten and is considered too general and basic for current mitigation planning needs and requirements. While the town, by default of daily operations, experience with major disasters since 2005 and advancements in mitigation planning and guidance from state agencies, has enhanced its mitigation efforts since 2005, these enhancements were not a direct result of the 2005 plan. There is a current understanding of the need to integrate the content of this update and its goals, actions and reporting into the daily operational structure and awareness of all town officials so that mitigation planning establishes itself as a consistent topic of concern and discussion. The development of this plan has followed a similar process to most community planning efforts, in addition to the Hazard Mitigation protocol established by FEMA. To start, a committee was developed to oversee the planning process, public participation, plan drafting, and finally the mitigation strategy. Following initial public input, which is described in detail below, the committee and the regional planning commission (Northeastern Vermont Development Association), researched potential hazards and assessed the risks that those hazards pose to the Town of Hardwick. They gathered initial available data and met with local officials and emergency response organizations, such as Local Emergency Planning Committee #9. Relevant plans, studies, reports and other technical information were reviewed and incorporated into the planning process as well, including:

- Hardwick Town Plan (2014)
- Hardwick Zoning ByLaws (2005), including Special Flood Hazard Regulations
- Town of Hardwick Local Emergency Operations Plan (2015)
- Town of Hardwick Flood Insurance Rate Study
- Town of Hardwick Flood Insurance Rate Maps
- Town of Hardwick Tax Maps/Floodplain Maps
- State of Vermont Hazard Mitigation Plan
- Regional Plan for the Northeast Kingdom 2006

The Committee also reviewed additional relevant data from state, federal and private resources, including:

- A HAZUS study of the Town
- Major power transmission lines (Hardwick Electric Department)
- Tier II Hazardous Materials inventory (Town of Hardwick; VT Emergency Management)
- Municipal water and wastewater treatment facilities (Agency of Natural Resources)
- Maps from the Northeastern Vermont Development Association.

Planning Committee

The committee included local expertise essential to the development of the mitigation plan; in other words, community members who have a vast knowledge of natural hazards and how they affect the local community. Committee members are also able to develop, evaluate, and prioritize mitigation actions that will counteract the effects of these hazards. The Hardwick Hazard Mitigation Plan Committee is listed below:

Tom Fadden, Town Road Foreman and Fire Chief
 Aaron Cochran, Police Chief
 Jeff Lecours, Hazen Union Shelter Coordinator
 Karen Holmes and Kristen Leahy, Town Zoning Administrator
 Dave Gross, Joe Rivard, Planning Commission,
 Mike Sullivan, Hardwick Electric
 Jon Jewitt, Town Manager
 Lawrence Hamel, Select Board member
 Bruce Melendy, NVDA Regional Emergency Preparedness Coordinator

Public Participation

The All Hazards Mitigation Planning effort was started at a warned public meeting of the Hardwick Select Board on December 18, 2014. Bruce Melendy, Regional Emergency Management Coordinator, NVDA, updated the Select Board and the general public on the facets of hazard mitigation and the update process. The Town Manger explained that the Northeastern Vermont Development Association (NVDA) was awarded a State planning grant to move forward with developing an All Hazards Mitigation Plan for Hardwick and three other nearby communities. The Town Manager described the work required to complete the plan, including the creation of a public committee to work on the project, consisting of an NVDA representative, the Town Manager, a Select Board member, the Police Chief, the Fire Chief, a Rescue Squad member, and two Hardwick citizens. At each proceeding Selectboard meeting, which were open to the public, a planning update was discussed related to the work accomplished on the Mitigation Plan. On March 4, 2015, the plan was submitted to the State for review. Using the standard review tool as a guide, the town began to work on the requested amendments to the plan in July of 2017. In August, 2017, a community survey was advertised to the residents as an opportunity to share concerns, question and comments related to mitigation planning. In August, 2017, all towns bordering Hardwick were sent notification (via email to the Town Clerk) of the plan's development and were asked to announce the notification and opportunity to provide input at the next Selectboard meeting. While no feedback was received, the towns upholds positive relationships with its neighboring towns and will continue to work with them when necessary.

Monthly updates on plan development were included in each following Selectboard meeting and an overview of hazards, disaster history and mitigation strategies was given at the September 21st, 2017 Selectboard meeting. In line with FEMA guidance in Local Mitigation Plan Review Tool Regulation Checklist, the plan was written using data sources that included:

- Surveys and warned, public meetings collecting public comment (issues raised were addressed in plan and the public meeting)
- 2014 HARDWICK Town Plan draft (provided current goals and regulations supporting mitigation, recent capital expenditures and infrastructure value helped to drive vulnerability assessment)
- 2004 HARDWICK Flood Hazard Regulations (Used for historical foundation for future investigation in joining the NFIP)
- 2017 HARDWICK Road Erosion Site Inventory (created in adjunct to this plan and used to scope infrastructure priorities for the 5-year planning cycle as well as give the town a method to track and capture needed work)
- 2013 Vermont State Hazard Mitigation Plan (provided key guidance language and definitions throughout the plan).
- Vermont Agency of Natural Resources (ANR) and Transportation (VTrans) (Provided key policy recommendations on environmental conservation, high accident locations, climate change, Dam and fluvial erosion data).
- Vermont Departments of Health (VDH) and Environmental Conservation (DEC) (provided information related with public health services that could be impacted during a disaster and state support functions designated to both VDH and DEC. DEC also provided river corridor data for mapping purposes.
- FEMA Open Source (data.gov) Data for Disaster History and PA funding (provided comprehensive declared disaster by year and type as well as project descriptions and cost per event).
- FEMA NFIP “Bureau.Net” database (provided detailed information on repetitive loss properties and associated flood insurance claims).
- EPA’s Incident Action Checklist for cold weather resilience of water systems (provides a guidance tool for public works to cross-reference actions on the system).
- 2013 ACCD Mobile Home Resilience Plan (served as resource for future mitigation actions)
- 2016 Town of Hardwick Unified Development Bylaw
- A HAZUS study of the Town
- Major power transmission lines (Hardwick Electric Department)
- Tier II Hazardous Materials inventory (Town of Hardwick; VT Emergency Management)
- Municipal water and wastewater treatment facilities (Agency of Natural Resources)

- Maps from the Northeastern Vermont Development Association.

While many small communities in Vermont face similar circumstances (e.g. flooding, winter storms and remote residents), each one has unique considerations and opportunities. There was a point made to capture the subtle characteristics of the town, its history and its residents. From this, the specific risks, vulnerabilities and mitigation strategies were developed. Based on the information obtained, input from town and state officials, the planning team, state and federal databases, local associations and NVDA, the plan was created.

The revised draft was made available for review at the town office and residents were informed via meeting minutes and the town bulletin board of the ability to review the draft and additional opportunity for formal comment and suggestions through correspondence with the town clerk (via email, phone or mail). All neighboring town offices alerted to the availability of the draft for review and comment as well. Responses from the community were minimal and non-specific in nature. After all required edits were made, the final draft was resubmitted to the state and then to FEMA for formal review and approval pending municipal adoption. A resolution of adoption is anticipated following final FEMA approval.

SECTION 2: HAZARD IDENTIFICATION

The 2005 Plan profiled the following hazards (bold indicates continued inclusion in this update):

- **Flooding/Flash Flooding/Dam Failure**
- **High Winds**
- **Hazardous Materials/Transportation Incident/Water Supply Contamination**
- **Severe Winter/Ice Storm**
- Fire: Urban/structure

For this update, the planning team considered the continued inclusion or deletion of the 2005 hazards profiled by developing and researching three distinct hazard categories and for each, considered prior history, current trends and available data to estimate risk. As highlighted above, some profiled hazards remain a risk for the town. However, other hazards, due to lack of occurrence frequency, risk and/or vulnerability have been removed in this update. Due to recent emphasis on climate change, extreme cold has been added to the profiled hazard category for this update. The definitions of each hazard, along with historical occurrence and impact, are described below:

The following is a discussion of existing and potential hazards in HARDWICK. The definitions of each hazard, along with historical occurrence and impact, are described. The three hazard categories:

- **Natural Hazards:** weather / climate hazards (drought, hurricane/tornado, high winds, severe winter storm, extreme temperatures, climate change, lightning, hail), flooding, geological hazards (landslide / erosion, earthquake, naturally-occurring radiation), and fire hazards.

Profiled Natural Hazards: High Winds, Severe Winter/Ice Storm, Flooding/flash flooding/ice jams/dam failure, Extreme Cold Temperature

Additional Hazard: Hazardous Materials Incident

2.1 County and Town Declared Disaster History:

The number of natural disasters in Caledonia County since 1998 (12) is at the US average (12). There have been 12 major disasters (Presidential) declared and 3 Emergencies declared. The causes of natural disasters have been; Floods: 9; Storms: 7; Winds: 2; Heavy Rain; 1 Landslide: 1; Snowstorm: 1; Tropical Storm: 1 (Note: Some incidents may be assigned to more than one category). Hardwick was impacted by several of the disasters and details are included below. The following discussion on natural hazards is based upon information from several sources. General descriptions are based upon the *2013 Vermont State Hazard Mitigation Plan*. Due to rural nature of Northeast Kingdom, there is little historical data available for presentation related to all hazards but when available, relevant data is included.

The highest risk hazards have been profiled to provide the basis of future mitigation strategies. However, lower risk natural hazards (drought, tornado, tornado, high winds, extreme temperatures, hail, landslide, earthquake, naturally-occurring radiation and fire hazards) are omitted from full profiling because they do not pose enough risk to substantiate mitigation efforts at this time.

Table 2-1: Summary of Vermont Emergency Declarations

Number	Year	Type
3338	2011	Hurricane Irene
3167	2001	Snowstorm
3053	1977	Drought

Source: FEMA

- *Table 2-2: Summary of Vermont Major Disaster Declarations since 1998 (Caledonia County: Bold and “*” denotes HARDWICK PA received).*

Table 2-2: Summary of Vermont Major Disaster Declarations since 1998 (Caledonia County in Bold with events that resulted in PA funding for the town with an “(*)”)

4207*	2015	Severe Winter Storm
4178	2014	Severe Storms and Flooding
4232	2015	Severe Storms and Flooding
4163*	2014	Severe Winter Storm
4140	2013	Severe Storms and Flooding
4120	2013	Severe Storms and Flooding
4066	2012	Severe Storms, Tornado and Flooding
4043	2011	Severe Storms and Flooding
4022*	2011	Tropical Storm Irene
4001	2011	Severe Storms and Flooding—Hardwick
1995	2011	Severe Storms and Flooding
1951	2010	Severe Storm
1816	2009	Severe Winter Storm
1790	2008	Severe Storms and Flooding
1784	2008	Severe Storms, Tornado and Flooding
1778	2008	Severe Storms and Flooding
1715*	2007	Severe Storm, Tornado and Flooding
1698*	2007	Severe Storms and Flooding—Hardwick
1559*	2004	Severe Storms and Flooding—Hardwick
1488	2003	Severe Storms and Flooding
1428	2002	Severe Storms and Flooding
1358	2001	Severe Winter Storm
1336	2000	Severe Storms and Flooding
1307*	1999	Tropical Storm Floyd
1228	1999	Severe Storms and Flooding
1201	1998	Ice Storm

Source: FEMA

Table 2-3: Hardwick PA Funding by Disaster

Disaster Number	Declaration Date	Incident Type	Applicant Name	Number of Projects	Federal Share Obligated
1307	11/10/1999	Severe Storm(s)	HARDWICK (TOWN OF), HARDWICK ELECTRIC DEPARTMENT	2	\$52,362.06
1559	09/23/2004	Severe Storm(s)	HARDWICK (TOWN OF)	4	\$11,119.57
1698	05/04/2007	Severe Storm(s)	HARDWICK ELECTRIC DEPARTMENT	2	\$6,142.27
1715	08/03/2007	Severe Storm(s)	HARDWICK (TOWN OF)	6	\$79,898.79

4022	09/01/2011	Hurricane	HARDWICK ELECTRIC DEPARTMENT	1	\$14,421.22
4022	09/01/2011	Hurricane	HARDWICK (TOWN OF)	1	\$9,051.30
4163	01/29/2014	Severe Ice Storm	HARDWICK ELECTRIC DEPARTMENT	1	\$30,316.86
4207	02/03/2015	Severe Storm(s)	HARDWICK ELECTRIC DEPARTMENT	2	\$85,165.06

2.2 Profiled Hazards:

An Introduction to Climate Change:

From 1962 to 2006, each five-year period resulted in 0-6 Major Disaster Declarations in Vermont. From 2007-2011, there were 11. It is commonly accepted that weather extremes are becoming more commonplace in Vermont. Since 2011, record setting snow, rain and cold have been experienced in the state. In recent years, it has become evident that human activities, mostly associated with the combustion of fuel, have added to the natural concentration of greenhouse gases in the atmosphere and are contributing to rapid climate change on a global scale. While projections of the effects of climate change vary, it is generally predicted that Vermont will have warmer temperatures year-round, with wetter winters and drier summers. An increase in the size and frequency of storms is also predicted. Thus, climate change in the next century will likely increase the chance of weather-related hazards occurring. An increase in precipitation may also result in increased flooding and fluvial erosion. Drier summers may increase the chance of drought and wildfire. A warmer climate may also result in the influx of diseases and pests that cold winters previously prevented. The severity of climate change is also difficult to predict, though the effects may be mitigated somewhat if greenhouse gas emissions are reduced soon. In 2011, Governor Shumlin formed the *Vermont Climate Cabinet*. The Cabinet, chaired by the Secretary of Natural Resources, is a multidisciplinary approach to enhance collaboration between various state Agencies. Its primary objectives include providing the Governor with advisory information and facilitating climate change policy adoption and implementation. In 2013, the Vermont Agency of Natural Resources (ANR) released the Climate Change Adaptation Framework which addresses climate change exposures, vulnerability-specific elements within each of the natural resource sectors, and ongoing and proposed actions that can be or have been taken to prepare for the expected changes. In line and in conjunction with the ANR report, the primary goal of a VTrans climate change adaptation policy is to minimize long-term societal and economic costs stemming from climate change impacts on transportation infrastructure.

High Winds

High wind events do occasionally cause damage for the town, normally measured in downed power lines. The last recorded high wind event as tracked by the National Weather Service was recorded on 17-18 January 2012. An 81-mph wind gust was measured atop Vermont's highest

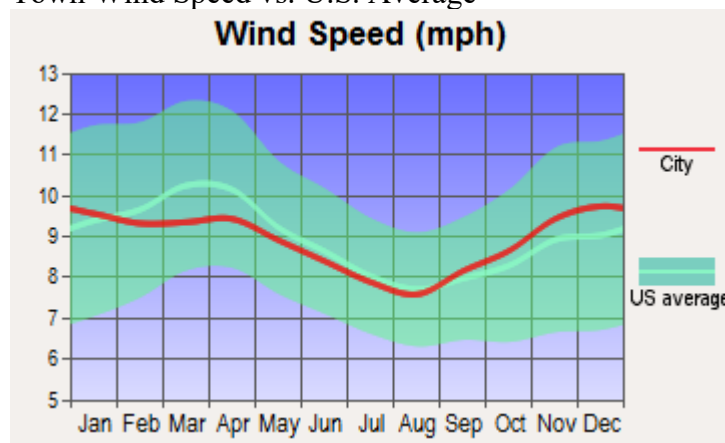
peak Mount Mansfield. During this event, Caledonia County had wind speeds of 30-40 mph. Specific data for the town was not available but town officials recall the 2015 event as being the most severe in memory and the town expects high wind events that may reach category 2 speeds but it is unlikely, based on previous events, that a category 3 event will occur in the region. However, the duration of power supply disruption in Hardwick for any hazard is 72 hours.¹

The following table describes the Beaufort Scale for non-hurricane winds.

Table 2-3: Beaufort Scale and HARDWICK Windspeed vs. U.S. Average

Beaufort*	Avg Miles per Hour	Knots	Surroundings
0 calm		0 - 1	Smoke rises vertically and the sea is mirror smooth
1 light air	1.2 - 3.0	1 - 3	Smoke moves slightly with breeze and shows direction of wind
2 light breeze	3.7 - 7.5	4 - 6	You can feel the breeze on your face and hear the leaves start to rustle
3 gentle breeze	8.0 - 12.5	7 - 10	Smoke will move horizontally and small branches start to sway. Wind extends a light flag
4 moderate	13.0 - 18.6	11 - 16	Loose dust or sand on the ground will move and larger branches will sway, loose paper blows
5 fresh breeze	19.3 - 25.0	17 - 21	Surface waves form of water and small trees sway
6 strong breeze	25.5 - 31.0	22 - 27	Trees begin to bend with the force of the wind and causes whistling in telephone wires. Some spray on the sea surface
7 moderate gale	32.0 - 38.0	28 - 33	Large trees sway. Moderate sea spray
8 fresh gale	39.0 - 46.0	34 - 40	Twigs break from trees, and long streaks of foam appear on the ocean
9 strong gale	47.0 - 55.0	41 - 47	Branches break from trees
10 whole gale	56.0 - 64.0	48 - 55	Trees are uprooted and the sea takes on a white appearance
11 storm	65.0 - 74.0	56 - 63	Widespread damage
12 hurricane	75+	64 +	Structural damage on land, and storm waves at sea

Town Wind Speed vs. U.S. Average



¹ Hardwick Electric Company

Severe Winter Storm

Winter storm frequency and distribution varies from year to year depending on the climatological patterns. Because such storms are expected during a Vermont winter, the town is well-equipped to deal with snow removal and traffic incidents. The most damaging types of snowstorms are ice-storms caused by heavy wet snow or rain followed by freezing temperatures. This leads to widespread and numerous power and telephone outages as lines either collapse due to the ice weight or are brought down by falling trees and branches. According to the *2013 Vermont State All-Hazards Mitigation Plan*:

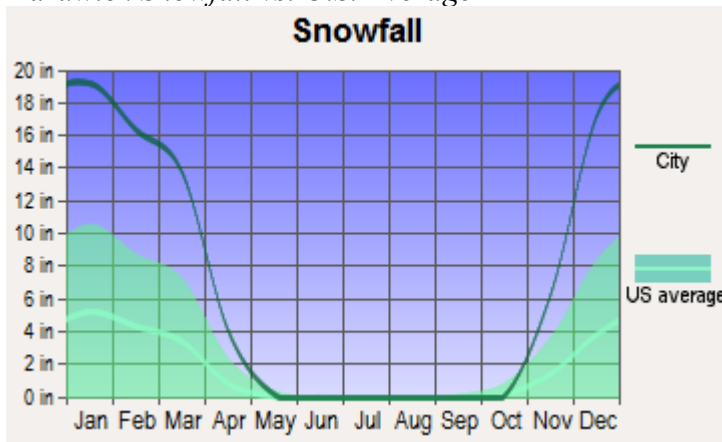
“A winter storm can range from moderate snow to blizzard conditions. A severe winter storm deposits four or more inches of snow during a 12-hour period or six inches of snow during a 24-hour period. A blizzard is a snowstorm with sustained winds of 40 miles per hour or more with heavy falling or blowing snow and temperatures of ten degrees Fahrenheit or colder. An ice storm involves rain, which freezes upon impact. Ice coating at least one-fourth inch in thickness is heavy enough to damage trees, overhead wires, and similar objects and to produce widespread power outages.”

The winters of 1969-72 produced record snowfalls for nearby St. Johnsbury, and greater than normal precipitation was recorded in 8 of the 11 years during 1969-79. According to the available history specific to the region, the max 24-hour snowfall occurred February 24-25, 1969 at 34” with an additional 2.12” of rain during the period. The winter of 2010-2011 was the third-snowiest on record with a total of 124.3 inches for the county. The record for the county was 145.4 inches set in 1970-1971. The potential for a major snowstorm that exceeds the capabilities of town exists every year but with the recent increase in snow fall totals and cold temperature duration, the town realizes the further consideration are required. NOAA's National Centers for Environmental Information is now producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two thirds of the U.S. The RSI ranks snowstorm impacts on a scale from 1 to 5, similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. NCEI has analyzed and assigned RSI values to over 500 storms going as far back as 1900. New storms are added operationally. As such, RSI puts the regional impacts of snowstorms into a century-scale historical perspective. The index is useful for the media, emergency managers, the public and others who wish to compare regional impacts between different snowstorms. The RSI and Societal Impacts Section allows one to see the regional RSI values for particular storms as well as the area and population of snowfall for those storms. The area and population are cumulative values above regional specific thresholds. For example, the thresholds for the Southeast are 2", 5", 10", and 15" of snowfall while the thresholds for the Northeast are 4", 10", 20", and 30" of snowfall. 2010, 2012 and 2015 have some of the highest rankings for notable storms. These rankings are based, in part on the severity of the storm using the following system. Since 2000, there has only been one event that reached a category 4 in the Northeast, five reached Category 3, eight were “significant” and all others were notable. Despite having considerably more snow than the U.S. average, Hardwick has had no major PA funding related to damage from snow events.

