

*Adopted by the Town of Waterford Select Board on
March 13, 2017*

**Town of Waterford, Vermont
All-Hazards Mitigation Plan
Update**

LAST APPROVED PLAN: 2005

Physical address:

532 Maple St.

WATERFORD, VT 05848

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FEMA Applicant #: 005-77125-00

**Prepared by
OPHC and the
Town of Waterford, Vermont**

CERTIFICATE OF LOCAL ADOPTION

Town of Waterford, Vermont

A Resolution Adopting the Update to the All-Hazards Mitigation Plan Update

WHEREAS, the adoption of this plan update is a continuation of the Town's commitment towards meeting its long term risk reduction (mitigation) goals. This resolution serves as the authorization of the updated plan's implementation with the assigned responsibilities described herein; and

WHEREAS, the Town of Waterford has worked with the public, stakeholders, neighboring communities, and with the assistance of OPH Consulting Services to identify hazards, analyze past and potential future losses due to natural and human-caused disasters, and identify strategies for mitigating future losses; and

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

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

NOW, THEREFORE BE IT RESOLVED that the Town of Waterford adopts this updated All-Hazards Mitigation Plan Update for the town.

Date 3/13/17

[Signature]
Selectman

[Signature]
Select Board Chair

Selectman

[Signature]
Attested to by City Clerk

Executive Summary

In the spring of 2015, the Town of Waterford contracted with OPH Consulting Services (OPHC) to update the Town of Waterford's Local All-Hazard Mitigation Plan (LHMP), which was adopted by the town as an annex to the 2005 Multi-jurisdictional Hazard Mitigation Plan submitted by the Northeast Vermont Development Association. The results of this work are contained herein and represent the collaborative efforts of the Town of Waterford Hazard Mitigation Planning Team, neighboring towns, NVDA and various state agencies that contribute resources and knowledge to community mitigation planning and resilience. While this update builds from the 2005 plan, it is considered the new, comprehensive, standard in mitigation planning for the town and will provide the basis for the incorporation of mitigation planning and actions into town policy and procedures. 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 reimbursement 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 a 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 Waterford
- 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 Waterford and describes the planning process used to develop this plan.

Section 2: Hazard Identification expands on the hazards identified by the Town of Waterford and from a historical perspective 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 as a means 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 identified hazards for Waterford are broken down in the grid below:

Severe winter storm	Power loss	Flooding
Telecommunications failure	Major transportation incident	Epidemic

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 Waterford Town Plan that support hazard mitigation and utilizes the town’s 2015 Road Erosion Site Inventory and 2013 Zoning Bylaws to formulate and support actions that address the identified hazards. An analysis of existing municipal actions that support hazard mitigation, such as planning and emergency services is also included. The town’s 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 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) Formation of a resource and information source for inclusion in the municipal comprehensive plan as described in 24 VSA, Section 4403(5).
- 7) Provision of detailed information and mitigation actions that will be used in the municipal/town operating and capital plans & programs as they relate to public facilities and infrastructure.
- 8) Support long-term solutions over short-term fixes to community needs and problems
- 9) Promote collaboration and cooperation through working partnerships between governments, non-profits, institutions, and businesses

Section 5 identifies and provides a detailed discussion of the following Mitigation Actions:

Action #1: Evaluate capabilities of existing road and storm water management infrastructure.
Continue and improve highway, culvert and bridge maintenance programs

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

Action #3: Reduce risk and impact of major transportation incidents

Action #4: Reduce vulnerability to telecommunications failure

Action #5: Increase knowledge of livestock and human epidemic mitigation factors

Action #6: Raise public awareness of hazards and hazard mitigation actions

Action #7: Continue fluvial geomorphology (in coordination with state recommendations and protocol) assessments and develop strategies in response to any identified risk

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 Waterford Planning Commission and Selectboard

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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 the municipality in continuing to identify all hazards facing their community and in identifying strategies to continue to reduce the impacts of those hazards. The plan also serves to better integrate and consolidate efforts of this municipality with those outlined in the most recent and future Town Plans as well as those of NVDA, relevant state agencies, including the Vermont 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 for the Town of Waterford with a goal to provide hazard mitigation strategies to aid in increasing the overall resilience of the Town, Caledonia County and the state as a whole.

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 five goals accomplished as a State since 2010 and as referenced in Section Five of the State’s 2013 Hazard Mitigation Plan and as part of Vermont’s Emergency Relief Assistance Funding (ERAF) requirements. With enhanced emphasis on community resilience, 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. According to 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 in order 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 LHMP
- 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 in order 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 LHMP 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
- Ease the receipt of post-disaster state and federal funding because the list of mitigation initiatives is already identified and action can be taken prior to the next event
- 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 as a whole 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 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) Formation of a resource and information source for inclusion in the municipal comprehensive plan as described in 24 VSA, Section 4403(5).
- 7) Provision of detailed information and mitigation actions that will be used in the municipal/town operating and capital plans & programs as they relate to public facilities and infrastructure.
- 8) Support long-term solutions over short-term fixes to community needs and problems
- 9) Promote collaboration and cooperation through working partnerships between governments, non-profits, institutions, and businesses

1.6 Town of Waterford: Population and Housing Characteristics

Chartered: November 8th, 1780
 Coordinates: 44 22'N 71 57'W
 Altitude ASL: 1,306'

1.6.1. Population

The Town of Waterford is a small rural community in north-central Vermont. This Caledonia county community is part of an area known as the Northeast Kingdom and covers 39.7 square miles with 1.4 of that as water. The town is located along the Connecticut River between St. Johnsbury, Vermont and Littleton, New Hampshire, both of which are under 10 miles away. There is a population of 1280 residents with a density of about 33 people per square mile. Population figures indicate a 15.9% increase in population in 2010. Since 1980, the population has increased by 398.

Table 1-1: Town of Waterford, selected population characteristics, 2010 Census

Category	Number	%
Total Population	1280	100
Median Age	45.8	--
Population age 60 years and over	311	24.3
Population under 20 years old	328	25.6
Population between 20 and 40	200	15.6
Population between 40 and 60	411	32.1

1.6.2. Housing and Demographics

Since the last approved plan in 2005, there has been no new development in the SFHA according to town records and the Zoning Administrator. The town continues to have no repetitive loss properties. Since 2005, the next amendment to the towns' zoning regulations occurred in 2013 and clear rules on development in the designated hazard areas were presented as follows:

§ 326: Flood Hazard Area Requirements

326.01 Lands to which these regulations apply. These regulations shall apply in all areas in the Town of Waterford identified as areas of special flood hazard on the National Flood Insurance Program maps which are hereby adopted by reference and declared to be part of these regulations.

326.02 Development permit required. A permit issued by the administrative officer is required for development in areas of special flood hazard. Conditional use approval by the DRB is required for the construction of new buildings, the substantial improvement of existing buildings or floodway development prior to the issuance of a zoning permit by the administrative officer.

With this and the zero development in the SFHA policy that the town plans to adopt in 2016, the town has taken the necessary steps to eliminate increased risk to new development in the SFHA.

The entire population of Waterford is housed, with more than half living in traditional nuclear families. The average family size is 2.84 and the average household size is 2.52. Estimated median household income is above the state average and the median house value is slightly below state average. Since 2010, there have been 13 new homes built averaging about \$170,000. The unemployment rate is significantly below state average as is the number of residents renting. The length of stay since moving is significantly above state average and house age is significantly below state average. The main source of household heating energy is fuel oil (66%), then wood (19%), bottled, tank, or LP gas (12%), electricity (1%), utility gas (1%) and coal (1%). *The following shows the types of housing within Waterford*

Table 1-2: Town of Waterford, selected housing unit data, 2010 Census Block Group 2

Category	Number	%
Total Housing Units	580	--
Occupied housing units	505	87
Vacant housing units	75	13
Owner-Occupied	462	79.7
Renter Occupied	43	7.4
Population in Renter-occupied	87	--
Households with individual over 65	145	25
Householders living alone over 65	43	--

1.6.3. Income and Employment

The Waterford unemployment rate is 2.3% compared to the state average of 3.7%. Most common employment sectors are; Construction (9%), agriculture, forestry, fishing and hunting (9%), health care (6%), educational services (5%), electrical equipment, appliances, and

components (4%), public administration (4%) and accommodation and food services (4%). The most common occupations are electrical equipment mechanics and repair occupations (7%), farming (6%), non-farming management (6%), grounds and maintenance (5%), auto repair (4%), other (4%). The town has an asphalt manufacturing plant, a concrete fabrication plant, a school, an inn and restaurant, the town office, library and a post office. The majority of the working population within the town work out of town.

1.6.4. Hospitals and medical centers near Waterford

- Northeastern Vermont Regional Hospital: Critical Access Hospital (about 7 miles away; St. Johnsbury, VT)
- St. Johnsbury, VT Health and Rehab (Nursing Home, about 7 miles away; St. Johnsbury, VT)
- FMC OF ST. Johnsbury Dialysis (about 7 miles away; St. Johnsbury, VT)
- Caledonia Home Health Care (about 7 miles away; St. Johnsbury, VT)
- Pines Rehab and Health Center (Nursing Home, about 11 miles away; Lyndonville, VT)
- North Country Home Health and Hospice Agency (Home Health Center, about 11 miles away; Littleton, NH)
- Lafayette Center, Genesis Healthcare (Nursing Home, about 14 miles away; Franconia, NH)

1.7 Summary of Planning Process

In June of 2015, the town contracted with OPH Consulting Services (OPHC) to facilitate the update of the plan. The last approved plan for the town was in 2005. This approval came after formal adoption of the Waterford 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 result of the 2005 plan. With this in mind, there is a current understanding of the need to integrate the content of this update into other town planning documents so that mitigation planning establishes itself as a consistent topic of concern and discussion. In late June of 2015, the planning team was developed, representing the community and state partners as best as possible. The kick-off meeting was convened on June 30, 2015. The planning team discussed the mitigation-related actions since the last approved plan, the current planning process and pertinent facts related to the town. Additionally, a survey was drafted asking for community input and made available through the town's standard public notification process with access on the town's website or in the town office. The survey introduced the importance and informational needs of a LHMP and asked for specific concerns the resident and/or business owner had. The survey and final planning team roster were approved and adopted by the select board in July, 2015. All towns bordering Waterford were sent notification of the plan's development, subsequent draft sections and were given an opportunity to provide input. While the planning participants associated with the 2005 plan are no longer affiliated with NVDA or the town, it is known that the 2005 plan was reviewed by town officials

and adopted in 2005. Incorporation and implementation since 2005 was assessed to the greatest extent possible and addressed in all relevant sections of this update. Monthly communication on plan development were included in each Selectboard meeting and an overview of hazards and disaster history was given at both the September Selectboard and Planning Commission meetings, where a discussion to incorporate facets of the updated LHMP into the next town plan and subsequent zoning regulations occurred along with a presentation by NVDA on the river corridor. Following FEMA guidance in Local Mitigation Plan Review Tool Regulation Checklist, the plan was written using data sources that included:

- 2008 Waterford Town Plan and updated language for the next adoption (including the 2013 Zoning Regulations)
- 2015 Waterford Road Erosion Site Inventory (created in adjunct to this plan) provided specific infrastructure projects that will serve as the basis for the 5-year work plan for road and storm water improvement projects.
- Waterford Winter Operations and Emergency Operations Plans provided current policies and procedures supporting hazard mitigation
- ACCD Mobile Home Resilience Plan: Provides resources for planners and residents with clearly defined recommendations for mitigating risk
- Surveys collecting public comment (issues raised were addressed in the plan and the public meeting)
- 2013 Waterford Zoning Bylaws (provided basis of current development protocol supporting hazard mitigation)
- 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 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 P-956: Living with Dams (provides clear guidance on planning and considerations for municipalities with dams).
- FEMA NFIP “Bureau.Net” database (provided detailed information on repetitive loss properties and associated flood insurance claims).