Table 2-4: NOAA’s Regional Snowfall Index (RSI) and HARDWICK Snowfall vs. U.S. Average

CATEGORY	RSI VALUE	DESCRIPTION
1	1–3	Notable
2	3–6	Significant
3	6–10	Major
4	10–18	Crippling
5	18.0+	Extreme

Hardwick Snowfall vs. U.S. Average



Specific snow totals for Hardwick were unavailable but county-based data provides an accurate portrait of the magnitude that the town can expect to experience in the future. In the county, the winter of 2010-2011 was the third-snowiest on record with a total of 124.3 inches. The Town has seen damage from declared snow disasters in the past, primarily dealing with debris removal from downed trees. The potential for even a robust highway department becoming overwhelmed to manage a major snowstorm without outside assistance exists every winter. In January of 2015, the area received 28'' of snow compared to only 11.3'' in 2014. The county experienced historic January snowfall totals in 1987 (47.5''), 1978 and 1979 (46.5'', 45.8''). Total average snowfall in December is 26.2'', January is 22.6'', February averages are slightly less at 16.9'' and March is 18.3''. February 14th-15th, 2007 saw the greatest 24-hour max snowfall total at 23.5''. The snowfall totals are annual averages based on weather data collected from 1981 to 2010 for the NOAA National Climatic Data Center. Because such storms are expected during a Vermont winter, the town is well-equipped to deal with snow removal and traffic incidents. The most damaging types of snowstorms are ice-storms caused by heavy wet snow or rain followed by freezing temperatures. This leads to widespread and numerous power and telephone outages as lines either collapse due to the ice weight or are brought down by falling trees and branches. Sources: www.ncdc.noaa.gov www.nws.noaa.gov

Ice Storm

Major Ice Storms occurred in January, 1998 and again in December of 2013 and 2014. The North American Ice Storm of 1998 was produced by a series of surface low pressure systems between January 5 and January 10, 1998. For more than 80 hours, steady freezing rain and drizzle fell over an area of several thousand square miles of the Northeast, causing ice accumulation upwards of 2'' in some areas. Hardwick received .5 to 1 inch of ice. The last ice storm event occurred in December 2014 and cost the Hardwick Electric Department approximately \$45,000 for repairs. While there is evidence that supports an increase in weather and precipitation severity, the incidence of ice storms remains fairly spaced out prior to 2013. The town expects to have another ice storm but unlike rain and snow events, the occurrence of a major ice storm is not expected every year. In the records available to the town regarding power outage, the longest duration outage was in December of 2014 at 72 hours and affecting 90% of Hardwick residents.

Ice maps can be found at: www.wrh.noaa.gov/map/?wfo=sto

Extreme Temperatures

While there is no historical evidence to support a concern over the consequences of extremely hot temperatures on human health and safety in Hardwick, high temperatures can help to create severe storms as the one evidenced on September 11th, 2013, where record heat (90F) helped to produce damaging hail and winds in parts of the NEK and other areas of Vermont and NY. Recent extremes in cold temperatures is a concern. 2015 tied the coldest winter (January to March) on record (1923) for Vermont as a whole according to the NOAA's National Climatic Data Center whose dataset dates to 1895. Cold temperatures are expected in the Northeast but they can pose a serious threat to health and safety, especially as the severity and duration increases in conjunction with other technological (e.g. power outage, fuel oil delivery disruption) and societal (ability to purchase heating fuel) factors. Maintaining a safe living environment for livestock during extreme temperatures, especially cold extremes, is a real concern for Hardwick and the rest of the state. Hardwick's winter of 2015 was the coldest anyone could remember with a mean temperature of 7.8 degrees Fahrenheit and a max-low of -26 degrees Fahrenheit in February for the region. However, the January of 1970 had a mean temperature of 6.6 degrees Fahrenheit which is the coldest mean temperature for the county and January is the statistically coldest month in all of Vermont. Since 1900, January produced temperatures in the negative 20's and 30's consistently for Caledonia County with record cold temperatures occurring in 1914 (-38). Cold temperatures are expected in the Northeast but they can pose a serious threat to health and safety, especially as the severity and duration increases in conjunction with other technological (e.g. power outage, fuel oil delivery disruption) and societal (ability to purchase heating fuel) factors. Maintaining a safe living environment for livestock during extreme temperatures, especially cold extremes, is a real concern for farmers in Hardwick and the rest of the state and while the temperatures for the town remain within averages seen in the last 85 years, the town expects dangerously cold temperatures every winter. There is no evidence to support concern over increases in high temperatures for the town as it relates to health and human safety at this time.

Flooding

During the summer months, flooding tends to be more of the flash flood type of event. Thunderstorms may form or move over mountainous areas or river basins and drop copious amounts of precipitation. Water on rivers and streams rises rapidly in a period of six hours or less and the main stem rivers can flood as well as the smaller streams. During the fall, there are several weather threats. Strong storm systems move from the Ohio Valley through the Great Lakes and into Canada. As these storms move into Canada, the associated cold front then moves across our area with strong west or northwest winds and colder air. Heavy rain may accompany these storms. Another threat in the fall is the remnants of Tropical Storms. Tropical Storm Irene in 2011 served as a flood-magnitude benchmark for many communities in the state. Flooding is the most common recurring hazard event in the state of Vermont. June 2015 broke records across the state for the wettest on record. Hardwick received nearly 6 inches of rain in June 2015 but flooding did not result. This amount is high but not highest for the region. 9.65'' fell in 1973 in Saint Johnsbury and the greatest 24-hour rainfall records for the town occurred in May 30th, 2011 at 6.47''. Recent history, including the flooding events of 2011 and the records set in 2015 suggest that increases in total rain fall and severity are to be expected along the lines seen with the records set across the state recently.

There are three sources of historical precipitation data for Vermont. The data are reported at the county level: 1) recurrence time intervals for 24-hour rainfall storm depth, 2) annualized daily frequency of rainfall, and 3) rainfall-intensity frequencies. The first source of data is the recurrence time intervals for 24-hour rainfall storm depth. The recurrence depth data describes the expected intensity of major rainfall events with respect to both rainfall depth and frequency of occurrence.

Table 2-8: 24-Hour Rainfall Depths (inches) for Common Recurrence Intervals (ANR, 2002)

County: Caledonia
1-yr, 24-hr Rainfall Depth: 2.1''
2-yr, 24-hr Rainfall Depth: 2.2''
10-yr, 24-hr Rainfall Depth: 3.1''
100-yr, 24-hr Rainfall Depth: 5.0''

The second source of data are the annualized daily frequencies of rainfall, which were obtained from the National Climatic Data Center (NCDC), Climate Normals program for 1981 – 2010. The data provides the average number of days per year with measurable precipitation (greater than 0.01 inches) on a county by county basis. This data allows for the conversion of the annual probabilities derived from the recurrence time intervals to daily probabilities. The annualized estimated daily frequency of measureable rainfall for Caledonia County is 174 days (highest in the state) with 119 days of rain and 55 days of snow. The final source of data are rainfall-intensity frequencies. Hourly precipitation totals throughout the state of Vermont were obtained from the NCDC's Cooperative Observer Program (COOP). Hourly rainfall data were available for 26 COOP locations between 1962 through 2012. Each station is associated with the specific county in which it was located, and the hourly precipitation totals for each station are aggregated by county to yield a frequency distribution of hourly rainfall intensities.

Table: 2-9: Caledonia County Rainfall-Intensity Range (in. /hr.)

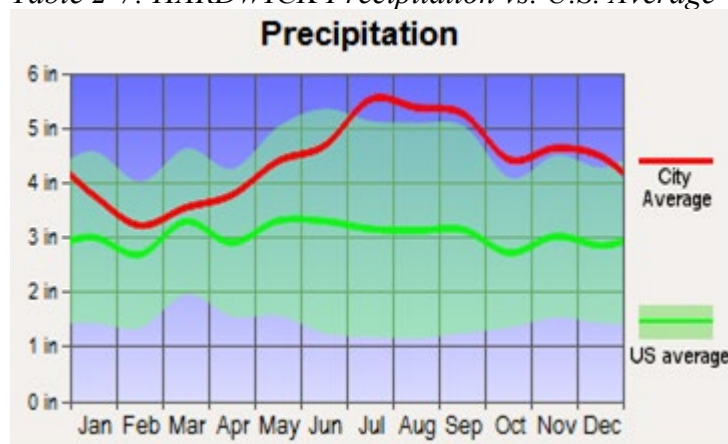
County: Caledonia
$x \leq 0.01$: 22.5%
$0.01 < x \leq 0.05$: 25.6%
$0.05 < x \leq 0.10$: 38%
$0.10 < x \leq 0.15$: 3.2%
$0.15 < x \leq 0.20$: 5.9%
$0.2 < x \leq 0.25$: .8%
$0.25 < x$: 4.7%

Floods can damage or destroy public and private property, disable utilities, make roads and bridges impassable, destroy crops and agricultural lands, cause disruption to emergency services, and result in fatalities. People may be stranded in their homes for a time without power or heat or they may be unable to reach their homes. Long-term collateral dangers include the outbreak of disease, loss of livestock, broken sewer lines or wash out of septic systems causing water supply pollution, downed power lines, loss of fuel storage tanks, fires and release of hazardous materials.

The National Weather Service issues flood watches and warnings when conditions are right for flooding. A flood watch indicates that meteorological conditions are conducive to flooding. People in the watch area are instructed to stay tuned to local radio or television stations for updates on flooding and weather conditions. When flooding is imminent, a flood warning is issued. The warning will identify the anticipated time, level and duration of flooding. Persons in areas that will be flooded are instructed to take appropriate protective actions, up to and including evacuation of family members and removal or elevation of valuable personal property

The Flood of 1927 is the one major flood event against which all others are judged due to the severe loss of life and property that was experienced. More than 50% of bridges and roads statewide were damaged in the flooding on November 27th. Most of Vermont’s present bridges over rivers were installed after that flood and are now being methodically replaced by the Vermont Transportation Agency on state roads and highways.

Table 2-7: *HARDWICK Precipitation vs. U.S. Average*



Inundation and Floodplains

Inundation-related flood loss is a significant component of flood disasters; the more common mode of damage is associated with the dynamic, and oftentimes catastrophic, physical adjustment of stream channel dimensions and location during storm events. These adjustments are often due to bed and bank erosion, debris and ice jams, or structural failure of or flow diversion by man-made structures. A greater threat is erosional damage. The state of Vermont has been conducting geomorphic assessment to identify areas vulnerable to erosional damage.

A section of the Lamoille River flows through town, including the “village” area. Hardwick has received digital GIS FIRM data, allowing for greater analysis of flood risks.

Flood risk information presented on FIRMs is based on historic, meteorological, hydrologic, and hydraulic data, as well as open-space conditions, flood control works, and development. To prepare FIRMs that illustrate the extent of flood hazard in a flood prone community, FEMA conducts engineering studies referred to as Flood Insurance Studies (FISs). Using information gathered in these studies, FEMA engineers and cartographers delineate Special Flood Hazard Areas (SFHAs) on FIRMs. SFHAs are those areas subject to inundation by a flood that has a 1-percent or greater chance of being equaled or exceeded during any given year. This type of flood is referred to as a base flood. A base flood has a 26-percent chance of occurring during a 30-year period, the length of many mortgages. The base flood is a regulatory standard used by Federal agencies, and most states, to administer floodplain management programs, and is also used by the National Flood Insurance Program as the basis for insurance requirements nationwide.

Of all types of natural hazards experienced in Vermont, flash flooding has historically resulted in the greatest magnitude of damage suffered by private property and public infrastructure. Most communities have undertaken significant mitigation measures in recent years. However, flash floods can strike at any time in areas that are not identified as typical flood hazard areas, and thus they continue to cause public and private damage. Flash flooding has been more frequent in Hardwick since the last Hazard Mitigation Plan was updated in 2005, with three separate (different) events during 2011 and one in 2012. The events of 2011 resulted in the Johnson

property located at 68 Church Street being declared uninhabitable and did great damage to roads in Hardwick.

Major roads and highways, Class One and Two, are governed and maintained by the Vermont Agency of Transportation, or VTRANS, and their highway district #7 covers the Town of Hardwick. Many of these Class Two roads experience flooding during flash floods, and as a result maintenance and repair of this infrastructure has been ongoing. VTrans staff has worked with the Town of Hardwick to adopt Local Codes and Standards as a best practice. The standards require upgrades on new roads, culverts and bridges to help withstand local flood related damages. Regarding flood inundation issues, the 2013 *Vermont State All-Hazards Mitigation Plan* states:

“While inundation-related flood loss is a significant component of flood disasters, the predominant mode of damage is associated with the dynamic, and often times catastrophic, physical adjustment of stream channel dimensions and location during storm events due to bed and bank erosion, debris and ice jams, structural failures, flow diversion, or flow modification by man made structures. Channel adjustments with devastating consequences have frequently been documented wherein such adjustments are linked to historic channel management activities, flood plain encroachments, adjacent land use practices and/or changes in watershed hydrology associated with conversion of land cover and drainage activities. The 100-year, or “base” floodplain is the national standard for floodplain management. The area is shown on City Flood Insurance Rate Maps (FIRMs) as issued by FEMA. The 100-year floodplain has one chance in a hundred of being flooded in any given year. The probability that a 100-year flood will occur is a statistical determination based on past flooding in an area. This is not to say that a flood of such magnitude cannot occur two years in a row or twice in the same year. The term only means that in any given year, the odds are 1% that the area will be flooded. The same logic holds true for defining a 500- year flood. In this case, a flood of the 500-year magnitude has a 0.2% chance of occurring in a year. Much flood damage in Vermont occurs along upland streams, damaging private property and infrastructure such as bridges, roads, and culverts. The failure of beaver dams, private ponds and public and private culvert crossings contributes to flood surges and often dramatically increased damage downstream. Homes and other private investments along these streams are generally not recognized as a flood area on FEMA maps of flood hazard zones and, thus, are not typically identified as being vulnerable to flooding or erosion. City plans and zoning regulations have generally not identified these stream corridors as areas needing protective setbacks for development or zoning.”

Fluvial Erosion

Erosion occurs on a consistent, but small-scale, basis within the riparian corridor of the town’s streams and rivers. This is a part of normal natural processes and as such is necessary for the proper functioning of the ecosystem of these waterways. However, fluvial erosion on a large scale can damage stream banks and undercut infrastructure such as roads, bridges and culverts as well as agricultural land and structures, causing severe damage. Fluvial erosion on a large scale

can cause stream bank collapses, which are generally classified as landslides. Most flood damage is associated with fluvial erosion rather than inundation. The *2013 Vermont State All-Hazards Mitigation Plan* contains the following discussion of fluvial erosion:

“Vermont’s landscape has historically contributed greatly to the widespread practice of the channelization of rivers and streams in order to maximize agricultural land uses and facilitate the development of transportation infrastructure. Channelization, in combination with widespread flood plain encroachment, has contributed significantly to the disconnection of as much as 70% of Vermont’s streams from their flood plains. In this unsustainable condition and when energized by flood events, catastrophic adjustments of the channel frequently occur, usually with consequent fluvial erosion damage to adjacent or nearby human investments. All areas of the state suffer equally from fluvial erosion hazards. Some areas have suffered more than others simply because of the location of storm tracks. Transportation infrastructure and agricultural property are the most frequently endangered types of human investment affected by fluvial erosion hazards. Residential, commercial and other municipal properties are also frequently endangered. Changes in watershed hydrology that significantly influence fluvial stability are commonly associated with urbanization or with silvicultural practices. However, watershed scale hydrologic changes have been observed in Vermont as a localized phenomenon either in small, highly urbanized watersheds or in small, rural sub watersheds where clear cutting of a large percentage of the watershed land area has recently occurred. Stream geomorphic assessments and a fluvial geomorphic database maintained by the Agency of Natural Resources have identified main stem rivers typically channelized from 60-95% of their lengths. When human investments and land use expectations include all the land in the valley up to the river banks, there results extreme public interest in maintaining this unsustainable morphological condition despite its great cost and resultant hazard to public safety.”

The Vermont Agency of Transportation (VTTrans) applies the term “scour critical” to stream crossing structures especially vulnerable to streambed scour—the undermining of bridge supports by water action and erosion. A spreadsheet database is maintained by VTTrans and continually updated by the Bridge Inspection Program. Structures inspected are only those of 20 ft. or longer owned by a municipality or the state. The scour critical rating is based on the structure itself, and does not consider debris jams, outflanking, channel change, or other issues commonly associated with fluvial erosion. Water supply source and distribution systems are also endangered by fluvial erosion. Many water distribution systems involve buried pipes that cross streams, which are vulnerable to fluvial erosion. In December 2014, the Vermont Department of Environmental Conservation (DEC) released the “Flood Hazard Area and River Corridor Protection Procedures” guide, outlining specific actions and considerations. While fluvial erosion potential has not been addressed yet, new data is constantly becoming available, such as the recently released River Corridors Base Map by the Agency of Natural Resources. While exposure is limited by the length and character of the rivers within the town, the potential for significant property damage under unique circumstances is a concern. Therefore, new river corridor data will be evaluated as it becomes available to identify any potential problem areas and any measures that will minimize or eliminate the impact of fluvial erosion shall be

implemented. Extent data related to the fluvial erosion hazard for each jurisdiction is unavailable.

Ice Jams

Ice jams, which can cause rapid and catastrophic flooding, are considered increasingly hazardous in parts of Vermont. In addition to the inundation damage they cause, ice jams can block infrastructure such as roads and culverts. Ice jams are not as much of a concern in Hardwick as elsewhere in Vermont. This is most likely due to the relationship between ice jams and the dam, the Moore Reservoir freezes over but the river is normally open. The Town has experienced significant ice jams on the Lamoille River in the past. After substantial ice forms on the rivers, several days of unusual warmth coupled with rainfall can lead to ice breakup. The chunks of ice form jams which cause localized flooding on rivers. Ice jams are most prevalent during the January thaw (late January) as well as in March and April during (Hardwick has ice jams in) the spring thaw on the Lamoille River. In 1994, with the engineering assistance from the US Army Engineer Research and Development Center of the Cold Regions Research and Engineering Laboratory (CRREL), the Town installed sloped granite ice control structures in the riverbed of the Lamoille River just east of the Village area to help retain ice floes in order to prevent ice jams and flooding further down the river. The structures have been very effective controlling ice on the east side of the village (by controlling ice) upstream of the Village and adjacent to Route 15. The Town occasionally expends local tax dollars as a preventative effort to break up the ice jams on the west side of the village. The Town experienced minor ice-related flooding along Wolcott Street in 2010 and in 2014. A list of historic ice jams, including municipalities and streams, is maintained by DEMHS and the Vermont Agency of Natural Resources (ANR). The US Army Corps of Engineers Cold Regions Research and Engineering Laboratory maintains a more specific database of ice jams, which includes over 903 events in Vermont with the latest occurring in 2013. Despite Hardwick not having any recorded events, nearby Passumpsic had 19 (10th highest in the state) and St. Johnsbury had 38 (5th highest in the state) with the Connecticut River being number one in the state with 84 recorded ice jams and the Passumpsic River with only one.

(Source: http://rsgisias.crrel.usace.army.mil/apex/f?p=524:39:10954063060296::NO::P39_STATE:VT)

High Hazard Dams

According to the 2013 *Vermont State All-Hazards Mitigation Plan*,

“The VT Agency of Natural Resources (ANR) Dam Safety Program maintains an inventory of 1205 dams (including 85 ANR owned dams) with impoundments greater than 500,000 cubic feet”.