Based on information obtained and input from town officials, the planning team, state plans and federal data bases, local associations and NVDA, OPHC drafted the plan. Building on new data,

town plans and community input, OPHC engaged in outreach with the following town staff and community organizations to provide an inclusive and strategic mitigation plan (**Names in bold indicate Planning Team Members**):

Kevin Fontecha, Fire Chief
Jon Smith, EMC
Lisle Houghton, Road Foreman
Gary Allard, Selectboard
Brent Beck, Selectboard
Fred Saar, Selectboard Chair
Joanne Jurentkuff, Town Clerk
Kelley Brooks, Waterford School Principal
Robbie Hallett, Calx Ambulance Service
Jim Manley, VT EHS Manager, Pike Industries
Sharron Caplan, Senior Living Facility Manager
Lisa Hale, Director of Day Care Center
Bruce Melendy, NVDA
Richard Fisher, Chair LEPC 9
Shauna Clifford, VTrans District Rep
Matt Cole, TransCanada
Ray Walker, State EMS

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. NVDA's role in assisting the entire region with all facets of planning provided crucial information and NVDA's Emergency Management Planning representative attended planning team meetings and provided guidance. While the LEPC provides the best platform to engage representatives from various towns and agencies, all bordering towns to Waterford (Concord, St. Johnsbury, Barnet and Littleton, NH) were contacted via email through the town clerk with planning objectives and a request to inform the selectboard via an agenda item to provide input via the community survey in addition to receiving a draft plan with an invitation to comment via email or phone to the planning team. State agency involvement included the State EMS office with points of contact including both Ray Walker and EMS Data Specialist Jenna Protzko. Vermont's Department of Emergency Management and Homeland Security (DEMHS) also provided information during the development of the plan. DEMHS also has representation at the LEPC meetings and will continue to provide input and guidance as the town moves forward with their mitigation strategies. On December 15th, 2015, the town held a warned public meeting to review the defined hazards and associated mitigation strategies. The draft plan was then revised based on collected input. The draft plan was then revised based on input and presented to the town. The revised draft was then 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. All neighboring town offices were sent the draft for review and comment as well. A resolution of adoption is anticipated following FEMA Approval Pending Adoption Notification. The final plan and adoption documentation will then be sent to FEMA for final approval.

SECTION 2: HAZARD IDENTIFICATION

The 2005 plan profiled the following hazards (Bold indicates continued inclusion of profiled hazards)

1. **Flooding**
2. **Severe Weather-Power Outages**
3. Dam Failure
4. **Hazardous Materials and Highway Incidents**
5. Water supply contamination

For this update, the planning team looked at three distinct hazard categories and for each, considered prior history, current trends and available data to estimate risk. While it is understood that FEMA will only reimburse the town for disasters caused by natural hazards, considerations for other the categories can increase resilience to a natural disaster as the technological and social hazards often occur as a secondary consequence of the natural disaster and in adjunct. The following is a discussion of existing and potential hazards in Waterford. 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
- **Technological Hazards:** utility failure (telecommunications failure, loss of electrical service, loss of sewer service, loss of water service, loss of gas service), hazardous substances (hazardous material storage and release, hazardous waste sites, military ordnance, pollution events), and transportation incident
- **Societal Hazards:** crime, civil disturbance, terrorism, epidemic / mass casualty, food supply crisis, economic downturn, and key employer loss

Profiled Hazards:

The highest risk hazards (**Severe winter storm, Power loss, Flooding, Telecommunications failure, Major transportation incident, Epidemic**) have been profiled to provide the basis of future mitigation strategies. However, lower risk natural hazards (drought, tornado, high winds, extreme temperatures, hail, landslide, earthquake, naturally-occurring radiation and fire hazards) are also included as means of establishing a comprehensive foundation of understanding for the town despite a lack of evidence to substantiate mitigation efforts at this time. Hence, these lower risk hazards are not fully profiled within the plan due to lower risk founded in lower likelihood of occurrence based on history for the town, region and state. This rationale supports the exclusion of these hazards from requiring mitigation efforts at this time.

2.1 Natural Hazards

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). Waterford was impacted by three of the disaster (noted below with the name of the town and an asterisk by the disaster number). 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.

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 in Bold with events that resulted in PA funding for the town with an “()—Waterford”)*

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—Waterford
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—Waterford
*1559	2004	Severe Storms and Flooding—Waterford
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

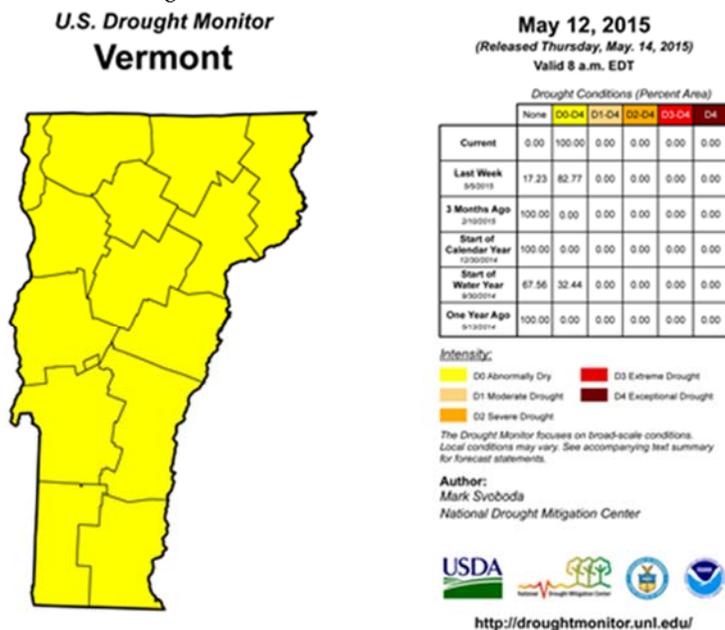
2.1.1. Weather and Climate Hazards

Drought

Severe droughts are rare in Vermont. Summer is potentially a dry period, but local thunderstorms and moisture from tropical air masses generally prevent serious drought. A severe drought during 1930-36 affected the entire State. The drought of 1960-69 affected the entire State and was the most severe for the Town. The recurrence interval of the drought was greater than 50 years. This drought was regional in scope, encompassing most of the northeastern United States.

Precipitation in the State was less than normal every year during 1960-68, which was the longest continuous spell of deficient precipitation since 1895. Streamflow deficiency was greatest during 1965. In 1969, the drought ended abruptly. Water was trucked in to provide relief to drought-stricken dairy herds. Below is the most recent drought monitor for the entire state. Spring can bring abnormally dry conditions as was evident in early 2015 and expects the extent of drought to remain as brief periods of abnormally dry conditions in the spring and occasionally, summer months. Table 2-3 below provides recent drought conditions and an explanation of the rating scale used. Data was not available specific to Waterford, nor is there any town-level reports of drought being a risk posing concern at this time.

Table 2-3: U.S. Drought Monitor: Vermont



Tornadoes, Hurricanes and High Winds

Tornado damage is classified by the Enhanced Fujita scale, ranging from relatively little damage (ef0) to catastrophic damage (ef5). Violent tornadoes (ef3 or greater) are capable of great destruction and loss of life. Objects such as sticks, glass, and lawn furniture become deadly missiles when driven by tornadic winds. The number of days with thunderstorms across Vermont and northern New York ranges from 20 to 30 days, with nearly a third of these days experiencing severe weather. According to the National Weather Service (NWS), severe thunderstorms can produce damaging winds in excess of 58 mph, hail one inch in diameter or larger, or even a tornado. Heavy rain and deadly lightning are also likely hazard. The Tornado Project has recorded a total of one tornado in Caledonia County during the period from May 1962 through May 2012 (F-scale:0). Tornado damage tends to be localized. The town received no significant damage from any tornado event. No formal hurricane events are recorded for the town since 2012.

Table 2-4: Tornado Events and Fujita Scale (F-Scale) for Caledonia County, Vermont

ID	Date	Event Num	Time	Dead	Inj	F-Scale	Beg Coor	End Coor	County
987	AUG 3, 2010	2	19:35	0	0	0	44.34 -072.22	44.34 -072.22	5

Tropical cyclones (storms) are officially ranked on one of five tropical cyclone scales, according to their maximum sustained winds and which tropical cyclone basin are located. Only a few scales of classifications are used officially by the meteorological agencies monitoring the tropical cyclones, but some alternative scales also exist, such as Accumulated cyclone energy, the Power Dissipation Index, the Integrated Kinetic Energy Index, and Hurricane Severity Index. Of most recent importance for Vermont was Tropical Storm Irene in 2011. Irene resulted in the worst Vermont flooding in 83 years. During Irene (August 28th-29th, 2011), Waterford received 3.89'' of rain (NOAA) in a 24-hour period. The county as a whole received 118% of its 100-year storm expected rainfall total, which was second highest in the state. With the increase in severe weather events related to rainfall, the town expects greater rainfall events, should they be a result of a tropical storm or smaller storms. However, tornadoes are very unlikely in the region and the town does expect to experience any enhanced threat with this hazard.

Source: http://www.uvm.edu/~transctr/research/trc_reports/UVM-TRC-14-016.pdf54348

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 Waterford was not available but town officials recall the 2012 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. The following table describes the *Saffir-Simpson* hurricane wind scale.

Table 2-5: Saffir–Simpson hurricane wind scale

Category	Wind speeds
Five	≥70 m/s, ≥137 knots ≥157 mph, ≥252 km/h
Four	58–70 m/s, 113–136 knots 130–156 mph, 209–251 km/h
Three	50–58 m/s, 96–112 knots 111–129 mph, 178–208 km/h
Two	43–49 m/s, 83–95 knots 96–110 mph, 154–177 km/h
One	33–42 m/s, 64–82 knots 74–95 mph, 119–153 km/h
Related classifications	
Tropical storm	18–32 m/s, 34–63 knots 39–73 mph, 63–118 km/h
Tropical depression	≤17 m/s, ≤33 knots ≤38 mph, ≤62 km/h

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

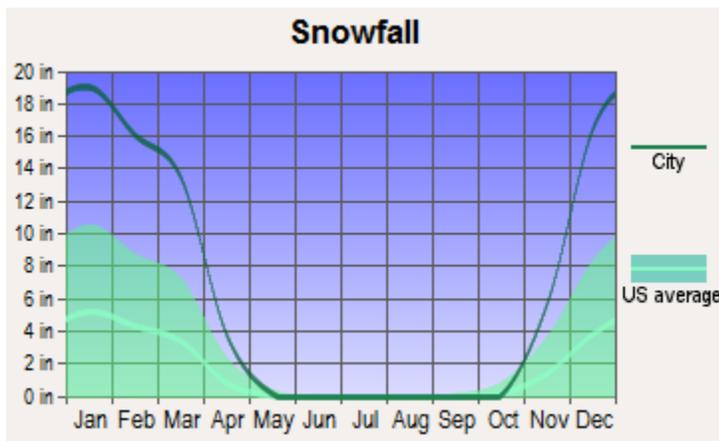
widespread power outages.”

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. The Fairbanks Museum Weather Station receives precipitation measurements from an independent residing in Waterford. According to the available history specific to Waterford, 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, Waterford has had no major PA funding related to damage from snow events.

Table 2-6: NOAA’s Regional Snowfall Index (RSI)

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

Table 2-7: Waterford Snowfall vs. US Average



While declared snow storm disaster have been declared for the county, Waterford has not received PA funding for these events. 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.

Ice Storm:

Major Ice Storms occurred in January, 1998 and again in December, 2013. Waterford received the most significant damage to forest stands in recorded history and power was disrupted for over seven days. 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. Waterford received .5 to 1 inch of ice. On December 13th, 2013, another ice storm hit portions of Caledonia County, including Waterford but the extent of this storm is unknown. While there is evidence that supports an increase in weather and precipitation severity, the incidence of ice storms remains fairly spaced out. 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 May of 2013 at 24.35 hours and affecting 100 customers.