Failure of any of these dams could result in significant downstream flooding. There are 55 high hazard dams on the dam inventory, none of which are considered at significant risk for failure in the town. The Moore Reservoir, owned by TransCanada, is an impoundment of the Connecticut River and occupies 3,181 acres. Created by the completion of the Moore Reservoir in 1956, several villages were flooded, including a portion of old Hardwick. With a capacity of 192

megawatts, it is the most productive of TransCanada's 13 hydroelectric facilities in New England. Also owned by TransCanada and downstream from the Moore Dam, the Comerford Reservoir is a 1029-acre impoundment located on the Connecticut River and formed by the Comerford Dam in the towns of Barnet, VT and Monroe, NH, impounding water into Littleton, NH and Hardwick, VT nearly to the Moore Reservoir. There have been no recent or historically relevant flooding events associated with the failure of any dam in Vermont. However, as stated in FEMA Guide P-956 *"Living with Dams: Know Your Risks"* (2013): "Although dam failures are infrequent, the impacts can be catastrophic, often far exceeding typical stream or river flood events." There are two hydro-electric dams in Hardwick. The Mackville dam was completely rebuilt in 2000. This dam is located Southeast of Town. HED is required to maintain safety checks, inform the public of inundation plans, and have an early warning system in place. Regular maintenance is ongoing to assure safety measures. Should a large flood event occur beyond the magnitude of the historical past of the region, the possibility exists for a major breach of a dam and severe inundation throughout the downstream areas. A well-situated, higher magnitude earthquake could also cause severe damage to dams. There are no other dams located within the Town of Hardwick.

Hazardous Substances

Hazardous Material Storage and Release:

A major Superfund Amendment and Reauthorization Act (SARA) provision is Title III, also referred to as SARA Title III or the Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA establishes guidelines for Federal, State and local governments and industry regarding emergency planning and providing communities with information on hazardous chemicals within their jurisdiction. The State of Vermont's implementation of its SARA requirements was approved by the Legislature in 1994. Caledonia County was designated as an emergency planning district and DEMHS established a Local Emergency Planning Committee, known as LEPC #10, for the county. The function of the LEPC is to carry out duties proscribed in SARA Title III. In addition, Vermont statute dictates that the LEPC shall insure that the local emergency response plan has been implemented upon notification of a release of hazardous chemical or substance, consult and coordinate with municipal emergency service providers, DEMHS and the managers of all HAZMAT facilities within Caledonia County regarding the facility plan, and review and evaluate requests for funding. Farmers are not required to report agricultural chemicals stored on their properties, but they do not typically store and keep large amounts of these chemicals. Hazardous materials accidents can occur anywhere there is a road, rail line, pipeline or fixed facility storing hazardous materials. These materials are poisonous, corrosive, flammable, and radioactive or pose other hazards. Almost the entire County is at risk for such an unpredictable accident. Most accidents are small spills and leaks, but some result in injuries, property damage, environmental contamination and other serious consequences.

Emergencies involving hazardous materials can be expected to range from a minor accident with no off-site effects to a major accident that may result in an off-site release of hazardous or toxic materials. The overall objective of chemical emergency response planning and preparedness is to minimize exposure for a wide range of accidents that could produce off-site levels of contamination in excess of Levels of Concern (LOC) established by the U.S. Environmental

Protection Agency. Minimizing this exposure will reduce the consequences of such (an) emergencies to people near facilities which manufacture, store and process hazardous materials.

Large volumes of hazardous materials are transported to and through the County by railroad and highway daily. Within Caledonia County there are a number of public and private fixed facilities that produce or use hazardous materials. In Hardwick, the following facilities produce, use or store hazardous materials on site²:

1. **Transportation Corridors** – That go through the village of Hardwick' Source Protection Area are Vermont State Highways 14 & 15, five Town Roads, and a small section of the former Lamoille Valley Railroad. These transportation routes have an asphalt surface. The Lamoille Valley Railroad tracks were removed by the State Agency of Transportation in 2005 and the surface is now crushed stone and gravel. The Town roads are properly drained in a manner to prevent siltation. Additionally, there are dirt driveways leading to homes, businesses, to the municipal pump house and to the wastewater treatment facility. Waste and other smaller haulers do use these roads. The State of Vermont and the Town have discontinued salting a 1,500' section of Routes 14 & 15 by the well house. The greatest threat to the contamination of the water supply is through the possibility of an accident or spillage of materials hazardous to a potable water supply. The Town has very little control over potential accidents. Signs have been posted notifying motorists of the Town of Hardwick's Water Supply Well Protection Area. In East Hardwick, the Source Protection Area is overlain by forest and farm fields. The above-mentioned railroad does cross the SPA and Ward Hill Road skirts a portion of its southwest edge, but this road is lightly used for mostly local traffic.

2. **The Vermont Food Venture Center** consists of a small cheese plant and several food preparation kitchens. The cheese plant uses caustic soda and a mixture of hypochlorite and hydroxide compounds for cleaning and disinfection. The chemicals are stored in 50-gallon carboys, with no more than two 50-gallon carboys of each of the chemicals on hand at any one time. The food preparation kitchens are cleaned and disinfected using quaternary ammonia and hydroxide/hypochlorite chemicals. These two chemicals are stored in 4-gallon containers with no more than 12 gallons onsite at any one time. All chemicals are stored inside the building.

3. **Vermont Soy, Hardwick Enterprise Group** – produces food products manufactured from soy, such as soy milk and tofu. Cleaning compounds consist of ammonium chloride, nitric acid, and a mixture of hydroxide and hypochlorite. These chemicals are stored in quantities of 5 gallons or less. All chemicals are stored inside the buildings.

4. **Caledonia Spirits and Honey Gardens Winery** – Produce distilled alcohol and wine products. They use a combination of phosphoric acid/nitric acid for pH adjustment and citric acid for cleaning, sanitizing. There is no more than 1-2 gallons of any of these chemicals stored at the plant at any one time, and all are stored inside the building.

² Tier II Data Reporting, Vermont Department of Public Safety.

5. **Service Stations/Gas Stations/Underground Storage** - There are two businesses in Hardwick Village that have large underground storage tanks: 1 - 3,000-gallon gas tank and a monitoring well - these tanks are all currently empty; Perry Global has 1 - 20,000 gallon gas tank; and Lamoille Valley Ford has 1 - 4,000 gallon gas tank. In East Hardwick, D&L Beverage & Deli sells gasoline and diesel fuel from underground tanks: Hardwick Motors, Greensboro Garage, Rowell Brothers, Dona's Car Store, Lanphear Sales and Services, Hay's Auto Repair, and Hill Group of Vermont Garage are all service stations that wash and repair vehicles and other small machinery. Each shop has oil-based materials stored on site, though not in large volumes.

6. **Auto Parking** - Most of the businesses have parking lots. The Grand Union/Brooks Plaza has the biggest parking lot and can hold approximately 75 cars. Cars are parked near all residences and have the potential of leaking fluids which could be hazardous to local water resources.

7. **Fuel Storage** - Many residences have concrete basements with 275-gallon fuel oil tanks which are regularly filled by one of three local oil companies. A few of the basements have earthen floors with no containment. Several homes have outdoor above ground fuel tanks. According to representatives of the fuel supply companies, they would have a very good idea of the use of oil and they believe that they would know if there was any leakage from customer tanks. They have informed us that they are required to notify the Owners if they suspect a leak and have promised to notify the town as well in an effort to prevent problems. Additionally, Bourne Energy has an above ground fuel storage tank located on Log Yard Road in the Pudvah Industrial Park. This tank is used to refuel log trucks that deliver logs for storage on Log Yard Road. Its volume is equal to 2,000 gallons. This tank is protected by secondary containment.

8. **W.E. Aubuchon/Poulin Lumber** - W.E. Aubuchon is a hardware/grain store. The premises sell a number of paints, fertilizers and other hardware products. These materials are all stored inside the building. Poulin Lumber sells much of the same contents that W.E. Aubuchon currently sells. The Town will be made aware if there is leakage of any substantial product. Chemicals are stored inside buildings.

9. **Hardwick Waste Water Treatment Plant** - The Sewer Plant has two - 5 million-gallon lagoons, 300 gallons of 12% hypochlorite, 220 gallon of 38% Sodium Bisulfate, 1000 gallon #2 fuel oil underground, and a 275 gallon diesel tank in the basement. The Town of Hardwick tests periodically for leakage of the lagoons through two monitoring wells. All chemicals are stored inside the control buildings at the water pollution control facility.

ANR Solid Waste Records

There are no permanent solid waste receiving or handling facilities within the Hardwick Urban Compact. All Metals Recycling and Gates Salvage yard are located in Hardwick, but are outside of the Urban Compact South West of the Village.

ANR Hazardous Waste Records

A 2012 review of the Agency of Natural Resources website of Vermont Hazardous Waste Sites identified the following sites within the Town's Urban Compact.

- Kwikstop #870082, not active, remediation complete
- House of Pizza #941602
- Hardwick Motors Inc. #962091 (now Lamoille Valley Ford)

The following sites are located in the Hardwick, but may be outside the urban compact and are not located in the Town water supply Source Protection Area.

- Hardwick Electric #770105, active
- Hay's Texaco #880229, active
- Ed's Deli #900490, active, (now called D & L Beverage)
- Brochu's Citgo #890439, active
- Perry's Oil #941608, active
- Green Mountain Sanitation #951792, active
- Barcomb Auto Sales #992671, active
- Mike's Gulf #880223, active
- Hay's Convenience #880229, active
- Gates Salvage #20033117, active

ANR PERMITTED WASTEWATER SYSTEM

The Town of Hardwick operates an aerated lagoon wastewater treatment facility that discharges tertiary treated, disinfected and dechlorinated wastewater to the Lamoille River.

RANKING OF ACTIVITIES

Highest Risk:

1. Transportation Corridors
2. Service Station/Gas Station/Underground Storage
3. Vermont Quality Dairies
4. Auto Parking
5. Fuel Storage
6. W.E. Aubuchon Hardware/Poulin Lumber

Lowest Risk: Hardwick Waste Water Treatment Plant

Mishandling and improper disposal or storage of medical wastes and low-level radioactive products from medical use are also a hazard to Caledonia County towns.

Community vulnerability is difficult to assess due to the nature of the incident. The next section lists the incidents that have occurred in the County since 2000. Most are considered minor fuel spills that are most likely to happen in the region.

Hazardous materials pose a risk to a large area of the town because of major east/west and north/south corridors: VT Routes 15, 14, and 16. Accidents are common, especially in the village center and occasionally involve commercial trucks, especially along Routes 14, 15, and 16. The municipal water supply just west of the village and along Route 15 is particularly vulnerable to accidents involving hazardous material spills. The traffic speeds within the urban compact are 25 to 30 MPH, which reduce the impact of traffic accidents in the higher population areas.

Traffic Related Hazards

The table below lists the High Accident Locations (HALs) for the Town of Hardwick for the last five (5) years:

Route/Intersection	Mileage	Crashes	Fatalities	Injuries
VT-14	0.480 - 0.780	5	0	4
VT-16	1.900 - 2.200	7	0	1
VT-15	4.342 - 4.642	7	0	3
VT-15	3.442 - 3.742	13	0	2
VT-15	2.842 - 3.142	13	0	2
VT-15	2.442 - 2.742	14	0	8
FAS 0257	0.000 - 0.300	7	0	0
VT-15, VT-16	5.680 - 5.840	10	0	6
VT-15, VT-14	3.310 - 3.390	20	0	2

Source:

<http://vtrans.vermont.gov/sites/aot/files/planning/2010-2014%20Formal%20High%20Crash%20Location%20Report.pdf>

These are repetitive accidents and not necessarily related to hazardous materials. The HAL table indicates areas that may be considered a high threat should a vehicle carrying hazardous materials be involved in an accident. More precise data is available in a full report entitled the Vermont Crash Reporting System (CRS) by the Vermont Agency of Transportation.

SECTION 3: RISK ASSESSMENT

3.1 Designated Hazard Areas

3.1.1. Flood Hazard Areas

All of Caledonia County is located in the Hardwick River watershed, a drainage area of approximately 164 square miles. The mainstem of the Hardwick originates from Tildy’s Pond in Glover, then travels through Hardwick and the Village of Caledonia, on to Lake Memphremagog’s South Bay in Coventry. The Hardwick River watershed contains one large tributary watershed, the Willoughby River (62 square miles), which drains from Lake Willoughby in Westmore, runs through Evansville and enters the Hardwick River just north of Caledonia Village. Based on digitized FIRMs that are geo-referenced with E911 addresses for structures, there are 78 structures within in the 100-year Flood Hazard Area. The maps were last revised in 2002. Some structures that appear to be in the Flood Hazard Area are not, and conversely, there may be some that may well be in it, but are not shown to be. The digitized maps are based on

base flood elevations and since the actual first floor elevations for most structures are not known, the graphic representation is a reasonable estimate. High risk areas for flooding are: Wolcott Street, Granite Street, Cottage Street, Brook Street and all low-lying areas adjacent to Wolcott Street.

Source: NFIP Insurance Report: Vermont

3.1.2. Fluvial Erosion Hazard Areas

About two-thirds of Vermont’s flood-related losses occur outside of mapped floodplains, and this reveals the fundamental limitations of the FEMA FIRMs. A mapped floodplain makes the dangerous assumption that the river channel is static, that the river bends will never shift up or down valley, that the river channel will never move laterally, or that river beds will never scour down or build up. River channels are constantly undergoing some physical adjustment process. This might be gradual, resulting in gradual stream bank erosion or sediment deposit – or it might be sudden and dramatic, resulting a stream bank collapse. The losses experienced during the May 2011 storms and Tropical Storm Irene were most often related to the latter, regionally. In fact, this type of flood-related damage occurs frequently in Vermont, due in part to the state’s mountainous terrain. Land near stream banks are particularly vulnerable to erosion damage by flash flooding, bank collapse, and stream channel dynamics. The Vermont Department of Environmental Conservation, Agency of Natural Resources, has identified river corridors, which consist of the minimum area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition. In other words, the river corridor provides “wobble room” for a stream as its channel changes over time. Keeping development out of the river corridors therefore reduces vulnerability to erosion.

Repetitive Loss Properties

Hardwick has had five losses and three properties that have experienced repetitive flooding in the past. Indicated below, each of these FEMA repetitive loss properties were residential. Of these, one has been bought-out through FEMA funds, the second has burned down, and the third is not a major concern to the town. A summary of these properties is included below.

Hardwick Mitigated?

1. House	Yes/Bought out	07/15/1997
2. House	Burned to ground 2004	02/11/1981
3. Condo	NO, Town not interested	08/06/1995

3.2 Non-designated Hazard Areas

Ice Storm Damage

High winds, large snowstorms, heavy rains and thick ice storms are common in Hardwick. With high elevations and residents living in remote areas, this could be a very serious problem. Power outages do occur but are not frequent. While ice storms can be expected annually, a large ice storm event such as the January 1998 storm that wreaked havoc on northern New England and

Quebec, Canada is infrequent. This type of storm forms when the lower levels of the atmosphere and the ground are at or below freezing, but rain is falling through warmer air aloft. The water freezes at the lower levels on trees, power lines and roads leading to (and causes) power outages and disruptions in everyday life. More common are the light events of freezing rain or mixed precipitation. Local town road crews are very efficient with sand and salt when weather warnings trigger extra attention to roads. Ice and snow events have caused damage in Hardwick, but generally damage has been less than experienced elsewhere in the State. The last ice storm event occurred in December 2014 and cost the Hardwick Electric Department approximately \$45,000 for repairs. 1998 data: <https://www.fema.gov/disaster/1201>

High Winds and Lightning

Ridgeline and hilltop homes as well as homes located in the midst of mature forests are the most vulnerable to damage from falling trees and tree limbs. High tension line near tree stands are at increased risk of damage and the Vermont Agency of Transportation, HED and the town work to keep limbs trimmed. As with many Vermont communities characterized by natural terrain, the issue of downed trees creating power loss and property damage is more common compared to urban areas. Historically, these instances are short and have not posed a serious risk for the town or its residents.

3.3 Previous FEMA-Declared Natural Disasters and Non-Declared Disasters

While the Town of Hardwick has had a history of flooding, losses to public infrastructure have intensified in recent years. Disasters in 1999, 2007 and 2015 caused the most damage throughout the town. Damage was largely contained to local back roads (unpaved) due to washouts. The town has been fortunate that its buildings and residential property has remained relatively unaffected by recent disasters. Hardwick has received public assistance funding from FEMA for the following natural disasters:

Table 3-1: Town of Hardwick, FEMA-declared disasters and snow emergencies, 1999-Current:

KEY:

DR	Date	Type
1307	11/10/1999	Severe Storms
1559	09/23/2004	Severe Storms
1698	05/04/2007	Severe Storms
1715	08/03/2007	Severe Storms
4022	09/01/2011	Trop. Storm
4163	01/29/2014	Severe Winter Storm
4207	02/03/2015	Severe Winter Storm

Disaster Number	PW Number	Application Title	Applicant ID	Damage Category Code	Project Amount	Federal Share Obligated	Total Obligated
4022	22	MOCAHARC1 TH-4	005-31825-00	C - Roads & Bridges	\$10,057.00	\$9,051.30	\$9,051.30
4022	698	GWHARF1 - Power lines	005-UQA0M-00	F - Public Utilities	\$16,023.57	\$14,421.22	\$14,421.22
4163	27	HEDF1 Hardwick Electrical Dept	005-UQA0M-00	F - Public Utilities	\$40,422.48	\$30,316.86	\$30,316.86
4207	3	HARDA01 Debris	005-UQA0M-00	A - Debris Removal	\$26,549.98	\$19,912.49	\$19,912.49
4207	6	HARDF01 Power Restoration	005-UQA0M-00	F - Public Utilities	\$87,003.43	\$65,252.57	\$65,252.57
1307	2	PUBLIC UTILITIES	005-31825-01	F - Public Utilities	\$63,584.08	\$47,688.06	\$51,083.44
1307	43	DEBRIS REMOVAL	005-31825-01	A - Debris Removal	\$6,232.00	\$4,674.00	\$4,958.18
1559	UK	Severe Storm(s)	005-31825-01	4 projects	UK	\$11,119.57	
1698	UK	Severe Storm(s)	005-31825-01	2 projects	UK	\$6,142.27	
1715	UK	Severe Storm(s)	005-31825-01	6 projects	UK	\$79,898.79	

UK or empty cell=Unknown

Sources: FEMA and the 2015 Hardwick Town Plan

Non-declared disasters (e.g. snow and rain storms) have not resulted in damage above and beyond normal maintenance. Extreme, long-lasting cold temperatures during winter months do pose a concern for the town as in many communities where the price of heating fuel often exceeds resident's ability to pay. Coupled with high unemployment, there is an increased risk for the town's residents to not meet the financial requirements for adequate heat, especially during long periods of extremely cold temperatures. Without adequate provisions, 48 hours of extremely cold temperatures could create a serious health hazard.

3.4 Hazard Assessment and Risk Analysis

Although estimating the risk of future events is far from an exact science, the Planning Team used best available data and best professional judgment to conduct an updated Hazards Risk Estimate analysis, which was subsequently reviewed and revised by town officials in 2017. This analysis assigns numerical values to a hazard's affected area, expected consequences, and probability and supports the inclusion of all profiled hazards in this plan. This quantification allows direct comparison of very different kinds of hazards and their effect on the town and serves as a method of identifying which hazards hold the greatest risk based on prior experience and best available data. The following scoring system was used in this assessment:

Area Impacted: scored from 0-4, rates how much of the municipality's developed area would be impacted.

Consequences: consists of the sum of estimated damages or severity for four items, each of which are scored on a scale of 0-3:

- Health and Safety Consequences
- Property Damage
- Environmental Damage
- Economic Disruption

Probability of Occurrence: (scored 1-5) estimates an anticipated frequency of occurrence based on prior experience and current information.

To arrive at the Overall Risk Value, the sum of the Area and Consequence ratings was multiplied by the Probability rating. The highest possible risk score is 80.