Lightning

The greatest concern associated with lightning is the impact on communications, especially communications between emergency responders, from lightning striking communications infrastructure. Due to the terrain and majority of the already sparse development in low lying areas, lightning damage has not posed a threat to the town's telecommunications to an extent that requires mitigation at this time. However, communication redundancy for response agencies is an effective and suggested practice. Vermont is ranked 17th per capita in lightning related deaths (1959 – 2003). Due to the fact that many residents work outside, there is a greater chance of being struck but even with this increased potential, the likelihood is very small. The limited development in the town also reduces the risk associated with infrastructure and/or communication disruption (*Source: <http://www.nekweather.net/wxVtclimatology.php>*). No further data was available regarding losses to forest, electric service, property or life.

Hail

The town does not consider hail a significant hazard, although hailstorms can have a devastating effect on local farmers. At present there is no historical data on hailstorms in Waterford. Hail storms tend to be very localized and the frequency is low. However, with the recent increases in extreme weather and evidenced by recent hail storms like the one occurring on September 11th, 2013, where record high temperatures were observed in the state, helping to produce a severe wind and hail storm in parts of the Northeast Kingdom, the potential for more frequent hail storms is certainly a possibility. The following excerpt is from a regional NEK paper concerning the event:

"ST. JOHNSBURY -- Storms rolled into the Northeast Kingdom Tuesday, delivering severe hail, a mudslide, at least one lightning strike, road damage, and tornado warnings. "That's been the biggest news around here, the tornado warning, I think" said meteorologist Lawrence Hayes at Fairbanks Museum & Planetarium in St. Johnsbury. Hayes heard no reports of tornado sightings. He thought chances for a twister by late Tuesday afternoon were slim. "But there will still be rain and some rumbles of thunder," Hayes said at about 5 p.m. The most extreme weather Tuesday hit areas like Lowell, where hail was reported at 1.25 inches in diameter, and Albany and Holland, which both saw hail at an inch in diameter."

(Source: <http://Caledoniacountyrecord.com/Main.asp?SectionID=14&SubSectionID=113&ArticleID=24859>)

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 Waterford, 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 Waterford and the rest of the state. Waterford'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. 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 Waterford 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.

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. However, recent winters have proved to be very cold. An increase in the size and frequency of storms is also predicted. As a result, climate change in the next century will likely increase the likelihood of the above 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 in the near future. 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 conjunction with the ANR report, the primary goal of a VTtrans climate change adaptation policy

is to minimize long-term societal and economic costs stemming from climate change impacts on transportation infrastructure.

2.1.2. Flooding

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. Waterford 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 ≤ 0.15: 3.2%
0.15 < x ≤ 0.20: 5.9%
0.2 < x ≤ 0.25: .8%
0.25 < x: 4.7%

Flood Vulnerability

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 Waterford. 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 Waterford 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 Waterford. 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.

Table 2-5: Bulk PA Funding as a Result of Flooding in Waterford since 2004

Disaster	Date	Amount of PA funding--Number of projects
1559	9/2004	\$38,926--6
1698	5/2007	\$10,907--2
4001	7/2011	\$486,232--14

Source: FEMA

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*).

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 Waterford 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. Water is drained in the reservoir for power generation and floating ice gets stuck behind the dam and in spring the water is generally low. Ice on the river below Moore Dam would back up at Comerford Dam. 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 Waterford 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 Waterford. 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 Waterford, 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.” A breach of the Moore Dam would result in catastrophic flooding in the town with inundation scenarios depicted the interstate being flooded with 30 feet of water for a time.

Inundation and Floodplains

Waterford’s floodplains are depicted on a FEMA Flood Insurance Rate Map (FIRM). This map depicts the Special Flood Hazard areas, which are floodplains that would likely become inundated during a significant flood known as a “base flood.” The base flood is often referred to as the “100-year flood.” Waterford’s FIRM is not accompanied by any insurance studies or base flood elevations, which would indicate how high the water would rise in a 100-year flood event. 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 town 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. Town plans and zoning regulations have generally not identified these stream corridors as areas needing protective setbacks for development or zoning.”

Flooding is a significant hazard in Waterford. However, despite having both the Connecticut and Passumpsic Rivers, associated reservoirs and numerous brooks and ponds with geography characterized by steep alterations in elevations where infrastructure is located at the low points, there are no repetitive loss properties in the town. And while DR 4001 resulted in significant damage, the mitigation work completed prior to Hurricane Irene withstood the storm where many neighboring towns were hit just as hard. Protecting river systems as a preventative measure, protecting property, and protecting human health and safety remain priorities for flood-related hazard mitigation and response in the state and the town. The Connecticut River is the longest river in New England (410 miles) and runs through the town. Despite this, the river is not a source of major concern for the town due to the relative absence of significant development near the river (15 homes located in the floodplain and all are on River Road) yet none are repetitive loss properties. Roads most susceptible to flooding include: Simpson Brook, Hale and East Village roads. Fortunately, these are not residential roads. Designated floodplain areas include areas of the Moose River, Stiles Brook leading onto Stiles pond, the Passumpsic River and west covering a portion of the railroad and river road, Simpson Brook, Chandler Brook, Mad Brook and the Connecticut River. The Gingue Farm on Stiles Road was flooded in the May floods of 2011 but this was land inundation, not structural. Stiles road, Lower Waterford Rd. (State Road 2), Hale Road (at Duck Pond Merger) have a history of flooding to the extent that residents can become isolated without means to get in or out but there is no additional history of property damage for these residents. The Passumpsic River passes through the western corner of the town and floods almost annually. Several smaller streams have a history of overflow and resulting damage in the town. These include Simpson Brook, Chandler Brook, and Mad Brook.

The town does maintain current river corridor maps that include properties located within the river corridor (which may or may not include associated floodplains). Despite some historic damage to roads and bridges, the town remains protected from structures being damaged because of their location within the floodplain and/or river corridor and has no history of receiving major or repetitive damage to municipal buildings, critical facilities or residential property.

Fluvial Erosion

Erosion occurs on a consistent, but small-scale, basis within the riparian corridor of the towns 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 (VTrans) 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 VTrans and continually updated by the Bridge Inspection Program. Structures inspected are only those of 20 feet or longer owned by a municipality or the state. The scour critical rating is based on the structure itself, and does not take into account 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, however, the town does not have a municipal water supply. 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 for all towns in the state. Waterford remains committed to enhancing awareness and incorporating recommendations in future planning and mitigation work. There is one location in the town that is a scour site and this area is located at Simpson Brook at Hale Road in the “narrows”. This site was a major project for the town following the May flooding of 2011 but remained intact during Irene.

2.1.3. Geological Hazards

Landslides

Landslides are sudden failures of steep slopes and can cause significant damage to streams, infrastructure, and property. Landslides can be caused by fluvial processes, as discussed above. Landslides can also be caused by slope steepening due to non-fluvial erosion, increased loading on the top of a slope, or pore-water issues. Landslides can destroy or damage structures and infrastructure that lie either above or below the slope. The town has some steep slopes and roads, bridges and culverts are all vulnerable when located at the base of sloped terrain. The biggest expense for the town during the May floods during 2013 was road damage that occurred as a result of the slope above it on Hale Road. Further discussion of landslides in the *2013 Vermont State All-Hazard Mitigation Plan* contains the following:

“Overall, the state of Vermont has had a moderate to low incidence of landslides. The USGS defines susceptibility to landslides as the probable degree of response of rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. The U.S. Geological Survey has produced a map entitled “Map showing slope failures and slope-movement-prone areas in Vermont” (Baskerville and Ohlmacher, 2001, 1:250,000 scale). This map identifies about 2.8% of the land area of Vermont as having evidence of slope movements. This corresponds to a moderate susceptibility as a low incidence is defined as less than 1.5% of the land area involved. The map serves to broadly identify some of the areas susceptible to landslides and the included text provides an excellent description of the types of slides found in the state, but the map is not detailed enough to meet current needs. The map generally does not identify slope failures in unconsolidated material in the valley bottoms....areas along Lake Champlain and the Green Mountains show a high susceptibility and moderate incidence. A moderate incidence is defined as 1.5%-15% of the area is involved. On the national map, none of the significant landslide events in the United States have occurred in Vermont.”

While fluvial erosion can constitute a landslide, there is little in way of historical data on Vermont landslide events. However, following tropical storm Irene in 2011, the magnitude of rain caused widespread damage, including significant scouring of riverbanks and stream channels. The most common types of landslides in Vermont are slides, which take two general forms; rotational slumps and translational slides. The translational slides occur on a wide variety

of unstable slopes underlain by weathered, dense till, as well as slopes underlain by sandy to clayey lacustrine deposits, whereas the rotational slumps are more common on unstable slopes underlain by sandy to clayey lacustrine deposits. Both rotational and translational failures imply that the material has internal cohesion; otherwise the material would disintegrate into some sort of flow. An active landslide is one that has moved within the last year. The sides and upper margin of such a landslide are generally sharp and any exposed slide surfaces are bare of vegetation or have only the beginnings of pioneer vegetation on them. An inactive landslide has not moved within the last year, but it is in a setting in which it could be reactivated. One that has been inactive for several years may be largely revegetated, at least with pioneer vegetation. Inactive landslides are common near actively migrating stream meander bends where the site of landslide activity has shifted downstream as the stream meander has shifted downstream. The inactive slides may very well be reactivated if another meander bend migrates down from upstream. A relict slide is one where there is no evidence of movement for many years and the likely causative agent is no longer present. An example would be a former stream cut bank formed by stream erosion in early Holocene time. If the stream has since cut down vertically and moved away in such a fashion that it is now trapped by bedrock and would be unable to move back to the old cut bank, that cut bank could be considered relict. Such a feature is generally completely revegetated and the edges have been softened by erosion. The Vermont Geological Society has developed a Protocol for Identification of Areas Sensitive to Landslide Hazards in Vermont (2012). This protocol was used in Chittenden County, Vermont with inclusion into the State Hazard Mitigation Plan. Fourteen potential parameters were considered as to their effect on landslide hazard. These included locations with respect to the marine limit of the Champlain Sea, aspect, distance to stream, elevation, hydrologic group, NDVI, profile curvature, roughness, slope angle, slope height, soil type, stream power index, surficial geology, and topographic wetness index. The protocol is applicable to areas in Waterford but currently, there is no data for the town.

(source: <http://www.anr.state.vt.us/dec/geo/pdfdocs/TechReports/LandslideProtocol2012.pdf>)

Earthquake

The risk of earthquake is quite low in Vermont. The risk is low enough, however, that it is not prudent to invest in mitigation for earthquakes. The most recent earthquake felt in Waterford occurred in April 2002. This magnitude 5.2 quake occurred 87.7 miles away from town. Information provided by the Vermont Geological Survey, Department of Environmental Conservation, and the Agency of Natural Resources can be helpful in estimated the impact of an earthquake and for Waterford, the risk is 90% less than the national average.

Radiation (Naturally Occurring)

Radon gas, a naturally occurring radioactive substance that can build up in homes and can cause health problems, is enough of a concern for Vermont that health officials recommend home testing. Waterford has the average predicted level of radon (between 2-4 pCi/L). The most common strategy for dealing with a radon problem is venting of basement areas. The Vermont Department of Health recommends mitigation steps be taken based on the type of radiation.