3.3.1. Natural Hazards and Hazardous Material Incident

According to the updated Hazard and Risk Estimation for Hardwick, the following natural hazards received the highest risk ratings out of a possible high score of 80:

- Severe Winter Storm (30)
- Flooding (40)
- Extreme Cold (40)
- High Winds (32)
- Hazardous Materials Incident (20)

Table 3-2 Natural hazards risk estimation matrix

Hardwick, VT Hazard & Risk Analysis: NATURAL HAZARDS with Hazardous Material Incident		Drought	Flooding	High Winds	Fluvial Erosion	Landslide	Lightning	Multi-Structure Urban Fire	Hazardous Materials Incident	Winter Storm	Extreme Cold
		Area Impacted									
Key: 0 = No developed area impacted											
1 = Less than 25% of developed area impacted											
2 = Less than 50% of developed area impacted											
3 = Less than 75% of developed area impacted											
4 = Over 75% of developed area impacted		2	3	4	1	1	1	1	2	4	4
Consequences											
<i>Health & Safety Consequences</i>											
Key: 0 = No health and safety impact											
1 = Few injuries or illnesses											
2 = Few fatalities or illnesses											
3 = Numerous fatalities		0	1	1	0	0	1	2	2	1	1
<i>Property Damage</i>											
Key: 0 = No property damage											
1 = Few properties destroyed or damaged											
2 = Few destroyed but many damaged											
3 = Few damaged but many destroyed											
4 = Many properties destroyed and damaged		0	1	1	1	1	1	2	1	2	1
<i>Environmental Damage</i>											
Key: 0 = Little or no environmental damage											
1 = Resources damaged with short-term recovery											
2 = Resources damaged with long-term recovery											
3 = Resource damaged beyond recovery		2	2	1	1	1	1	1	2	0	2
<i>Economic Disruption</i>											
Key: 0 = No economic impact											
1 = Low direct and/or indirect costs											
2 = High direct and low indirect costs											
2 = Low direct and high indirect costs											
3 = High direct and high indirect costs		1	3	1	1	1	1	3	3	3	2
Sum of Area & Consequence Scores		5	10	8	4	4	5	9	10	10	10
Probability of Occurrence											
Key: 1 = Unknown but rare occurrence											
2 = Unknown but anticipate an occurrence											
3 = 100 years or less occurrence											
4 = 25 years or less occurrence											
5 = Once a year or more occurrence		1	4	4	2	1	2	1	2	3	4
TOTAL RISK RATING											
Total Risk Rating =		5	40	32	8	4	10	9	20	30	40
Sum of Area & Consequence Scores											
x Probability of Occurrence											0

3.5 Hazard Summary

According to the risk estimation analysis, the highest rated hazards for Hardwick are:

1. Flooding (flash flood/dam breach)
2. Severe Winter/Ice Storm
3. Extreme Cold
4. High winds
5. Hazardous Materials Incident

Flood-related disasters have had the greatest financial impact on the town. While no deaths or injuries have been recorded for declared or non-declared disasters, the potential for health and safety risk during a severe winter storm are considered higher than that posed by a flooding event. Lighting and high winds further the risk for power loss and while high winds can occur any time of year (and normally occur in unison with rain or snow events). The town is vulnerable to power loss and in colder months, this could place the residents of the town in harm's way. While the history of major power loss over extended periods of time is minimal, there have been repetitive short-term outages. This duration poses a health and safety risk to residents as well as limiting response capabilities of town staff. With the recent severity of cold temperatures lasting for longer durations, accessibility of heating fuel is a concern and this accessibility is defined by transportation issues resulting from a major storm where roads are impassable and from resident's ability to pay for the fuel. As with many disaster scenarios, many hazards categories are related to one another. Natural hazards can cause a technological problem which can then cause a societal problem. In mitigating a natural hazard, there is the potential for a cascade of protection for both the technological and societal considerations the town has defined as concerns.

SECTION 4: VULNERABILITY ASSESSMENT

Vulnerability refers to the potential impact of a specific loss related to an identified risk. Hardwick is a small town with very few buildings aside from residential. While the loss of any one facility would cause a disruption in town services and operations, the overall vulnerability is low. There are roads, bridges and culverts vulnerable to flooding and those are identified below. Loss of equipment function for the highway department is a vulnerability for the town but the risk is not due or predicted to be a result of a disaster, merely, the required maintenance expected of highway-related machinery. For this section of the plan, the planning team looked at prior history and worst-case scenarios. The primary vulnerability for the town is transportation-related infrastructure.

The specific vulnerability to the population as a whole or any specific sub-population (e.g. elderly) is subjective because there is no historical data to rank vulnerability to health and safety

of residents, workers or travelers. A vulnerability analysis for Hardwick began with an inventory of possible hazards and an assessment of the risks that they pose.

Additional considerations include seasonal patterns, areas likely to be most affected, probable duration of the hazard, and speed of onset. A combination of the risk ranking, disaster history expenditures and frequency of the hazard was used to classify the community vulnerability as HIGH (25 years or less-low end), MODERATE (unknown but anticipate occurrence or 25 years or less-high end) or LOW (100 years or less). For example, a flood event is highly likely in many communities but the degree of impact varies. A highly likely flood with critical or catastrophic impact rates the community vulnerability as HIGH. Another community with a highly likely or likely flood with a limited impact would receive a vulnerability rating of MODERATE. The vulnerability of a community having the occurrence of an event as possible or unlikely with limited or negligible impact would be classified as LOW.

Vulnerability Narrative for Profiled Hazards:

Severe winter storm: 25 Years or Less

Summary: While all structures are vulnerable to major snow loads, there is little evidence to support concern over structure failure due to snow loads on roofs, ice on gutters, etc. Town snow removal equipment is vulnerable to damage with greater use, especially during emergency situations as well as road damage from plowing. Populations caught outdoors, commuting or working outside during a severe winter storm are more vulnerable to cold-related injury and/or snow related accidents but winter comes every year and residents and the town are accustomed to making intelligent decisions regarding safety and protection of infrastructure. Special populations (e.g. aging, disabled, etc.) are more vulnerable in terms of mitigating structure loads, hazardous travel and relocating to safety.

High Winds: 25 Years or Less

Summary: Infrastructure and people are vulnerable to power loss during extreme cold due to potential of pipes freezing and maintaining safe body temperatures. With a town-owned power supply operation, there is significant financial implications should a long-duration outage occur.

Flooding: 25 Years or Less

Flooding is the most common recurring hazard event in the state of Vermont. There are three main types of flooding that occur in Vermont: flooding from rain or snow melt, flash flooding and urban flooding. Flooding has also been known to occur as a result of ice jams in rivers adjoining developed towns and cities. These events may result in widespread damage in major river floodplains or localized flash flooding caused by unusually large rainstorms over a small area. The effects of all types of events can be worsened by ice or debris dams and the failure of infrastructure (especially culverts), private and/or beaver dams. Rain storms are the cause of most flooding in Hardwick. Winter and spring thaws, occasionally exacerbated by ice jams, are another significant source of flooding, especially when coupled with high rain levels. Much of this flooding is flash flooding, occurring within hours of a rainstorm or other event. Flash flooding, as opposed to flooding with a gradual onset, causes the largest amount of damage to

property and infrastructure. Floods cause two major types of damage: water damage from inundation and erosion damage to property and infrastructure. The *2013 Vermont State All-Hazards Mitigation Plan* discusses flooding extensively. While that plan is concerned with all of Vermont, the information on flooding is all relevant to Hardwick in that:

“Recent studies have shown that most flooding in Vermont occurs in upland streams and road drainage systems that fail to handle the amount of water they receive. Due to steep gradients, flooding may inundate these areas severely, but only briefly. Flooding in these areas generally has enough force to cause erosion capable of destroying roads and collapsing buildings. These areas are often not mapped as being flood prone and property owners in these areas typically do not have flood insurance (DHCA, 1998). Furthermore, precipitation trend analysis suggests that intense local storms are occurring more frequently. Additionally, irresponsible land use and development will exacerbate the preexisting vulnerability. Urban flooding usually occurs when drainage systems are overwhelmed and damages homes and businesses. This flooding happens in all urban areas, but specifically in Burlington where the downtown area is located at the bottom of a gradient, which adds to the intensity of this localized flooding....

...Over the past two decades, flood damage costs have risen dramatically in Vermont due to increasing occurrences of flooding and increases in vulnerability associated with unwise land use development in flood plains or within stream corridors. The geography and topography are right for a significant localized storm with extreme damage at almost any location in Vermont. Heavy rains with previous ground saturation, which causes runoff, are a significant part of the flooding formula in Vermont. Steep topography and narrow, inhabited, stream and river valleys further increase the dangerous nature of this hazard. Furthermore, precipitation trend analysis suggests that intense, localized storms that can cause flash flooding are occurring with greater frequency. While flooding will continue, planning and other mitigation measures can help minimize damages.

All of Vermont’s major rivers have inhabited flood plains. While residents in mountain valleys are at risk, they may not be aware of the danger or may choose to ignore it. There are many reasons property owners are reluctant to relocate to less flood prone ground, not the least of which is the lack of personal experience of flooding. In addition, many communities originated beside rivers and streams; some of the most attractive property is located in vulnerable areas. Lakeshore property in Vermont is vulnerable to flooding from high water levels, either by surface water erosion or flooding. Occasionally, water-saturated ground and high water tables cause flooding to basements and other low lying areas. Lakeshore property is highly desirable and valuable, making the development of lakeshore areas very likely, even with the high potential for flooding. Restrictions on lakeshore property development have significant negative economic and tax revenue impacts that must be carefully weighed against the gains in personal safety and protection of property.”

Vermont experienced major floods long before Federal disaster assistance became available. The most destructive recorded event was in November of 1927. In the month before the flood, rains in excess of 150% of normal precipitation fell after the ground had frozen. The flood itself was precipitated by 10 inches of rain falling over the course of a few days. The flood inundated parts of many towns and damaged or destroyed numerous bridges in the county. As the history of the flooding cited above bears out, the geography and topography are right for a significant localized

storm with extreme damage at almost any location in Vermont. Numerous floods have resulted in Presidentially-declared disasters and an influx of Federal disaster assistance. Of these disasters, 1973 flood inflicted widespread damage across the state and the residual rains of Hurricane Belle in 1976 resulted in substantial federal disaster assistance in Vermont. The following chart provides the history of recent PA funding related to flooding events in Hardwick. While this does not reflect the total impact of flooding on the town, PA funding history does provide a reference for vulnerable areas in the town and those areas will be addressed.

Previous experiences have proven to the town that flooding is the greatest risk and another flood event is probable by the time this plan requires an update. With this conviction, the need to complete viable mitigation actions to town infrastructure becomes incredibly important and the town remains aware of this. The estimated Capacity-Disruption Levels Given a Measured Rainfall Event can be interpreted as the conditional probability that a particular roadway capacity disruption occurs, given that a rainfall event occurs. For Caledonia County, the probability that the intensity of a rain event will result in approximately a 2%, 7.5%, or 13.5% roadway capacity reduction are 28.2%, 69.2%, or 2.6%, respectively (*Source: A Risk-Based Flood-Planning Strategy for Vermont’s Roadway Network, 2015*).

Extreme Cold: 25 Years or Less

Summary: Recent evidence shows that greater extremes in temperature and overall weather fluctuation are occurring with increased frequency. A long-duration cold snap can cause significant damage to structures due to bursting pipes and the residential health and safety considerations include factors related to financial resources, fuel supply, sheltering, provisions and employment.

Hazardous Materials Incident: Unknown but anticipate an occurrence

Summary: Hazardous materials pose a risk to a large area of the town because of major east/west and north/south corridors: VT Routes 15, 14, and 16. Accidents are common, especially in the village center and occasionally involve commercial trucks, especially along Routes 14, 15, and 16. The municipal water supply just west of the village and along Route 15 is particularly vulnerable to accidents involving hazardous material spills.

Table 4-2: Vulnerability Summary Table

Hazard	Vulnerability	Extent (Storm Data from most severe event)	Impact (economic/health and safety consequence)	Probability
Flood	<p>Culverts, bridges, road infrastructure, HED</p> <p>There are 78 structures within in the 100-year Flood Hazard Area. 73 mobile homes w/out land, 134 with land,</p>	<p>The greatest 24-hour rainfall record for immediate region occurred in late August 2011 at 4.01”’. The greatest level of precipitation in any month occurred in August 2011 at 11.12”’. No detailed data was available for fluvial erosion damage in town in terms of numbers of</p>	<p>DR 1715 (8/2007) resulted in greatest financial impact and damage to roads and bridges with nearly \$80,000 in FEMA funding for 6 projects.</p>	25 years or less

		acres lost during each event.		
Extreme Cold/ Snow/Ice Storm	The entire Town is vulnerable, including road infrastructure, town and privately-owned buildings, utility infrastructure	Snowfall has varied, from a few inches to over a foot or more. Heavy snow and wind may down trees and power lines. Snow/ice contributes to hazardous driving conditions. The winter of 2010-2011 was the third-snowiest on record with a total of 124.3 inches for the county. The record for the county was 145.4 inches set in 1970-1971.	For roof collapse: monetary damages will depend on each structure but, collapse of barn roof is often a total loss. This does not include the loss of livestock. Collapse of a house roof may be at a 50% loss. For car crashes due to poor driving conditions: minimal damage to vehicle to totaled vehicle and operator injury. Health impacts could vary significantly. Loss of energy or communication capabilities may occur and impede recovery. DR 4207 resulted in \$85,000 in FEMA funding to the electric plant with 2 projects.	25 years or less
Hazardous Materials Incident	Facilities, residential structures and people within proximity of event (dependent on characteristic and state of chemical).	Amounts of any previous release not known.	Any chemical spill can be hazardous but given prior event, mass fatalities is a possible consequence.	Unknown but anticipate and occurrence
High Winds	The entire town is vulnerable to the results of high wind exposure. Significant damage possible to trees, power lines, building roofs	Specific data for the town was not available but town officials recall the 2015 event (DR 4207) as being the most severe in memory and the town expects high wind events that may reach category 2 speeds but it is unlikely, based on previous events, that	DR 4207 resulted in \$85,000 in FEMA funding to the electric plant with 2 projects.	25 years or less

		a category 3 event will occur in the region.		
--	--	--	--	--

4.1 Critical Facilities

The Center for Disaster Management and Humanitarian Assistance defines critical facilities as: “Those structures critical to the operation of a community and the key installations of the economic sector.” As mentioned in the summaries above, some critical facilities have increased vulnerability during specific hazard events. Hardwick has two critical facilities in the Special Flood Hazard Area – the fire station and the Hardwick Electric garage. The town should consider a full range of options to mitigate risk to these structures in the future in order to ensure continuity of services during a disaster. Potential mitigation measures should include either relocation of the facility or its elevation/flood-proofing to the 500-year flood level (this is the elevation for a flood event that has a 0.2% annual chance of flooding). However, there is no evidence to suggest that any critical facility is highly vulnerable during any hazard event. All critical facilities in the town are outside the designated flood hazard areas and have no history of damage due to a disaster. In this regard, the town is resilient to critical facility damage during a natural disaster most likely to affect the region. The town electric plant is an important facility for the town but the office itself is not at risk of flood damage based on prior history.

4.2 Infrastructure

Flooding is the highest risk profiled hazard and town infrastructure has high vulnerability to damage during major flood events. The information presented below summarizes town infrastructure and high vulnerability areas.

4.2.1 Town Highways

Vermont's local roads are classified according to their importance and general use. This classification system applies to all town highways, and is used to determine the amount of state highway assistance provided to each community. Class 1 roads are those highways that while the responsibility of the town to maintain, are extensions of the state highway system and carry a state highway route number. Hardwick has 1.5 miles of class 1 roads including portions of Routes 14 and 15 that ran through the former village. Class 2 roads are the most important highways serving as corridors between towns, and consequently carry a large volume of local and regional traffic. Center Road, East Main Street (Greensboro Bend), Hardwick Street/East Church Street, and Belfry Road are Class 2 roads (see Table 7). Class 3 roads are comprised of secondary town highways that are passable year-round by standard vehicles. Class 4 roads are dirt roads typically functional for only part of the year for normal traffic. The following table illustrates town highway mileages in Hardwick and surrounding communities.

Table 4-2 Town highway mileage by class, Town of Hardwick

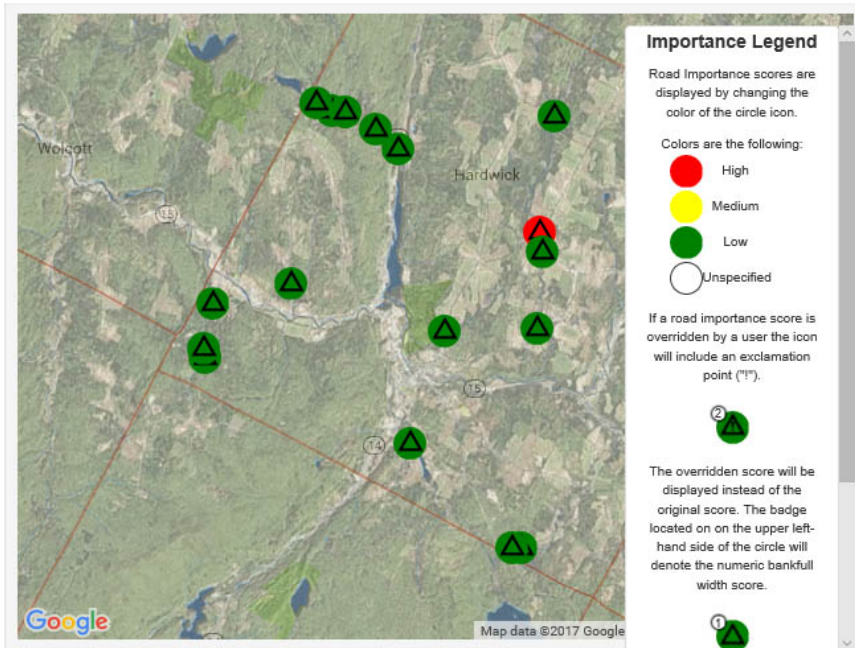
Class 1	Class 2	Class 3	Class 4	State Hwy	Fed Hwy	Interstate	Total 1, 2, 3, State Hwy
1.5	10.4	53.03	6.92	16.5	0	0	81.8

Source: data derived from VTrans TransRDS GIS data –Town Plan 2014

4.2.2 Bridges, Culverts, and Dams

Bridges

There are 19 bridges on town highways in the VTCulverts database, but the condition, year built and other specifics have not been entered in the database. Below is the importance map of town bridges with only one rated as high importance:



Culverts

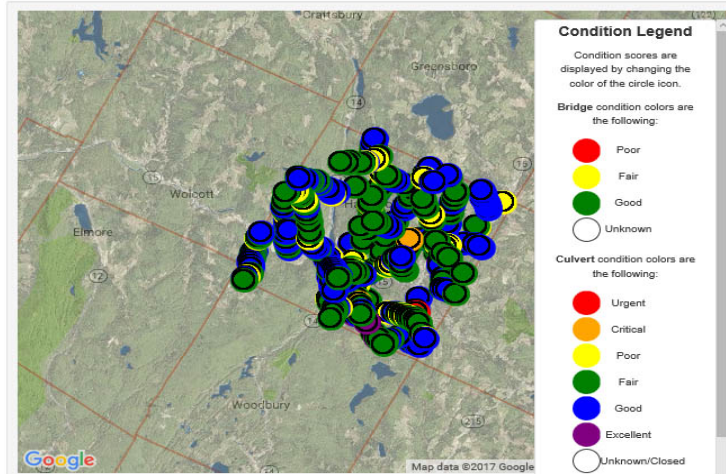
The combination of roads, steep slopes, and running water not only constitute areas of higher Road Erosion risk, it also often marks areas where the Town of Hardwick has installed and maintains culverts and bridges. VTCulverts.org shows that Hardwick has 474 culverts, with the majority found to be in fair to poor condition. The two critical culverts are on Porter Brook Road and Scott Road.

Hardwick Highway Culvert Conditions (2013):

- Excellent 6 1.3%
- Good 219 46.2%
- Fair 192 40.5%
- Poor 55 11.6%

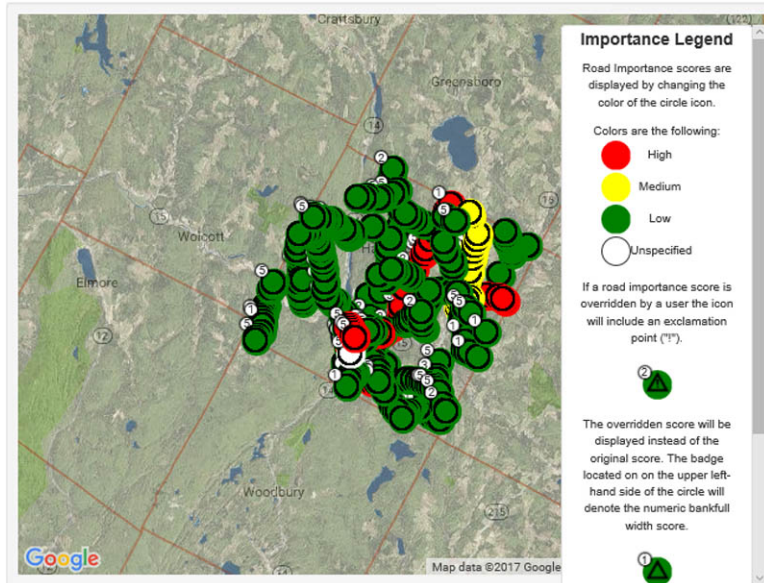
Critical 2 0.4%

Table 4-3: Hardwick Culvert Condition by Location (VTCulverts.org)



Critical (failing) means that less than 25% of the culvert was open at the time it was assessed. This is due to sediment load which is deposited during storm events. Undersized or “plugged” culverts often result in storm runoff flowing over the road or highway, rather than under it, and damaging or even washing out the roadway. The Northeastern Vermont Development Association (NVDA) annually assists towns in updating their culvert data by hiring consultants to do the field work using GIS and then uploading this to the VTCulverts. The VTrans Maintenance Districts ideally want an inventory done every three years, but NVDA can only do 4-5 towns per year. NVDA is working to get towns to use VTCulverts to input their annual updates so that they will always have an up to date inventory. NVDA did a training in January 2014 which was attended by the Head of Hardwick’s Public Works Department.

Table 4-4: Vulnerability Ranking Map for Hardwick Culverts



Source: <https://www.vtculverts.org/structures>

Dams:

There are two dams located in the Town. The Mackville dam is located on Nichols Brook on the southeast side of town and was rebuilt in 2004. The Jackson dam is located on the Lamoille River on the southwest side of town downstream of downtown and the industrial park. Neither of these dams provide electrical generation. There is no electrical generation in the Town of Hardwick aside from solar voltaic panels and wind generators which are all owned by private individuals.

4.2.3 Water, Wastewater and Natural Gas Service Areas

The Hardwick Community Water Supply system has two wells that supply all of the water used by the village of Hardwick. The municipal wells are located near the Hardwick Industrial Park adjacent to Wolcott Street. The East Hardwick Fire District #1 supplies water to the village of East Hardwick from springs located on Ward Hill to the south. The Town has well head protection areas and plans for providing water in case of a shortage due to unexpected circumstances. Private wells are not permitted within the water distribution area of the Urban Compact. The Urban Compact of the Village of Hardwick, now the Town of Hardwick, is served by a tertiary wastewater treatment facility built in 1978. The facility has been upgraded three times since its initial construction to increase capacity and to provide a higher level of wastewater treatment. Private septic tanks and leach fields are allowed outside of the collection area of the Hardwick Urban Compact. The Hardwick Sewer Department serves 583 customers, covering the same area as the water lines. The Hardwick Sewer Department, like the Water Department, is funded entirely by user fees and receives no money from the Town General Fund.

The wastewater treatment facility is an aerated lagoon system built in 1980. It has a rated capacity of 371,000 gallons of domestic sewage per day. The town conducted a 20-year review of the facility in 2001. While still in good shape, several upgrades to equipment were required. These upgrades will extend the life of the facility and will also make it more efficient. One requirement was the installation of a phosphorous removal system which was completed in 2007. The wastewater treatment facility is set for relicensing in 2014. Tightening of water quality standards at the state level could require further capital improvements at the facility and throughout the storm drainage system in the village area. Currently, about 1/3 of the facility's capacity is available for new users. This capacity is sufficient to accommodate some residential and industrial growth but major growth in population or a heavy industrial user could require expansion of the existing facility. The maximum capacity of the sewer system, the amount of waste that can be received and treated, affects growth by limiting the number of homes and businesses that can hook onto the system. One significant area of concern is the age of the wastewater collection system. Some of the sewer lines date back 100 years or more. Town staff have identified streets where sewer lines have partially collapsed, but the Town has made significant efforts to slip line and replace bad sections of piping and that effort will continue until all damaged lines have been repaired. Outside of the village service area, all sewage is treated via individual, on-site septic systems. Permitting and enforcement of these systems is the responsibility of the State Department of Environmental Conservation Regional Office in St. Johnsbury.

4.2.4 Electric Power Transmission Lines and Telecommunications Land Lines

The Town of Hardwick owns its own power company, the Hardwick Electric Department, which provides power to 5 communities in 3 different counties. It serves 90% of Hardwick with the remaining 10% served by Washington Electric. There are two cell towers located in Hardwick, one on Hopkin Hill on the Claire and Rod Mayo farm and one located off from Bridgman Hill on the Wendell and Beverly Shepard Farm.

4.3 Estimating Potential Losses in Designated Hazard Areas

Three properties in Hardwick have received repetitive damage over the past twenty-four years. Although the FIRM maps have been recently updated, they are not compatible with the GIS maps containing contour, rivers, roads and structures and it is not possible to accurately estimate the amount of potential loss at this time. Given the frequency of flooding in Hardwick, it is recommended that the base flood elevations for the NFIP maps be confirmed and that 1' contour maps for the Village area be obtained that are geo-referenced to Vermont Geographic Information System standards based on orthophoto mapping. Accurate FIRMS combined with the contour maps will make it possible to specifically identify what are structures and areas will be impacted by flooding. If one percent (1%) of all properties in Hardwick were damaged, the value would be assessed at \$1,865,826 based on the equalized Grand List. If all structures in the Flood Hazard Area were inundated and averaged \$50,000 of damage per structure, the estimated damage total is \$3,900,000.

4.4 Land Use and Development Trends Related to Mitigation

Hardwick has grown minimally since 2005. While the Census shows a 5.1% drop in the population over the past 10 years, the number of housing units actually increased slightly by 1.1%. The town and village have zoning regulations in place to guard against future development in inappropriate locations such as flood prone areas. Due to the increasing commercial activity on Route 15, and the fact that there are frequent problems due to flooding and traffic accidents, Hardwick has taken action to develop traffic calming in this area. All development strategies are carefully reviewed by the Zoning Planning Commission, and specific physical projects are reviewed by the Development Review Board. Many upgrades in commercial structures are being required to include fire safety features. All buildings being improved in or near frequently flooded areas are required to elevate or provide additional mitigation measures. The following list represents current town policies that support Hazard Mitigation:

- Vermont Statutes Act No. 16 became effective on May 6, 2013. It is an act relating to municipal and regional planning and flood resilience. It states that as of July 1, 2014, municipal and regional plans must contain a Flood Resilience Element. To encourage flood resilient communities the goals in Act 16 are:
 - a) New development in identified flood hazard, fluvial erosion, and river corridor protection areas should be avoided. If new development is to be built in such areas, it should not exacerbate flooding and fluvial erosion
 - b) The protection and restoration of floodplains and upland forested areas that attenuate and moderate flooding and fluvial erosion should be encouraged.
 - c) Flood emergency preparedness and response planning should be encouraged
- The Town currently regulates development in the Special Flood Hazard Area in accordance with FEMA's minimum standards. If new development is to occur in the SFHA, it must meet certain standards, such as elevation and floodproofing. While minimally compliant flood hazard regulations will allow property owners to purchase flood insurance at more affordable rates, the regulations should not be seen as an effective way to minimize flood risks
- In the event either critical facility is repaired or improved at an expense that represents more than 50% of the value of the structure, the facility should be floodproofed or elevated to the 500-year flood elevations
- The Local Emergency Operations Plan (LEOP) establishes lines of responsibilities in the critical hours immediately following a disaster. This information is particularly important in coordinating responses through mutual aid towns, and regional and state entities. The LEOP is updated and adopted annually after Town Meeting Day

4.4.1. Proposed Land Use

The 2016 Unified Development Bylaws hold to the recommended practices under the NFIP and all continued compliance and participatory requirements are managed by the Zoning Administrator. The Administrative Officer (AO) enforces the flood hazard regulations, which are integrated with the City's zoning regulations. The AO receives and reviews permit applications and forwards for board review as appropriate. In accordance with FEMA requirements, the AO maintains records of all permits issued for development in areas of special flood hazard; elevations, in relation to mean sea level, of the lowest floor, including basement, of all new or substantially improved buildings; elevations, in relation to mean sea level, to which buildings have been flood proofed; flood proofing certifications; and all variance actions, including justification for their issuance.

4.4.2. Land Use Goals

The town is committed to retaining its rural character and its economic base of working farms and productive forests without hampering the landowner's ability to profit from either the use or sale of his or her assets. Additionally, In order to achieve the goals of the town plan, the Town of Hardwick is divided into seven districts with two overlay districts. These districts include: Central Business District, Village Neighborhood, Highway Mixed Use, Compact Residential, Industrial, Rural Residential, and Forest Reserve, as well as the two overlay districts of Flood Hazard Area and Wellhead Protection Area. The plan attempts to classify the town into various districts based on current land uses, characteristics identified in earlier chapters, conversations with neighbors and residents, and by using common sense.

4.4.3. Land Use Strategies

The town will continue to encourage stewardship of its natural resources through information and education and promote viability of resources through Current Use, Vermont Land Trust and Local Vermont products. The town supports initiatives which will make farming and forestry more economically viable into the future.

4.4.4 Future Development and Housing

Despite the advantages of attracting new businesses and housing, the town does not foresee major development occurring in the next five-year planning cycle nor has there been significant development since 2005. Therefore, there has not been a change in vulnerability nor is one perceived in the current planning cycle. As part of the Central Business District Plan, one issue with future land use in this district lies with vacancies in a couple of older buildings. Though few, these buildings are in conspicuous locations which challenge the vibrancy of the area. Continued development of new shops and restaurants will enhance the appeal of the area. Future development in Hardwick should be timed so that the demands placed on community services will not result in them being overburdened. The Town has a responsibility to its taxpayers and residents to continue to provide the highest level of service while keeping costs under control. Future development - both residential and non-residential - should be encouraged in a manner that is sensitive to this responsibility.

Housing

Single-family units are the predominate form of housing in Hardwick. A breakdown of housing from the Grand List records is as follows:

- 644 residential homes on 6 or less acres
- 243 residential homes on 6+ acres
- 73 mobile homes without land
- 134 mobile homes with land
- 13 vacation homes on 6 or less acres
- 35 vacation homes on 6+ acres
- 26 operating farms
- 11 commercial apartments

According to the 2010 Census, there were 1,423 housing units in Hardwick. Of these units, 1,239 are occupied, with 909 being owner-occupied, and 330 renter-occupied. The most recent American Community Survey 5-Year Estimates shows a lower housing unit count of 1,335, probably because it is based on a sampling averaged over multiple years. Nevertheless, the ACS data does shed some light on the overall makeup of Hardwick's housing stock: Single family homes account for about 90% of Hardwick's housing stock (936 single family detached houses, 17 single family attached units, and 265 mobile homes.) The remaining are duplexes (26) and multi-unit housing (91 units). There was a drop in seasonal housing units, from 72 units to just 60. The difference may be attributed to a decrease in average household size, from 2.61 persons in 2000 to 2.41 persons. Hardwick's decline in household and family size is similar to Caledonia and other parts of Vermont. There were 77 building permits issued in Hardwick in 2010, 69 permitted units in single-family buildings, and 8 permitted units in multi-unit buildings. Interestingly, Hardwick's projected population for 2011 shows another slight decrease from the 2010 Census (2014 Town Plan).

SECTION 5: MITIGATION STRATEGIES

In understanding that a requirement for this update is to explain what the town has accomplished in relation to the actions identified in the 2005 plan, the town must address this requirement by explaining that there was very little adherence or attention to the 2005 plan and the actions established in it were general. The greatest advancement in mitigation planning the town has achieved since 2005 has come from the direct experiences in responding to, and recovering from, the major disasters that have impacted the town in the last decade. These disasters, have, to a very large extent, redefined how the entire state views and addresses mitigation. The work of state agencies, including those devoted to transportation, planning and emergency management have also changed the way towns go about their day-to-day operations and planning, both in emergency situations and out. It is because of this that the town views this update as the new standard in their mitigation planning efforts. This plan allows for the systematic documentation of efforts in the next planning cycle in formats that the town will continue to use. There has not been a formula for ongoing, documented, mitigation efforts prior to this update. The implementation matrix captures specific progress in certain areas but more importantly, gives the

town a guide from which all future action and updates can be based on. Since 2005, the town has accomplished the following:

1. The Town has adopted a zoning ordinance that includes the designation of a Flood Hazard Area and associated regulations. Hardwick is in the National Flood Insurance Program (NFIP).
2. A series of granite ice retention structures have been placed in the Lamoille River north of the village to prevent ice jams.
3. All culverts are being upgraded to meet the State Highway Standards and the State Highway Standards policy has been adopted for all new construction. Kate Brook Road is usually the hardest hit and has had three culverts upgraded through FEMA funds. Smith Farm Road is the last area in the community to be upgraded with a large box culvert through the Vermont Transportation Agency (VTRANS) Bridge and Culvert Program. Gabian Baskets have been used on some roads for erosion control. Bunker Hill has had the road collapse but the town is working with USDA Rural Development on mitigation strategy. A Driveway and Culvert policy is in effect for private driveway access.
4. New downtown buildings have installed sprinkler systems and firewalls. Older buildings are at risk and are upgrading to sprinkler systems.

5.1 Town Goals and Policies that support Hazard Mitigation

5.1.1. *Community Goals*

- a. Minimize the risk exposure and associated expense to Hardwick residents
- b. Take advantage of the UVM/ACCD mobile home park preparedness programs to support resiliency of this disproportionately impacted population during disasters.
- c. Consider implementation of special population tracking within the community where-by residents unable to drive or that have no one to depend on can self-identify for inclusion in a maintained data-base so that rescue personal and emergency managers can account for this demographic.
- d. Ensure that the Town and its facilities are prepared to meet the demands of the next flood.
- f. For Hardwick to have safe and affordable housing available in a variety of types for all incomes, ages, and for those with special needs.
- h. For Hardwick to have a diverse and resilient economy based on agriculture, small business, and light industry that is compatible with Hardwick's scenic landscape and will raise income levels and provide employment for Hardwick residents.
- i. For Hardwick to be a regional center for commercial activity and employment.

5.1.2. *Capital Improvement Goals*

- a. Provide services and facilities deemed necessary for the orderly and rational development of the Town.
- b. To ensure adequate facilities and services are available to protect and enhance the lives of the residents, visitors, and businesses of Hardwick. the voters.

5.1.3. Public Participation Goals

- a. Continue to solicit input regarding planning issues from town residents and from other entities which can help to offer solutions and insight into the problems the Town faces both now and in the future via formal meetings and advertised opportunities for input.
- b. Utilize the LEPC and NVDA to increase awareness, enhance planning and engage in exercises that address needs in the community.

5.1.4. Regulatory Devices Goals

- a. Continue to use the Zoning Bylaw. The bylaws have been established to conform to, and be in harmony with, the Vermont Municipal and Regional Planning and Development Act. Any conflicts that are identified between the two documents will defer to Title 24 VSA, Chapter 117 as the prevailing authority
- b. Maintain and continue a Capital Expense Budget and Program for the purpose of ensuring that the rate of growth does not outstrip the town's ability to pay for the associated necessary services such as roads, schools, police and fire protection, solid waste, etc.
- c. Develop and maintain a "No Adverse Impact" (NAI) approach to flood hazard management by institutionalizing the best practices set forth by the ASFPM.
- d. Utilize best practices in flood-plain management for farm-related development in town.

5.1.5. Land Use

- a. Work to develop a Flood Hazard Area Overlay District to include all designated flood hazard areas. The purpose of the Flood Hazard Area Overlay District is to (1) protect public health, safety, and welfare by preventing or minimizing hazards to life and property due to flooding, and (2) to ensure that private property owners within designated flood hazard areas are eligible for flood insurance under the National Flood Insurance Program (NFIP).
- b. The Planning Commission and Select Board should review all 'Act 250' applications for its impact on community facilities and services in town. Where the application is determined to not conform to this chapter or any goal or policy, the Planning Commission or Select Board should participate in the 'Act 250' process in order to ensure the concerns of the town are addressed.
- c. Maintain Hardwick's present patterns of land use: dense residential and commercial uses concentrated in Hardwick village and East Hardwick and sparsely developed agricultural and forest land outside these village centers, with a rural and natural skyline.

5.1.6 Natural Resources

- a. Ensure that the existing health ordinance is enforced to maintain protection of both surface and groundwater supplies.
- b. Ensure that permits issued for development near sensitive areas, such as steep slopes, high elevations, wetlands, scenic vistas and wildlife habitats, contain conditions assuring conformance to the goals set forth by the state of Vermont and when applicable and feasible, those defined as best practices by floodplain management organizations such as the ASFPM as well as those set forth in this plan and the most recent town plan.
- c. The town should work with the NVDA and ACCD to continue the process of identifying the Town's land conservation priorities, and to the degree possible, link them to broader regional conservation work.
- d. In line with the VTTrans mission statement regarding climate change, the town remains committed to:
 - Ensure that there are viable alternative routes around vulnerable infrastructure such as bridges and roadways
 - Make safety a critical component in the development, implementation, operation and maintenance of the transportation system
 - Develop contingency plans for a wide-variety of climate impacts to be implemented as data/information becomes available
 - Utilize information technology to inform stakeholders during times of emergency
 - Educate of the public and other stakeholders on the threats posed by climate change and fluvial erosion hazards
 - Increase inspection of infrastructure if warranted by climate change indicators
 - Apply a decision-making framework to incorporate cost-benefit analyses into adaptive plans and policy
 - Work to protect essential ecosystem functions that mitigate the risks associated with climate change
 - Educate individuals within the agency to use best-practices during recovery periods to avoid ecological damage that may further exacerbate risk
 - Recognize the interconnected nature of our built environment with ecological processes
 - Protect the state's investment in its transportation system and adapting transportation infrastructure to the future impacts of climate change
- e. In line with DEC's best practices regarding fluvial erosion, the town will work to:
 - Slowing, Spreading, and Infiltrating Runoff (The State Surface Water Management Strategy is found at <http://www.watershedmanagement.vt.gov/swms.html> and <http://www.watershedmanagement.vt.gov/stormwater.htm>)
 - Avoiding and Removing Encroachments. http://www.watershedmanagement.vt.gov/rivers/htm/rv_floodhazard.htm

http://www.watershedmanagement.vt.gov/rivers/docs/rv_RiverCorridorEasementGuide.pdf

- River and Riparian Management: DEC has prepared a compendium of *Standard River Management Principles and Practices* to support more effective flood recovery implementation; improve the practice of river management; and codify best river management practices in Vermont. The document compiles the most current river management practices based on the best available science and engineering methods to create consistent practice and language for risk reduction while maintaining river and floodplain function. Best practices are established to address common flood damages, including:
 - Erosion of banks adjacent to houses and infrastructure
 - Erosion of road embankments
 - Channel movement across the river corridor
 - River bed down-cutting that destabilizes banks, undermines structure foundations, exposes utility crossings, and vertically disconnects rivers from adjacent floodplains
 - Bridge and culvert failure

Source: http://www.watershedmanagement.vt.gov/permits/htm/pm_streamcrossing.htm

5.1.7. Policies

a. Through both town and state-level management, the town will work to:

- Encourage and maintain naturally vegetated shorelines, buffers and setbacks for all rivers, ponds and streams
- Allow higher density or cluster development in existing and designated settlement areas and low-density development in the remaining areas
- Reduce flood hazard and repetitive road and driveway washout through continued updates and adherence to priorities in road, bridge and culvert improvement projects
- Identify and manage pollution, flooding and fluvial erosion hazards along rivers and streams as they arise

5.1.8. Transportation Plan

In adjunct to town-specific planning, the town is committed to continually subscribing to all current state standards related to:

- a. Maintaining safe operating conditions on the present system of town roads through design and modification to keep traffic at appropriate speeds and to assure the safest possible driving conditions, including consideration of additional paving (though only on portions of roads prone to damage) should state funding become available.
- b. Protection of existing town roads from flood damage and uncontrolled storm water runoff.
- c. Preserving the capacity of town roads and maintain adequate traffic flows and safety.
- d. Support the road maintenance crew through Town-provided training sessions. This includes ICS training along with the Road Commission (Selectboard).

- e. Support policies and procedures that ensure longevity of essential town-equipment and develop and maintain MOU's with neighboring towns related to equipment use during emergencies.
- f. Continue long term access opportunities to gravel and sand deposits for future road maintenance use.
- g. Consider developing a standard operating procedure (SOP) based on ICS principles for highway department response events were coordination, communication and support are at a heightened level.