2.1.4. Fire Hazards

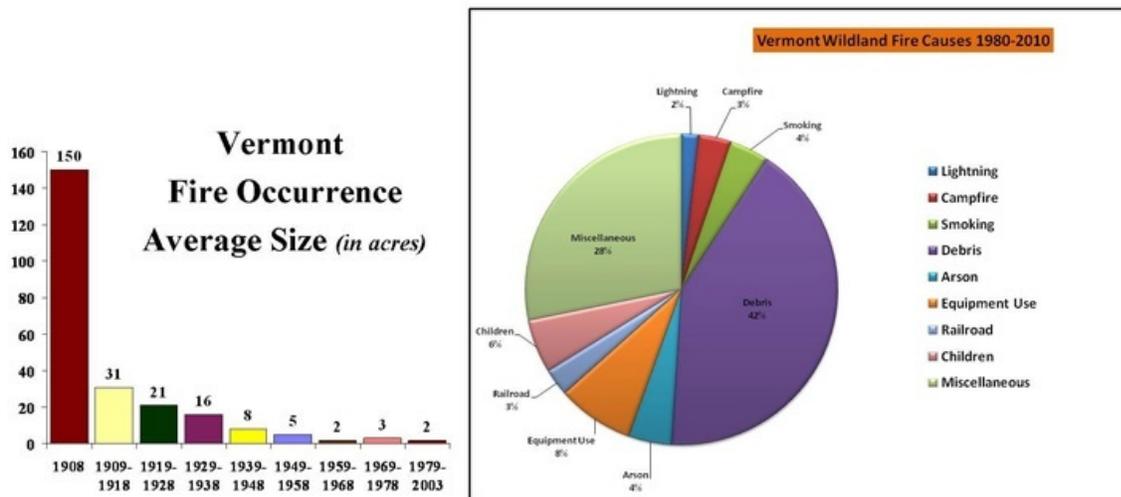
Major Fire – Urban

While structure fires have been removed from the 2013 *Vermont State All-Hazards Mitigation Plan*, the impact on the most urban area in Waterford to a fire is substantial as all buildings are in close proximity to another and a fire in one is likely to spread to the next. Vermont has one of the highest per capita death rates from fire in the nation. This is the deadliest form of disaster throughout the state. In 2000, there were 831 structural fires in the state, 12 of which resulted in 22 civilian deaths. 20 of those deaths occurred at residences. Although there have been requirements for smoke detectors in rental housing for over 20 years, and requirements for smoke detectors in single family dwellings since 1994, only one building involved in the fatal fires in 2000 had working smoke alarms. For some remote locations, access to water for emergency vehicles has been a factor in controlling an outbreak of fire. Additional risk for the town is having the required funding to supply equipment to its Fire Department. Slightly over 6% of all fire calls in 2014 were for building fires in Waterford.

Major Fire –non-developed

Due to its climate and primary vegetation types, Vermont is not considered to be at serious risk for large-scale wildfires. Despite not having had a major wildfire in the last 50 years, fire suppression systems are in place at the local level. These involve burn permits, burn restrictions, prevention, and detection of fires. Isolated homes with single access roads are more vulnerable to wildfires than more heavily populated areas, and the threat is increased during dry periods, especially in the late summer and fall. The primary forms of ‘wildfire’ fire in Waterford are brush and grass fires accidentally started by persons burning trash, leaves or brush. The town has not seen a significant fire to the extent that data has been captured in terms of duration or acreage.

Table 2-6: Vermont Fires: Size and Causes



2.2 Technological Hazards

The following discussion on technological hazards is based upon information from several sources. However, the town lacks any significant investment in utilities.

2.2.1. Utilities

Telecommunications System Failure

Land-line telecommunications services in town are largely provided by Fairpoint Communications. Fairpoint is responsible for operation, maintenance and repair of telecommunications facilities. While service outages do occur, the frequency and magnitude remains slight. Distribution of phone lines generally follows the same corridor as roads. Weather or other problems interrupting services outside of the town or even outside the State of Vermont have the potential to disrupt service in the town. Service outages that affect emergency communications are of concern to local officials. Cellular phone service lacks consistency in the town due to the varying terrain and proximity to reception towers. The concern over the prospect of a computer virus that could propagate and shut down computer systems, public and private, across the county could certainly impact the town but the likelihood of such an occurrence has not been evaluated and due to a sincere lack of businesses or critical facilities in town, Waterford, on its own remains insulated from such an occurrence.

Loss of Electrical Service

Energy resources are available to Waterford in sufficient supply. Vermont Electric Cooperative, and Green Mountain Power, and Citizens Energy supply electricity. Wood, heating oil, and propane gas are all available through local distribution. Gasoline and diesel fuel are available in adjacent towns and through local fuel suppliers. The most significant disruptions to electrical services are events which cause outages lasting more than a day and those which affect a wide area. There has not been a major electric outage in the last decade. Pike Industries has a policy to reduce consumption of electric power to divert more to the rest of the town when required.

2.2.2. Hazardous Substances

A major Superfund Amendments and Reauthorization Act (SARA) provision is Title III, also referred to as or 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 9, 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 material release is a concern for the Waterford because of the sections of state highway that run through the town. According to the Waterford Fire Department, a collection source for facility tier II reports, only the school, Pike Industries (asphalt) and Calco, Inc. (concrete) submitted a 2015 Tier II report. With this, there are minimal reported hazardous material storage sites in Waterford. Sites that contain large amounts of fuel or store what DEMHS calls Extremely Hazardous Substances are the most likely to cause significant problems in a hazardous materials incident and the town is free from such areas. Farms and businesses have smaller fuel tanks for diesel and gas. There are various sized propane tanks all around town. Garages have various automotive products, such as oil, grease and antifreeze. While any site can be the source of a spill, history remarks positively to the responsible actions of business owners and farms in the town as there have been no significant chemical spills in the town. Nearly 6% of all fire department responses were for outside waste/trash or equipment fires. Of most concern for the town is a transportation incident occurring on Interstate 93, 91 or Vermont Route 18. This reflects a pertinent issue related to local response and fire responding to major highway accidents.

According to the 2014 hazardous materials data obtained, the following sites in Waterford are required to file a Tier II report.

Table 2-4: Town of Waterford, Tier II Reporting Facilities

Owner / Facility	Type of Substance
WATERFORD SCHOOL	HEATING OIL
PIKE INDUSTRIES	LIQUID ASPHALT, NATURAL GAS, EMULSION
CALCO, INC.	CONCRETE, DIESEL

Pollution Events

No data was available or obtained beyond the hazardous materials release data. This data shows that nearly all such hazardous materials spill incidents consist of accidental discharges of gasoline, diesel or fuel oil when customers or delivery personnel are pumping these products. The majority of spills were in quantities of less than 5 gallons. DEC's *Local Planning and Zoning Options for Water Quality Protection* supports efforts that could increase water quality protection by addressing issues such as: development setbacks from ponds, lakes, rivers and streams; requiring vegetation in watercourse buffer zones; keeping thorough inventories of water bodies; and protecting and maintaining water quality through wetland protection regulations. Water resources often cross town, county, state, and national borders. A watershed's water quality can only be protected or enhanced through the cooperation of the municipalities and landowners that live, work, and play in the watershed. Pollution is not a major concern for the town at this time.