5.1.9. Utilities and Facilities Goals

- a. For residents and visitors of Hardwick to have access to a range of broadband opportunities.
- b. For mobile telecommunication services to be available at a variety of frequencies, including cellular, PCS, and "WiFi", to meet a variety of information and communication needs.
- c. For Hardwick to have 100% coverage for DSL, cable, and cellular phones in town by 2018.
- d. Develop policies and procedure that ensures equipment longevity to the greatest extent possible.
- e. Sewage and septic: All wastewater in Hardwick is appropriately treated so as to protect public health.
- f. Water: All household water supplies should be clean and be of an adequate supply.
- g. Public safety: To provide a safe environment in which to work, live, and play.
- h. Health facilities: For Hardwick to continue to have a variety of quality local health care options.
- i. Child care: To have quality affordable local child care opportunities in Hardwick.
- j. Solid waste facilities: For Hardwick's residents and businesses to responsibly dispose of solid waste including efforts to reduce the amount of waste generated and increase recycling.
- k. Storm drainage: To provide storm drainage facilities as needed for the proper treatment of storm runoff.

5.1.9.1. Educational Goals

- a. The School Board should work with the Selectboard, the American Red Cross and Fire Department to ensure that the necessary equipment exists at the school for its use as an emergency shelter.
- b. Increase emergency planning cohesion between school and town EOPs through mutual participation and presentation at scheduled LEPC meetings and town and/or school meetings.
- c. Continue collaboration with the Vermont Chapter of the American Red Cross on their sheltering initiative program to further readiness with training and supplies related to sheltering operations.

5.2 Existing Town of Hardwick Actions that Support Hazard Mitigation

The town has done an excellent job at monitoring and addressing transportation issues, engaging in a documented and systematic approach to mitigation actions. The Selectboard has successfully pursued funding to address needs. Exemplified by Better Back Roads, Structures Grants and FEMA funding, the town has been able to enhance its resilience and overall preparedness. The town has addressed its current and future needs and by and large, road improvement projects remain the primary focus for the town and the areas identified were selected based on the condition of culverts and ditches and primarily focused on runoff issues particularly as the incidence of heavy storms has increased. In many cases, culverts properly sized for normal rain events are overwhelmed by the severe ones. The town will seek local, state and federal funds to address the sites identified as priorities. Hardwick will earmark the funds necessary to complete one major project each year for the next 5 years and will keep its culvert inventory current to improve its institutional memory. The town currently participates in the NFIP program and will continue to regulate floodplain use through the Hardwick Zoning Bylaw and application regulations concerning floodplain development which were adopted on 05/17/2012. These regulations are enforced using the FEMA FIRMS maps last revised in 07/17/2002. The ongoing enforcement of these regulations maintains the town's compliance with the NFIP with the Hardwick Zoning Administrator being the 'Administrative Officer' charged with implementation. The town will continue to enforce these regulations to maintain future NFIP compliance. There are 34 NFIP insurance policy holders within the town, 30 of which are located in the 100-year flood zone. 56 claims have been filed since 1978, with \$263,307 in payouts, since 1978. The town has also adopted municipal road and bridge standards that meet or exceed the 2013 standards and has an approved and adopted Local Emergency Operations Plan and Town Plan. Related to flood resilience goals and strategies, the (date) Town Plan states:

5.2.1. Flood Resilience Goals:

- Mitigate Hardwick's flood hazards in the most cost-effective manner possible
- Minimize the risk exposure and associated expense to Hardwick tax payers
- Ensure the Town and its facilities are prepared to meet the demands of the next flood
- Ensure the Town can receive the maximum outside assistance in the event of the next Federally declared disaster

5.2.2. Flood Resilience Strategies:

- Identify and protect Hardwick's natural flood protection assets, including floodplains, river corridors, other lands adjacent to streams, wetlands, and upland forested cover
- Adopt flood hazard regulations that at a minimum, protect property from known risks
- Review and evaluate statewide river corridor information, when it becomes available
- Consider adopting regulations that will protect erosion prone areas for additional Development and encroachment
- Maintain and regularly update the Local Emergency Operations Plan.
- Continue to meet the VTrans Road and Bridge standards. Participate in regional Road Foreman trainings and Transportation Advisory Committee meetings to stay abreast of flood resilience measures for the Town's roads and bridges
- Continue to update the Town's transportation infrastructure information in the Vermont Online Bridge and Culvert Inventory Tool

- Upgrade undersized and failing culverts
- Maintain the Local Hazard Mitigation Plan
- Equip the town’s emergency shelter (the school) with a generator

5.3 Town of Hardwick All-Hazards Mitigation Goals

The following goals were developed by the planning team, vetted during a warned community meeting and approved by the Town of Hardwick during the development of this plan:

- 1) Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
- 2) Mitigate financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
- 3) Maintain and increase awareness amongst the town’s residents and businesses of the damages caused by previous and potential future hazard events as identified specifically in this Local All-Hazards Mitigation Plan.
- 4) Recognize the linkages between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and storm water management and the planning and development of various land uses.
- 5) Maintain existing municipal plans, programs and ordinances that directly or indirectly support hazard mitigation.
- 6) Develop a mechanism for formal incorporation of this Local All-Hazards Mitigation Plan into the municipal comprehensive plan as described in 24 VSA, Section 4403(5). This mechanism will be developed by the Planning Commission, Selectboard and NVDA and integrate the strategies into the existing town plan as annexes until the next formal update occurs, where a section devoted to mitigation planning will be integrated into the plan.
- 7) Develop a mechanism for formal incorporation of this Local All-Hazards Mitigation Plan particularly the recommended mitigation actions, into the municipal/town operating and capital plans & programs as they relate to public facilities and infrastructure. With the development of the road erosion site inventory, the town will begin a process that incorporates the budgetary requirements of the defined mitigation strategies into its formal budgeting paradigm. The Planning Commission will review the LHMP and use language/actions from it to inform the integration and update process. Town Meeting Day will serve as the formal time that mitigation strategy budgetary considerations will be approved and incorporated into the town budget.

5.4 Mitigation Actions

In following FEMA guidance, the following mitigation action categories form the basis of the town’s future mitigation actions. The planning team decided to adopt this approach for all future

mitigation work. For each mitigation action to follow, an indication of group will be given with the abbreviations below:

Mitigation Action Groups:

(P) Prevention: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.

(PP) Property Protection: Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter-resistant glass.

(PEA) Public Education & Awareness: Actions to inform and educate citizens, elected officials, and property owners about potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.

(NRP) Natural Resource Protection: Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

(SP) Structural Projects: Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms

5.4.1. Current Capabilities, Progress since 2005 and Need for Mitigation Actions

The Town Plan’s goals and policies that support hazard mitigation and the existing mitigation actions demonstrate the variety of policies and actions forming the foundation of this All Hazards Mitigation Plan. As with most towns in the state, mitigating flood-prone areas is a continuous effort that sees increased attention following a major event. Specific priorities have changed since 2005 by the nature of time that has passed. Many infrastructure issues in 2005 have been addressed in the natural progression of maintenance but also in response to the declared disasters since 2005. The table below summarizes the status of actions that the town set forth to accomplish since 2005. Priority categories (e.g. flood resilience) have, however, essentially remained the same since 2005.

Table 5:1 Progress in Mitigation Efforts since 2005

2005/2011 goals	Status
-----------------	--------

Adopt a zoning ordinance that includes the designation of a Flood Hazard Area and associated regulations and is in the National Flood Insurance Program (NFIP).	Completed
Review NFIP Maps and confirm base flood elevations. Get digital maps. (2011 goal)	Completed
Update Rapid Response Plan	No longer relevant. Replaced by LEOP.
Fluvial Erosion Mapping	Complete
All culverts are being upgraded to meet the State Highway Standards.	Ongoing
Engineering study to prevent ice flow backup west of Village area.	Complete
Create Evacuation Plan for businesses and residences in the Flood Hazard Area	Still needed

Note: While the 2011 Update was not submitted, the goals are considered viable and the town has put effort into accomplishing them based on need.

Current Capabilities

- 1) Severe Winter Storm: The Town regards its current hazard mitigation efforts carried out by the road departments as adequate to address winter storm impacts to local roads, however temporary road closure due to winter storms may isolate parts of town. Winter/Ice storms are often the cause of the power loss and telecommunications failure.
- 2) High Winds: The town owns and operates the electric utility and is responsible for restoring service when disrupted. All public assistance for the electric service branch of town government is reserved for restoration only. Tree trimming and vegetation management, coupled with maintaining adequate repair vehicles and personnel are the primary means of mitigation in non-response times. The town can incorporate the use of public information to support community resilience during a power outage. The town will develop a plan for mass communication during an extended outage if telecommunication lines are down, this will provide a method for alerting residents of the alternate means of information dissemination and/or protocol (e.g. shelter logistics).
- 3) Flooding: Major infrastructure that has seen repeated damage, however minor, due to flooding is a concern for the town and they are active in identifying priorities, working with State Transportation and Natural Resource Agencies as a means to increasing infrastructure resilience. NFIP maps have been digitized, base flood elevations are confirmed case-by-case and fluvial erosion mapping has been accomplished. Funds have been set aside to remove ice with excavator before flooding occurs in prone areas. Upsizing culverts and stone-lining ditches is consistently being accomplished to mitigate high-risk areas in addition to controlling new development in floodplains.

- 4) Hazardous Materials: Communication and relationships with facilities is established for future planning. With the availability of Hazardous Materials Emergency Preparedness (HMEP) funding available to the local LEPC, there is an opportunity to learn more about what types of chemicals are being transported through the town and what response mechanisms may need to be in place.
- 5) Extreme Cold: The town is aware and has formally documented its awareness and intentions to assist to the best degree possible the logistical and economic factors related to vulnerabilities associated with extreme cold durations.

5.4.2. Specific Mitigation Actions

The following seven actions define the mitigation measures to be taken by the town in the next five years.

- Action #1: Improve road infrastructure and municipal systems protection programs
- Action #2: Improve resilience to severe winter storms
- Action #3: Reduce impact of extreme cold durations
- Action #4: Raise public awareness of hazards and hazard mitigation actions
- Action #5: Increase resilience of mobile homes through accepted structural modifications and resident awareness of programs and opportunities
- Action #6: Continue fluvial geomorphology assessments in collaboration with DEC and develop strategies and regulatory actions in response to identified risk
- Action #7: Reduce risk and impact of hazardous materials incident
- Action #8: Reduce impact of high wind events

Each of the seven actions listed above are explained below in regard to progress, project leads and partner agencies and specific action steps:

Action #1: Improve road infrastructure and municipal systems protection programs

Group: SP, NRP, PP

Lead Responsible Entity: Town of Hardwick Road Foreman and Selectboard

Potential Partner Entities: Vermont Agency of Natural Resources; Vermont Agency of Transportation; NVDA, DEMHS, FEMA and the Agency of Commerce and Community Development

Timeframe: Winter 2017 – Winter 2022

Funding Requirements and Sources: FEMA or other hazard mitigation grants; FHWA grants; VAOT grants; Municipal Operating and Capital budgets.

Progress: The Road Foreman continually monitors road and storm water management capabilities. Since 2005, all bridges and culverts have been electronically accounted for and the town is diligent in maintaining a comprehensive and newly-formed, Road Erosion Site Inventory Plan that serves to guide action by identifying areas of road erosion, estimated costs of repair and

future needs. In 2015, the University of Vermont released Scour research and opportunities for scour sensors.

Specific Identified Tasks:

- 1) Infrastructure Assessment for Storm Water Vulnerability – Funding and staff resources permitting, assess the vulnerability and operational capability of municipal-owned roads, culverts and other storm water management infrastructure to predicted storm water and snowmelt in areas with a documented history of recurring problems. The infrastructure will be evaluated regularly prior to replacement or upsizing of the existing infrastructure.
- 2) Continued Monitoring of Vulnerable Infrastructure - Monitor bridges and culvert locations that have erosion and scouring concerns and track via the Road Erosion Site Inventory.
- 3) Road Improvements and Landslide Protection - Within political and financial restraints, re-engineer certain sections of roads to lower overall maintenance costs, improving snow plowing speeds and improve overall capability of roads to handle current and projected traffic volumes. Specific projects, numbered by priority (details included in Road Erosion Site Inventory) include:
 1. Cobb School Road (800’), Bunker Hill Road (1200’), Browns Farm Rd. (700’), Ward Hill (600’): All of these locations will receive ditching and stone enhancement work and if required based on substantiated need, upgraded culverts. Stone size for ditching will be in line with AOT standards.
 2. Complete planning study to assess efficacy of installing duckbill gates on storm drains in Village along Cooper Brook near Bridge 43 and 66. Also assess efficacy and feasibility of lowering elevation south of river and/or dredging.
 3. Develop procedure for ongoing lockdown of manholes during high-rain events
 4. Assess efficacy and feasibility of installing and maintaining drop-down barricades for water treatment facility.
 5. Assess and develop plan to protect structures in NFIP
 6. Increase capability of HED to mitigate outages through budgetary allotment, planning and consistent mitigation of risk variables.
- 4) Documenting – Develop a methodology that serves to efficiently capture work and expenditures on sites and keep this information at the town office.
- 5) Increase Awareness of Funding Opportunities - Increase understanding of FEMA’s HMGP program so that this potential funding source can be utilized through trainings and communication with the State Mitigation Office.
- 6) ICS Training and Emergency Operations (SOP) Plan Development – Enhance knowledge of the principles of ICS and develop a Standard Operating Procedures that details the relationship, roles and responsibilities of the Highway Department and Road Commission during major events.

Rationale / Cost-Benefit Review: Conducting vulnerability assessments facilitates a targeted and effective approach to road and storm water management infrastructure. This will prove useful in the development and implementation of municipal capital and operating plans as well as the development and implementation of grant-funded mitigation projects. Some areas suffer low-level but consistent damage during heavy rains and snowmelt. Mitigating against these problems would reduce short and long-term maintenance costs and improve the flow of traffic for personal and commercial purposes during flooding events. Tracking road work and understanding the

HMGP program can open funding streams into the town and can make the application process much easier when required information is already available. A basis understanding of ICS will serve the town and at little or no cost. As a requirement for an approved LEOP, municipal ICS-awareness is seen as necessary state-wide. During an emergency event when the Highway Department personnel are required to work beyond normal capacity, increased communication and collaboration between the Highway Department and local entities can be enhanced with a basic SOP. An SOP can also serve to increase institutional memory when there are staff changes at every level as well as provide a template from which tabletops and drills can be based off of.

Action #2: Maintain and improve resilience to severe winter storms

Group: SP, PP, PEA

Primary Responsible Entities: Town of Hardwick Selectboard, Planning Commission and Emergency Management director;

Potential Partner Entities: LEPC, Hardwick Fire Chief, ARC's Sheltering Initiative Program

Timeframe: Winter 2017 – Winter 2022

Funding Requirements and Sources: DEMHS or FEMA hazard mitigation funding; existing programs, contingent on available resources and funding.

Progress: Roads are monitored and altered, when necessary so that plowing can occur without damage to trucks and/or road. _____ has been identified as the primary emergency shelter. The school does have an emergency generator. The _____ is the secondary shelter and it does have a generator in place. The Fire Department is the third. Snow clearing equipment is regularly serviced and the town maintains an adequate supply of salt.

Specific Identified Tasks:

- 1) Maintain Existing Shelter Capability: Maintain and improve capabilities of existing shelters. Notification procedures and shelter staffing is a priority for the town and intends to move forward on planning and public involvement. More formalized training is required and the ARC's "Shelter Initiative Program" can be used at no cost to the town to enhance both shelter management knowledge and sheltering supply cache.
- 2) Reduce risk of power failure due to ice storms: Enhance collaboration between town road foreman and electric company related to down-limbed induced power failure. Maintain function of generators.
- 3) Notification: Develop a notification/communication plan that conveys essential sheltering information using school phone system and back-up methodology (email, text, etc.)
- 4) Residential Programs: Provide guidance and communication to residents on the structural and mechanical actions that can occur to reduce risk to severe winter storms (e.g. weather-proofing, anchoring, alternative heating sources, tree trimming, financial programs, etc.)
- 5) Continue to monitor roads for safe and effective plowing: Efficient snow removal is the foundation to winter storm (snow) events, assuring roads are plowable before winter remains an important facet of highway department functions
- 6) Increase awareness of ICS structure and recommended practices: The town can mitigate the effects of a severe winter by understanding how a large-scale storm is managed when the State EOC is operational. Additional awareness of local-level roles and responsibilities during statewide event is a mitigation action.

Rationale / Cost-Benefit Review:

This mitigation action serves to reduce the economic impact and risk to both human and animal (livestock and pet) health and safety during severe winter storm events by reducing risk and enhancing the mechanisms of winter storm mitigation in the long term. More formalized policy formation in both staffing and notification procedures, especially pertaining to vulnerable populations where transportation and special needs are a concern could potentially significantly reduce the physical, psychological and social impacts of a disaster.

Action #3: Reduce impact of extreme cold durations

Group: PEA, PP, SP

Risk or Hazard Addressed: Risk to infrastructure, livestock and residents

Primary Responsible Entities: Town of Hardwick Selectboard and planning commission, NVDA, Hardwick School, local/regional assistance organizations.

Potential Partner Entities: Vermont DMEHS, LEPC

Timeframe: Summer 2018-Summer 2022

Funding Requirements and Sources: Financial factors may produce barriers to change. Strategic planning and understanding of the total scope of needs and potential for change is logical first-step.

Specific Identified Tasks:

- 1) Economic Resilience: Establish program for assistance in paying heating bills during crisis situations, if not already required by state law. Develop and sustain a program that serves to connect resource organizations with residents in need of support services.
- 2) Maintain Existing Shelter Capability: Maintain and improve capabilities of existing shelters. Notification procedures and shelter staffing is a priority for the city and intends to move forward on planning and public involvement. More formalized training is required and the ARC's "Shelter Initiative Program" can be used at no cost to the town to enhance both shelter management knowledge and sheltering supply cache.
- 3) Assess Vulnerable Population— Develop an awareness of the most at-risk community members during an evacuation and/or sheltering event. Focusing on those that lack resources or capability to reach facilities when in need and create plans, including outreach protocol on how to address this potential hurdle.
- 4) Notification and Education – Investigate and develop a notification/communication plan that conveys essential sheltering information. Educating citizens regarding the dangers of extreme cold and the steps they can take to protect themselves when extreme temperatures occur by sustaining a process that serves to disseminate educational resources for homeowners and builders on how to protect pipes, including locating water pipes on the inside of building insulation or keeping them out of attics, crawl spaces, and vulnerable outside walls. Inform homeowners that letting a faucet drip during extreme cold weather can prevent the buildup of excessive pressure in the pipeline and avoid bursting through a yearly public service campaign.

Rationale / Cost-Benefit Review:

With an increase in extreme weather, including cold, there is a need to protect property and the population. Given the magnitude of population dependence on social services, indicating

economic and other social vulnerabilities, effective outreach, education and collaboration with resources supports this mitigation action category.

Action #4: Raise public awareness of hazards and hazard mitigation actions

Group: PEA

Risk or Hazard Addressed: Risk to property, residents

Lead Responsible Entities: Town of Hardwick, Fire Chief, LEPC, NVDA

Potential Partner Entities: Vermont state agencies and regional organizations

Timeframe: Winter 2017-Winter 2022

Funding Requirements and Sources: Majority of information is available and both state agencies and organizations can provide materials for outreach

Progress: As mitigation planning continues to integrate into normal, day-to-day operations, the town has an opportunity to engage its residents with information that will serve to mitigate several risks. The LEPC meets regularly and covers a host of topics related to emergency preparedness and raises awareness in the community about what organizations are doing around emergency response planning and chemical safety. Town meeting day can serve as an annual update and outreach opportunity as well.

Specific Identified Tasks:

- 1) Hazard Resilience for Property Owners- Develop and maintain education materials to inform property owners on how to protect their homes and businesses through accepted hazard resilience actions (e.g. securing their structures from high winds, elevating their electrical equipment/furnaces in basements, protecting from lightning strikes by grounding electrical outlets, etc.).
- 2) HMGP Awareness: Attend informational sessions on the HMGP funding opportunities for acquisition, elevation and flood-proofing projects. Work with NVDA to develop an information brochure for residents.
- 3) School Programs – Assure the school is structurally ready to handle natural hazard risks to the greatest extent possible. Continue school programs to raise student awareness of hazards, safety, preparedness and prevention. Explore establishing the school emergency notification system as the primary methodology for all emergency notification procedures and build in the contact information accordingly.
- 4) Family Programs – Continue family programs, such as car safety seat and bike safety programs, to raise family awareness of hazards, safety, preparedness and prevention.
- 5) Fire Prevention Programs – Continue National Fire Prevention Week and other programs to raise public awareness of fire hazards, safety, preparedness and prevention.
- 6) Other hazard awareness programs – Develop public awareness programs, based on all-hazards needs. Programs to address pandemic hazards, preparedness and mitigation may be appropriate as directed by the state department of health and its jurisdictional offices of local health

Rationale / Cost-Benefit Review: Improved public awareness could potentially significantly reduce the loss of life and property damage through ongoing, formal, ongoing, public information campaigns that address property protection actions (flood proofing, elevation, anchoring mobile homes/propane tanks, electric and water system elevation, electric grounding,

etc.) Improved awareness would also build understanding and public support for municipal mitigation actions to reduce potential infrastructure and liability costs.

Action #5: Increase resilience of mobile homes through accepted structural modifications and resident awareness of programs and opportunities

Group: PP, PEA, SP

Primary Responsible Entities: Town of Hardwick, NVDA

Timeframe: Fall 2018-Winter 2021

Funding Requirements and Sources: Implementation through existing programs, contingent on available resources and funding.

Specific Identified Tasks:

- 1) Collect recommendations from both UVM and ACCD programs devoted to MH resilience
- 2) Develop outreach mechanism that serves to address needs, resources and agencies that can assist the resident and/or owner of the MH. Develop and/or acquire informational brochure regarding accepted mitigation actions specific to mobile homes (e.g. anchoring home and fuel tanks, elevating electric and furnaces, etc.) and distribute to residents in most economical way. UVM program and ACCD have the recommendations and information to use
- 3) Work with NVDA to map all mobile homes in the town and use this map to assess flood risk, create risk ranking and gauge outreach accordingly

Rationale / Cost-Benefit Review:

Research in Vermont has proven that mobile homes are disproportionately impacted during disasters. The high percentage of mobile homes in the town provides requires efforts to protect these structures to the greatest degree possible. In doing so, the town is taking steps to protect its tax base as well as its residents.

Action #6: Continue fluvial geomorphology assessments in collaboration with DEC and develop strategies and regulatory actions in response to identified risks

Group: P, NRP, PEA, PP

Status: Ongoing

Primary Responsible Entities: Department of Environmental Conservation District Representative, NVDA Planners, Agency of Natural Resources (VT ANR) District Representative, Town of Hardwick Planning Commission.

Potential Partner Entities: Nonprofits, other Town of Hardwick officials, and other appropriate entities.

Timeframe: Spring 2019–Fall 2022

Progress: DEC has completed assessments for Basin ID 15 (Passumpsic). NVDA can assist in enhanced mapping of the floodplain within the town and has provided the town with updated

River Corridor Maps. The town has adopted flood hazard area zoning regulations and is considering a “no development” policy in the SFHA for the future. NFIP maps are digitized.

Specific Identified Tasks

- 1) Fluvial Geomorphic Assessments – The town will work with DEC through coordinated meetings, workshops and communication to increase understanding of current findings and develop an applicable framework to help guide decisions related to priority infrastructure work and vulnerability.
- 2) Fluvial Erosion Hazard Mapping – Develop a fluvial erosion hazard map for the waterways, using the GIS extension known as SGAT (or Stream Geomorphic Assessment Tool) for assessed stream reaches. As assessments are completed, a map of all assessed waterways in the town will be created.
- 3) River Corridor Management Plans – Using the River Corridor Maps, the town will develop an outreach strategy to residents/structures in or near the defined corridor. This communication should focus on flood resilience measures and opportunities. With the lack of repetitive loss properties in the town, the likelihood of viable HMGP acquisition projects is low but increasing awareness of this program can serve the town well.
- 4) Fluvial Erosion Hazard Mitigation Implementation - The town will draft strategies to avoid or mitigate losses from the identified fluvial erosion hazards. These strategies may include the adoption and implementation of programs, mechanisms or regulations to prevent endangerment of persons and property in riparian corridor areas from fluvial adjustment processes. Efforts could range from a relatively simple, public information campaign about the map to the adoption of a municipal ordinance or by-law that restricts development in such hazard areas.
- 5) Administrative and Zoning Regulations: Zoning administrator will work with town officials and residents to determine if a “Zero Development” policy in high flood/erosion risk areas is required in the town and progress accordingly.

Rationale / Cost-Benefit Review:

Continuing this project will require a sustained succession of grants, state appropriations and other funding to complete assessments in Hardwick. Successful completion will provide municipal and regional benefits. The municipality’s fluvial erosion areas would be adequately and electronically mapped. This will enable the municipality to make residents and businesses aware of fluvial erosion hazards and potentially lead to municipally-directed programs, mechanisms and regulations that further mitigate against this hazard, protecting existing structures and infrastructure. Identifying fluvial erosion hazard areas could also help the municipality restrict future development in hazardous areas, if that should be an advantage to the town in the future. More accurate knowledge of fluvial geomorphology will enable the community to have a better understanding of hazard areas and what mitigation measures might most effectively address those concerns. Flooding is the most common and most significant hazard that can trigger a Federal disaster declaration in Hardwick. Along with an update to the flood hazard area maps, identifying the fluvial erosion hazard areas provides improved opportunities for the community to mitigate potential losses and gauge future development initiatives. With the upcoming advent of an advanced software system (CAI), the town can begin

to develop enhanced mapping in-house using currently available data and use this resource as a guide for communication, planning and policy formation.

Action #7: Reduce risk and impact of hazardous materials incident

Group: PEA, PP, SP

Risk or Hazard Addressed: Risk to infrastructure, environment, livestock and residents

Primary Responsible Entities: Town of Hardwick Selectboard and planning commission, NVDA, Identified facilities

Potential Partner Entities: Vermont DMEHS, LEPC

Timeframe: Spring 2019-Fall 2020

Funding Requirements and Sources: Financial factors may produce barriers to change. Strategic planning and understanding of the total scope of needs and potential for change is logical first-step. Using HMEP funding to better understand scope will be explored through LEPC.

Specific Identified Tasks:

- 1) Work with facility leads on understanding risk factors and what can be done to mitigate and enhance training and skills for response to major highway accidents
- 2) Develop understanding of likely chemical characteristics and what area would be impacted under likely scenarios involving discharge/spill
- 3) Explore using HMEP funding to increase awareness, knowledge and collaboration a means to developing future mitigation actions
- 4) Explore using Homeland Security exercise planners to develop tabletop exercise based on likely scenarios

Action #8: Reduce vulnerability to high wind events with accepted best practices

Group: P, PP

Lead Responsible Entities: Hardwick Planning Commission, HED, Fire Chief, NVDA.

Timeframe: Winter 2017 –Winter 2022

Funding Requirements and Sources: Considering Hardwick Electric is a municipal service, funding provisions for this mitigation action can assessed after additional planning actions occur to understand the scope of need. Included below are the tasks that will be assessed on a benefit-cost ratio level in this planning cycle.

Specific Identified Tasks:

1. Developing and maintaining a database to track community vulnerability to severe wind: Use GIS to map areas that are at risk to the wind hazard associated with different non-hurricane conditions and identify concentrations of at-risk structures. Create a severe wind scenario to estimate potential loss of life and injuries, the types of potential damage, and existing vulnerabilities within a community to develop severe wind mitigation priorities.
2. Establish standards for all utilities regarding tree pruning around line: Incorporate inspection and management of hazardous trees into the drainage system maintenance process. Support and suggest the testing of power line holes to determine if they are

rotting. Support the inspection of utility poles to ensure they meet specifications and are wind resistant. When feasible, support burying power lines to provide uninterrupted power after severe winds. Avoid use of aerial extensions to water, sewer, and gas lines when possible. Support use of designed-failure mode for power line design to allow lines to fall or fail in small sections rather than as a complete system to enable faster restoration.

3. Public Outreach: Ensure that school and hospital officials are aware of the best area of refuge in buildings and that their plans are viable in high wind mitigation events. Instruct property owners on how to properly install temporary window coverings before a storm. Support education to design professionals to include wind mitigation during building design/modification to an extent deemed necessary.

Rationale / Cost-Benefit Review:

High winds have impacted the city and do pose a risk for infrastructure, transportation and public safety. Many mitigation actions associated with high wind risk also address and reduce risk associated with other hazards affecting the city and maintaining the functionality of the city is not only important for the city and its residents but for the region as well.

5.4.3. Prioritization of Mitigation Strategies

Because of the difficulties in quantifying benefits and costs, it was necessary to utilize a simple “*Action Evaluation and Prioritization Matrix*” in order to effect a simple prioritization of the mitigation actions identified by the town. This method is in line with FEMA’s STAPLEE method. The following list identifies the questions (criteria) considered in the matrix so as to establish an order of priority. Each of the following criteria was rated according to a numeric score of “1” (indicating poor), “2” (indicating below average or unknown), “3” (indicating good), “4” (indicating above average), or “5” (excellent).

- Does the action respond to a significant (i.e. likely or high risk) hazard?
- What is the likelihood of securing funding for the action?
- Does the action protect threatened infrastructure?
- Can the action be implemented quickly?
- Is the action socially and politically acceptable?
- Is the action technically feasible?
- Is the action administratively realistic given capabilities of responsible parties?
- Does the action offer reasonable benefit compared to its cost of implementation?
- Is the action environmentally sound and/or improve ecological functions?

The ranking of these criteria is largely based on best available information and best judgment of project leads. For example, all road improvement projects were initially identified by Road Foreman and approved for inclusion in this plan by the road commission. It is anticipated that, as the town begins to implement the goals and actions of their Mitigation Strategies, they will undertake their own analysis in order to determine whether or not the benefits justify the cost of the project. Also, most proposed FEMA HMGP mitigation projects will undergo a benefit-cost analysis using a FEMA BCA template and approved methodology.

Table 5-2: Hardwick Action Evaluation and Prioritization Matrix

Rank	Mitigation Action	Responds to high hazard	Funding potential	Protection value	Time to implement	Social and Political acceptance	Technical feasibility	Admin feasibility	Benefit to Cost	Environmental advantage	TOTAL
2	Improve road infrastructure and municipal systems protection programs	5	4	5	2	5	4	4	5	4	38
3	Improve resilience to severe winter storms	2	5	5	4	5	5	4	5	2	37
7	Reduce impact of extreme cold durations	3	2	4	2	3	2	2	3	3	24
5	Reduce impact of high wind events	3	4	5	2	5	3	3	5	1	27
4	Reduce risk and impact of hazardous materials incident	3	5	4	4	5	4	3	5	1	34
1	Raise public awareness of hazards, hazard mitigation and disaster preparedness	4	5	5	5	5	5	5	5	3	43
6	Increase resilience of mobile homes through accepted structural modifications and resident awareness of programs and opportunities	2	2	3	3	4	3	2	4	4	27
8	Continue fluvial geomorphology (in coordination with state recommendations and protocol) assessments and develop strategies in response to any identified risk	3	2	4	2	2	2	2	3	3	23

5.5 Implementation and Monitoring of Mitigation Strategies

5.5.1. Public Involvement Following Plan Approval

After adoption, the town will continue to maintain web-presence of the mitigation plan with an opportunity for community input available on its website. Additionally, the town will hold an annual public meeting after performing the annual progress report for the mitigation plan to discuss achievements and the following year's implementation plan. At town meeting, the town

will present mitigation information and provide the public an opportunity to increase understanding and involvement with planning efforts. The LEPC will also host an annual mitigation plan presentation where response/state agencies, neighboring communities and other stakeholders can provide input. The town will also notify its neighboring municipalities of the availability of information for review and any significant risks and/or mitigation actions that have an impact on surrounding towns.

5.5.2. Project Lead and Monitoring Process

The Town Manager is the project lead and will work in conjunction with the Selectboard, town clerk and NVDA to complete the yearly progress report included in the plan. The town will create a mitigation action collection system that will be used as the source of future updates following the annual evaluation that will occur in conjunction with the progress report using the Plan Implementation Matrix provided below. While mitigation actions are, by default, often addressed at monthly Selectboard meetings, the town will schedule one meeting annually to formally assess the plan and adopt updates following the annual progress report and community meeting regarding the LHMP. Once the plan is approved by FEMA, the calendar will begin for annual review. The town will take the following implementation matrix and add actions to it each year, modifying tasks and/or needs as required so that the next LHMP update will be populated with the specific actions related to each mitigation strategy by year.

5.5.3 Plan Evaluation and Update Process

The Town Manager will lead the plan evaluation process as part of the annual progress report. Prior to town meeting and in preparation for the annual town report, a mitigation section will be included that provides an executive summary for the public that addresses the following topics:

- Status of recommended mitigation actions for the five-year planning period
- Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk
- Identification of a lead person to take ownership of, and champion the Plan if different from Town Manager
- An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.)
- Discussion of how changing conditions and opportunities could impact community resilience in the long term
- Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience

By engaging in the annual evaluation, the town will have a viable method for capturing the facets of efficacy and areas needing revision and improvement in its mitigation plan. The town is committed to “institutionalizing” mitigation into its normal operating procedures and with approval of this plan, embarks on the formal incorporation of mitigation actions and discussion, maintaining an awareness that involves not only the Selectboard, Town Clerk and Road Foreman but also the community at large, including the organizations represented by the current planning team. Along these lines, the town will maintain a contact list of the current planning team and make revisions as required, including the team on the evaluation process each year. Through this consistent attention resulting from the evaluation process, progress reports and communication in

the annual town report, the town will achieve the consistency required to enhance resilience through planning, assessment and actions devoted to mitigation.

5.5.4. Plan Update Process

Although the plan will be reviewed, pending ongoing financial resources, in its entirety every five years the town may review and update its programs, initiatives and projects more often based on the above procedure as changing needs and priorities arise.

The Plan update will be led by the Town Manager. Depending on funding availability, the town may elect to acquire the assistance of NVDA and/or a consultant to update the plan following a declared disaster and/or the next five-year planning cycle. To assure that the Plan does not expire, the town will begin the update process within no less than six months of the current Plan's expiration date. Following a disaster and during the recovery phase, the town will use the experience to assess the current Plan's ability to address the impact of the most recent disaster and edit the plan accordingly. Using the annual progress reports and evaluation narratives as a guide, along with perceived changes in risk or vulnerabilities supported by data and/or observation, strategies will be captured in accordance with FEMA guidelines, which includes reconvening the planning team during the update process. The town will establish a "Mitigation File" that documents all evaluations and progress reports, along with actions, especially related to infrastructure improvement projects. While the progress reports are designed to capture the specific actions the town has accomplished related to implementation, keeping a narrative list with dates on all actions relatable to mitigation (e.g. school drills, LEOP updates, Fire Safety Awareness, meetings, etc.), will provide the town the bulk of information required in the update process.

5.5.5. Implementation Matrix for Annual Review of Progress

The following table is intended to aid municipal officials in implementing the mitigation actions for Hardwick and to facilitate the annual monitoring and progress reporting. Progress has been included as a guide to future updates. Each year, the town will reserve a Selectboard meeting to review and update the Implementation Matrix as means to establishing an accurate evaluation of the plan's efficacy and the information required for the succeeding update to the plan. The matrix includes each mitigation action for the project period, the timeline for accomplishment and the task leads. The town will update the matrix each year related to the full mitigation action items for each action category as they relate to progress status (completion or deletion from planning cycle initiatives) and rationale (new information, social, political and/or budgetary restrictions). There should one matrix for each year of the planning cycle (2018, 2019, 2020, 2021, 2022).

Action	Primary Responsible Entity (INCLUDED AS EXAMPLES)	Timeline (One for each year in the planning cycle)	Task (LIST TASKS ACCOMPLISHED IN LINE WITH SPECIFIC MITIGATION ACTIONS)	Brief Description (DESCRIBE EACH TASK: WHAT WAS DONE OR WHY IT WASN'T)	Progress (YEAR): 2018 (COMPLETED/IN PROGRESS/NO LONGER NEEDED OR POSSIBLE)
Continue fluvial geomorphology assessments and develop strategies in response to identified risk.	VT DEC, NVDA, VT ANR	Spring 2019–Fall 2022	<u>Fluvial Geomorphic Assessments</u>	The town will work with DEC through coordinated meetings, workshops and communication to increase understanding of current findings and develop an applicable framework to help guide decisions related to priority infrastructure work and vulnerability	
	NVDA, VT ANR	Fall 2018	<u>Fluvial Erosion Hazard Mapping</u>	Develop a fluvial erosion hazard map for the waterways, using the GIS extension known as SGAT (or Stream Geomorphic Assessment Tool) for assessed stream reaches. As assessments are completed, a map of all assessed waterways in the town will be created.	
	Planning Commission and Selectboard, NVDA	Spring 2019	<u>River Corridor Management Plans –</u>	Using the River Corridor Maps, the town will develop an outreach strategy to residents/structures in or near the defined corridor. This communication should focus on flood resilience measures and opportunities. With the lack of repetitive loss properties in the town, the likelihood of viable HMGP acquisition projects is low but increasing awareness of this program can serve the town well.	
	Hardwick Planning Commission	Summer 2018-	<u>Fluvial Erosion Hazard Mitigation Implementation</u>	The town will draft strategies to avoid or mitigate losses	.

		Summer 2021		from the identified fluvial erosion hazards. These strategies may include the adoption and implementation of programs, mechanisms or regulations to prevent endangerment of persons and property in riparian corridor areas from fluvial adjustment processes. Efforts could range from a relatively simple, public information campaign about the map to the adoption of a municipal ordinance or by-law that restricts development in such hazard areas.	
	Hardwick Planning Commission	Summer 2018	<u>Administrative and Zoning Regulations:</u>	Zoning administrator will work with town officials and residents to determine if a “Zero Development” policy in high flood/erosion risk areas is required in the town and progress accordingly.	.
Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
Improve road infrastructure and municipal systems protection programs	Road Foreman, Commission	Winter 2017 – Winter 2022	<u>Infrastructure Assessment for Storm Water Vulnerability</u>	Funding and staff resources permitting, assess the vulnerability and operational capability of municipal-owned roads, culverts and other storm water management infrastructure to predicted storm water and snowmelt in areas with a documented history of recurring problems. The infrastructure will be evaluated regularly prior to replacement or upsizing of the existing infrastructure.	
	Road Foreman,	Winter 2017	<u>Continued Monitoring of Vulnerable</u>	Monitor bridges and culvert	.

Commission	– Winter 2022	<u>Infrastructure</u>	locations that have erosion and scouring concerns and track	
Road Foreman	Winter 2017 – Winter 2022	<u>Road Improvements and Landslide Protection</u>	<p>Within political and financial restraints, re-engineer certain sections of roads to lower overall maintenance costs, improving snow plowing speeds and improve overall capability of roads to handle current and projected traffic volumes. Specific projects, numbered by priority (details included in Road Erosion Site Inventory) include: Cobb School Road (800’), Bunker Hill Road (1200’), Browns Farm Rd. (700’), Ward Hill (600’): All of these locations will receive ditching and stone enhancement work and if required based on substantiated need, upgraded culverts. Stone size for ditching will be in line with AOT standards.</p> <p>Complete planning study to assess efficacy of installing duckbill gates on storm drains in Village along Cooper Brook near Bridge 43 and 66. Also assess efficacy and feasibility of lowering elevation south of river and/or dredging. Develop procedure for ongoing lockdown of manholes during high-rain events</p> <p>Assess efficacy and feasibility of installing and maintaining drop-down barricades for water treatment facility. Assess and develop plan to</p>	

			protect structures in NFIP Increase capability of HED to mitigate outages through budgetary allotment, planning and consistent mitigation of risk variables.	
Road Foreman, Commission	Winter 2017 – Winter 2022	<u>Documenting</u>	Develop a methodology that serves to efficiently capture work and expenditures on sites and keep this information at the town office.	
Road Foreman, Commission	Winter 2017 – Winter 2022	<u>Increase Awareness of Funding Opportunities</u>	Increase understanding of FEMA’s HMGP program so that this potential funding source can be utilized through trainings and communication with the State Mitigation Office.	
Road Foreman, Commission	Winter 2017 – Winter 2022	<u>ICS Training and Emergency Operations (SOP) Plan Development</u>	Enhance knowledge of the principles of ICS and develop a Standard Operating Procedures that details the relationship, roles and responsibilities of the Highway Department and Road Commission during major events.	

Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
Maintain and improve resilience to severe winter storms	Selectboard, EMD	Winter 2017 – Winter 2022	<u>Improve Existing Shelter Capability</u>	Maintain and improve capabilities of existing shelters. Notification procedures and shelter staffing is a priority for the town and intends to move forward on planning and public involvement. More formalized training is required and the ARC’s	

				“Shelter Initiative Program” can be used at no cost to the town to enhance both shelter management knowledge and sheltering supply cache.	
	Selectboard, HED	Winter 2017- Winter 2022	<u>Reduce risk of power failure due to ice storms:</u>	Enhance collaboration between town road foreman and electric company related to down-limbed induced power failure. Maintain function of generator	
	Selectboard, HED,EMD, Shelter Lead	Fall 2018- Winter 2018	<u>Notification</u>	Develop a notification /communication plan that conveys essential sheltering information using school phone system and back-up methodology (email, text, etc.)	
	EMD, HED, NVDA	Winter 2017- Winter 2022	<u>Residential Programs</u>	Provide guidance and communication to residents on the structural and mechanical actions that can occur to reduce risk to severe winter storms (e.g. weather-proofing, anchoring, alternative heating sources, tree trimming, financial programs, etc.)	
	Road Foreman/Commission	Winter 2017- Winter 2022	<u>Continue to monitor roads for safe and effective plowing: structure and recommended practices</u>	Efficient snow removal is the foundation to winter storm (snow) events, assuring roads are plowable before winter remains an important facet of highway department functions	
	Road Foreman/Commission	Winter 2017- Winter 2022	<u>Increase awareness of ICS</u>	The town can mitigate the effects of a severe winter by understanding how a large-scale storm is managed when the State EOC is operational. Additional awareness of local-level roles and responsibilities during statewide event is a mitigation action.	LEOP approval requires lead to have base level training

Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
Reduce impact of extreme cold durations	Planning Commission, HED	Summer 2018-Winter 2022	<u>Economic Resilience</u>	Establish program for assistance in paying heating bills during crisis situations, if not already required by state law. Develop and sustain a program that serves to connect resource organizations with residents in need of support services.	
	EMD, Shelter Leads, Selectboard	Summer 2018-Winter 2022	<u>Maintain Existing Shelter Capability:</u>	Maintain and improve capabilities of existing shelters. Notification procedures and shelter staffing is a priority for the city and intends to move forward on planning and public involvement. More formalized training is required and the ARC's "Shelter Initiative Program" can be used at no cost to the town to enhance both shelter management knowledge and sheltering supply cache.	
	EMD, Fire and EMS Chiefs	Summer 2018-Winter 2022	<u>Assess Vulnerable Population</u>	Develop an awareness of the most at-risk community members during an evacuation and/or sheltering event. Focusing on those that lack resources or capability to reach facilities when in need and create plans, including outreach protocol on how to address this potential hurdle.	
	EMD, Fire and EMS Chiefs	Summer 2018-Winter 2022	<u>Notification and Education</u>	Investigate and develop a notification/communication plan that conveys essential sheltering information. Educating citizens regarding the dangers of extreme cold and the steps they can take to protect themselves when	

				extreme temperatures occur by sustaining a process that serves to disseminate educational resources for homeowners and builders on how to protect pipes, including locating water pipes on the inside of building insulation or keeping them out of attics, crawl spaces, and vulnerable outside walls. Inform homeowners that letting a faucet drip during extreme cold weather can prevent the buildup of excessive pressure in the pipeline and avoid bursting through a yearly public service campaign.	
--	--	--	--	---	--

Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
Increase resilience of mobile homes through accepted structural modifications and resident awareness of programs and opportunities	EMD, Hardwick Fire Chief, Selectboard	Fall 2018-Winter 2021	<u>Collect recommendations from both UVM and ACCD programs devoted to MH resilience</u>	Both entities have completed work that is accessible and free to towns	
	EMD, Hardwick Fire Chief	Fall 2018-Winter 2021	<u>Develop outreach mechanism that serves to address needs, resources and agencies that can assist the resident and/or owner of the MH. Develop and/or acquire informational brochure regarding accepted mitigation actions specific to mobile homes (e.g. anchoring home and fuel tanks, elevating electric and furnaces, etc.) and distribute to residents in most economical way. UVM program and ACCD have the recommendations and information to use</u>	See above	
	Planning Commission	Fall 2018-Winter 2021	<u>Work with NVDA to map all mobile homes in the town and use this map to assess flood risk, create risk ranking and gauge outreach accordingly</u>	UVM program may be able to support work as well	River corridor maps may be used as foundation is applicable

Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
Reduce risk and impact of hazardous materials incident	EMD, Facility leads, Hardwick Fire Chief, NVDA, Selectboard	Spring 2019-Fall 2020	<u>Work with facility leads</u>	Increasing understanding of risk factors and what can be done to mitigate and enhance training and skills for response to major highway accidents is advantageous	
	EMD, Facility leads, Hardwick Fire Chief, NVDA, Selectboard	Spring 2019-Fall 2020	<u>Develop understanding of likely chemical characteristics and what area would be impacted under likely scenarios involving discharge/spill</u>	Similar to above	
	EMD, Facility leads, Hardwick Fire Chief, NVDA, Selectboard	Spring 2019-Fall 2020	<u>Explore using HMEP funding to increase awareness, knowledge and collaboration a means to developing future mitigation actions</u>	With competent management, this funding source can move understanding and coordination forward in a short amount of time	
	EMD, Facility leads, Hardwick Fire Chief, NVDA, Selectboard	Spring 2019-Fall 2020	<u>Explore using Homeland Security exercise planners to develop tabletop exercise based on likely scenarios</u>	An excellent way to test response and free	
Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
Raise public awareness of hazards, hazard mitigation and disaster preparedness.	Emergency Management Director; Hardwick Fire Chief	2018	<u>Hazard Resilience for Property Owners-</u>	Develop and maintain education materials to inform property owners on how to protect their homes and businesses through accepted hazard resilience actions (e.g. securing their structures from high winds, elevating their electrical equipment/furnaces in basements, protecting from lightning strikes by grounding electrical outlets, etc.).	
	Emergency Management Director; Hardwick Fire Chief	2018	<u>HMGP Awareness:</u>	Attend informational sessions on the HMGP funding opportunities for acquisition, elevation and flood-proofing projects. Work with NVDA to develop an information brochure for residents.	

	Emergency Management Director; Hardwick Fire Chief	2018	<u>School Programs</u>	Assure the school is structurally ready to handle natural hazard risks to the greatest extent possible. Continue school programs to raise student awareness of hazards, safety, preparedness and prevention. Explore establishing the school emergency notification system as the primary methodology for all emergency notification procedures and build in the contact information accordingly.	
	Emergency Management Director; Hardwick Fire Chief	2018	<u>Family Programs</u>	Continue family programs, such as car safety seat and bike safety programs, to raise family awareness of hazards, safety, preparedness and prevention.	
	Emergency Management Director; Hardwick Fire Chief, School, Selectboard	2018	<u>Fire Prevention Programs</u>	Continue National Fire Prevention Week and other programs to raise public awareness of fire hazards, safety, preparedness and prevention.	
	EMD, NVDA, LEPC		<u>Other hazard awareness programs</u>	Develop public awareness programs, based on all-hazards needs. Programs to address pandemic hazards, preparedness and mitigation may be appropriate as directed by the state department of health and its jurisdictional offices of local health	
Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress

Reduce vulnerability to high wind events with accepted best practices

HED, Planning Commission	Winter 2017 – Winter 2022	<u>Developing and maintaining a database to track community vulnerability to severe wind:</u>	Use GIS to map areas that are at risk to the wind hazard associated with different non-hurricane conditions and identify concentrations of at-risk structures. Create a severe wind scenario to estimate potential loss of life and injuries, the types of potential damage, and existing vulnerabilities within a community to develop severe wind mitigation priorities.	
HED, Planning Commission	Winter 2017 – Winter 2022	<u>Establish standards for all utilities regarding tree pruning around line:</u>	Incorporate inspection and management of hazardous trees into the drainage system maintenance process. Support and suggest the testing of power line holes to determine if they are rotting. Support the inspection of utility poles to ensure they meet specifications and are wind resistant. When feasible, support burying power lines to provide uninterrupted power after severe winds. Avoid use of aerial extensions to water, sewer, and gas lines when possible. Support use of designed-failure mode for power line design to allow lines to fall or fail in small sections rather than as a complete system to enable faster restoration.	
HED, Planning Commission	Winter 2017 – Winter 2022	<u>Public Outreach:</u>	Ensure that school and hospital officials are aware of the best area of refuge in buildings and that their plans are viable in high wind mitigation events. Instruct property owners on how to properly install temporary window coverings before a storm. Support education to design professionals to	

				include wind mitigation during building design/modification to an extent deemed necessary.	
Action (ANY NEW ACTIONS LISTED HERE)	Primary Responsible Entity	Timeline	Task	Brief Description	Progress

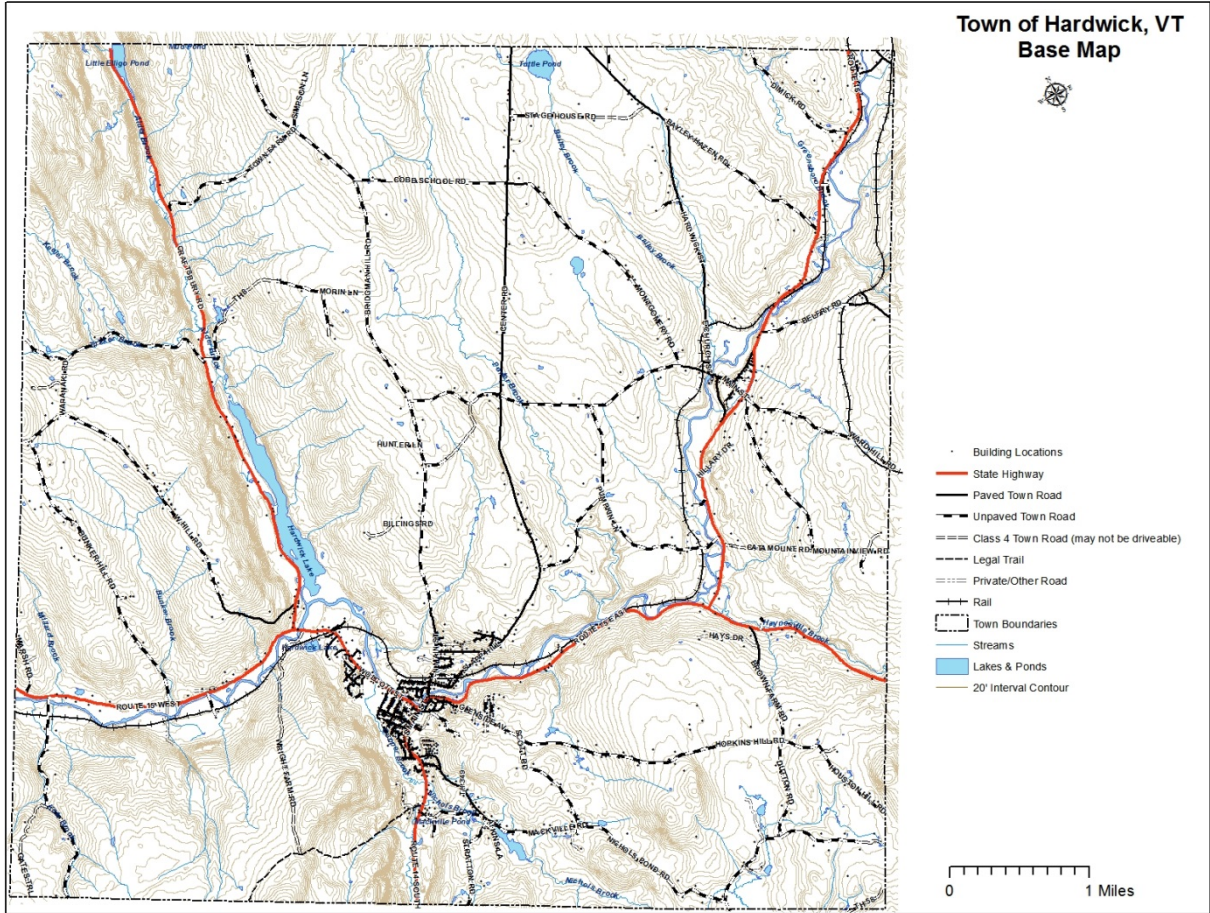
APPENDICES

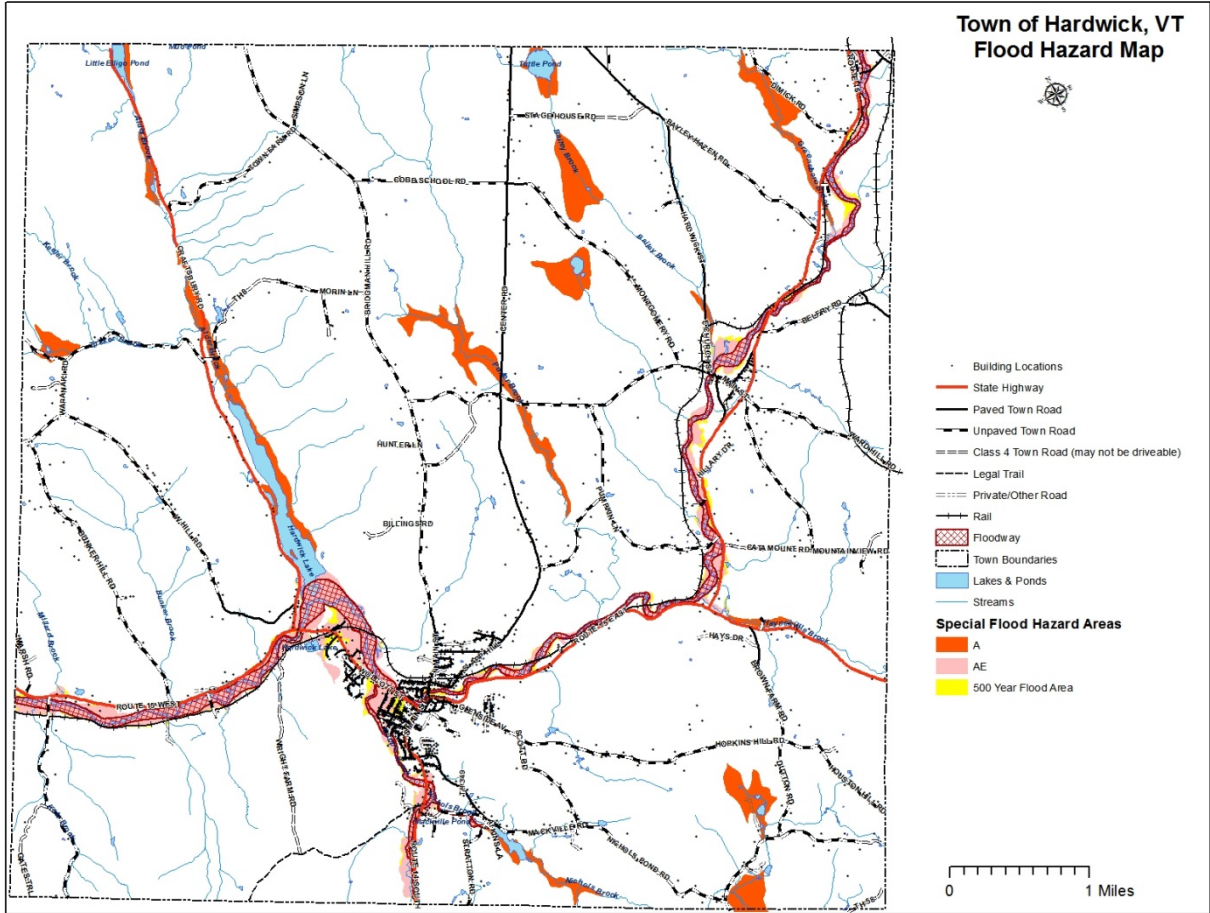
NOTE: Appendices B-C not included with State submission or for FEMA review)

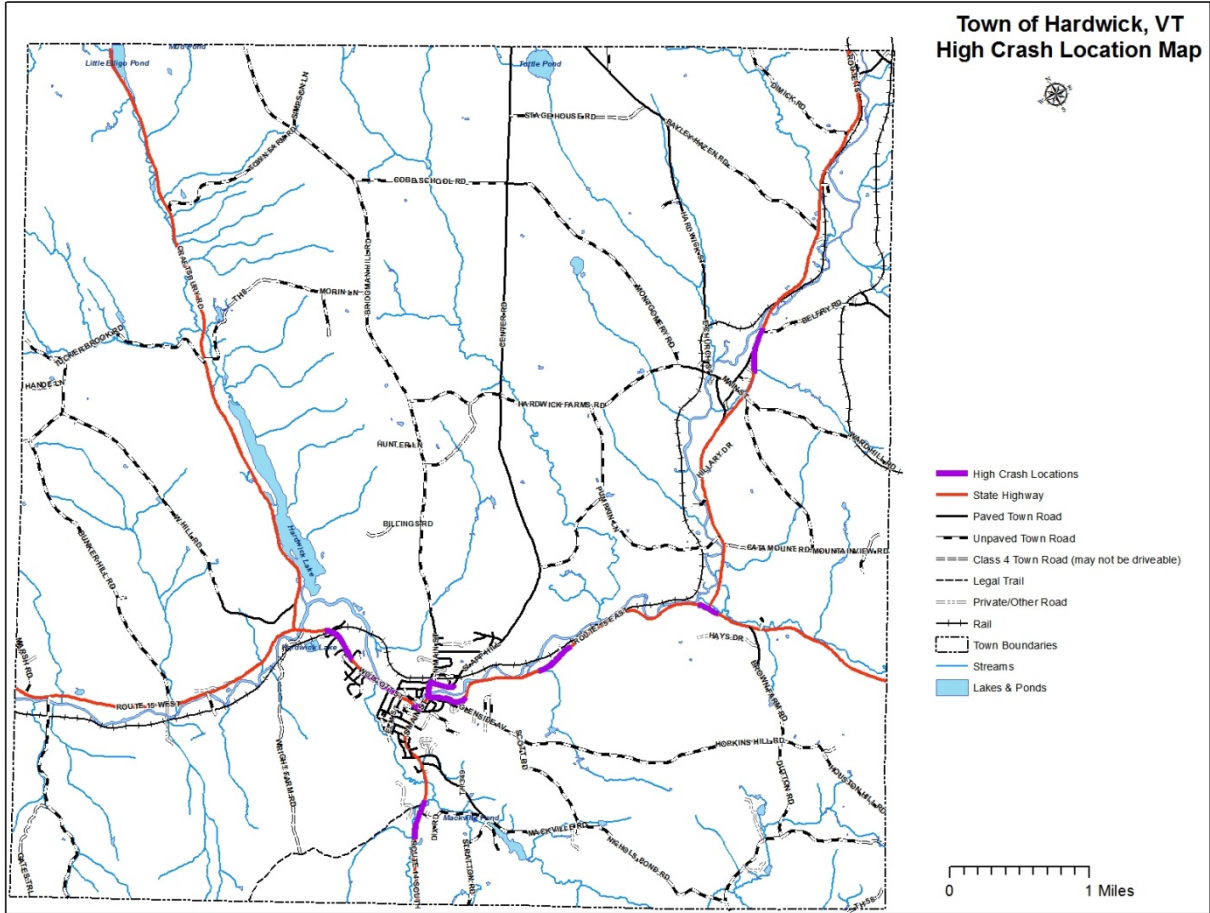
Appendix A: Maps

Appendix B: No Adverse Impact Floodplain Management Fact Sheet (ASFPM)

Appendix C: Farm Structures in Designated Flood Hazard Area Planning Checklist (VAAFPM)







**Hazard Mitigation
Community Outreach Form**

Introduction: Hazard Mitigation Planning is an important facet for any town and a mandatory requirement of FEMA before any FEMA funding can be awarded to the town. By developing an approved plan, the town can earn a greater percentage of state funding during recovery from a disaster and be better prepared to handle a future crisis. Your input is crucial to the planning process and the information you provide will help produce a plan that will serve the town for years to come. Please take the time to share your thoughts on the questions below. Thank you!

Instructions: Please use this form to share your thoughts on the questions below. When completed, please drop off at the Town Clerk’s office or mail by to:

**Town of Hardwick Mitigation Survey
P.O. Box 523, 20 Church St.
Hardwick, VT 05843
(802) 472-6120**

Questions?

Please call the Town Clerk’s Office: (802) 472-6120

Community Concerns:

- 1. As a resident, business owner or employee of the Town of Hardwick, what are your concerns about emergency events in the town?**

- 2. What do think the community could plan to accomplish to be better prepared, both financially and in health and safety, for the next emergency event?**

What other thoughts or concerns do you have about emergencies, hazards and emergency response in the town? _____