2.2.3. Transportation Incidents

The most common form of transportation incident is an automotive accident. The town is concerned about transportation-related chemical accidents and the ability of its fire department to respond to interstate accidents, when required, regardless of cause. Interstate 93, 91, Vermont

Route 18 and US-5 are the main transportation arteries in the town with I-93 and US-5 having high-accident locations as defined by VTrans. In collaboration with LEPC 9, emergency managers from NVDA, the Selectboard and Fire Department, exploring the benefits of a HMEP-grant funded study to better understand what is being transported through the town is a future goal. The interstates pose a unique challenge to the town in that it is required to assist with accidents. 18% of all fire/EMS activations for the town were vehicular accidents but not all of these were interstate-related. Proper training, safety and suitable equipment are all required for vehicular accident response calls.

High Accident Locations

VTrans has identified 10 locations on Interstate 93 (in Waterford) as high-crash sites with 87 reported accidents from 2006-2010. US-5 also was reported with two locations resulting in 10 accidents during the same time frame. (*Source: VTrans High Crash Location Report 2006-2010*).

Road Infrastructure Failure

The town has had damage to its roads, most of which occurred in the spring floods of 2011 (DR 4001), with Hale Road needing a substantial amount of repair. Despite being hit hard with DR 4001, the town did not require any PA funding in relation to road failures during Tropical Storm Irene (DR 4022). This is explained primarily by the quality of work done in the spring to improve resilience of town infrastructure as many nearby towns were hit just as hard by 4022 as they were in 4001. The remainder of historic PA assistance for infrastructure has been relatively minor with ditching and drainage projects not exceeding \$15,000 per project. Non-declared disaster damage to infrastructure has also occurred and will be described in a later section. As with any town, each year provides both new areas in need of upgrade and/or repair as well as new funding opportunities. These locations for the next five years will be addressed in another section.

2.3 Societal Hazards

The following discussion of societal hazards is based upon qualitative information from discussions with law enforcement professionals as well as quantitative data from the State of Vermont. The 2013 Vermont State All-Hazards Mitigation Plan is also referenced.

2.3.1. Crime

Vermont crime statistics indicate a total downward trend in crime based on data from 13 years prior when violent crime was increasing and property crime was decreasing. Overall, the total crime rate for 2015 is expected to be lower than 2012. Vermont remains lower on every statistical crime scale in comparison to the country as a whole. The town does not feel that crime is a major issue currently. With several current and retired law enforcement officials residing in the town, adding to the overall consensus that Waterford is a very safe place to live, residents do not report a perceived need to address crime in the town. However, with a significant increase in drug-related crime in nearby St. Johnsbury, theft and other drug-related activity are becoming a concern for the region.

2.3.2. Terrorism

A threat to the town exists in an act of terrorism at the Moore or Comerford Reservoir. A small bomb could result in major flooding very quickly in the town. Regarding terrorism in Vermont, the *2013 Vermont State All-Hazards Mitigation Plan* states:

“Terrorism and civil hazards include actions intentionally aimed at threatening lives and property. They may range from a single person on a shooting rampage to a cyber attack that harms computer systems, to the organized use of weapons of mass destruction (WMD). WMD events could involve chemical, biological, explosive or radioactive weapons. DEMHS and Vermont State Police conducted a risk/threat assessment of potential WMD attacks in 2000 that ranked potential targets by State Police district. At that time, no known or suspected terrorists have been identified as operating in Vermont. However, some in the U.S intelligence community believe that radical Islamist/extremist organizations may have small cells in Montreal and Toronto, not far from the US border. In this regard, Vermont is considered a potential transit point for terrorist organizations operating out of Canada who may travel through the state to reach points to the south....Vulnerability studies conducted at the state level have focused on dam security-”

The town is not responsible for operations or security at the Dams but they do actively participate in drills and exercises and would be required to play a role in the notification procedures associated with a breach, regardless of cause.

2.3.3. Epidemics and Mass Casualty Incidents

Fatal or serious contagious diseases are increasingly being considered as hazards. In the US, influenza kills an average of 36,000 people per year. An influenza epidemic on the scale of that which occurred in 1918 could potentially sicken up to 35% of the population, including over 200,000 people in Vermont (Vermont Department of Health, *Pandemic Influenza Preparedness and Response Plan*, 2012). Due to the process of manufacturing vaccines, sufficient supply might not be available in the event of a serious outbreak of influenza. Concerns about avian influenza in 2006 prompted the Vermont Department of Health to issue a report, the *Pandemic Preparedness and Response Plan*, outlining the state’s response to an avian influenza epidemic. There is also concern over how to distribute supplies, enforce quarantines, keep critical personnel from becoming ill, and disseminate information in the case of an epidemic. Other health threats mentioned in the Vermont State All-Hazards Mitigation Plan are water or food supply contamination, bioterrorism, an epidemic affecting farm animals and poultry, and rabid animals. Of these, avian influenza remains a concern for state officials and Vermont poultry owners, regardless of size. The Vermont Agency of Agriculture recommends adherence to strict disease prevention measures. Rural communities have an inherent protection from epidemics compared to densely population urban areas. As with any disaster, effective and planned communication is crucial to protecting the safety of residents. Waterford is not a community with high percentage of poultry farmers.

2.3.4. Food Supply Crisis

Some state and local officials have become concerned with the ability of local and regional food systems to adequately feed the population in the event of a fuel shortage or other emergency that disrupts inter- and intra-state food supply chains. Given the rural nature of Waterford, a food supply issue remains a concern but less of one compared to a more densely populated area. There are no grocery stores in the town. However, there are food-supply retailers less than 10 miles away. Given the right circumstances (e.g. prolonged road closures or mass urban influx resulting from a disaster), resources could become scarce. The State's Commodity Point of Distribution (CPOD) Plan addresses a food supply crisis but it remains up to individual regions and associated towns to plan for the dissemination of supplies in an actual event.

2.3.5. Economic Recession

The United States formally entered a recession in December 2007, which dramatically accelerated in September 2008. Vermont was not among the states hardest hit by the recession. According to the Vermont Department of Labor, unemployment in Vermont increased by 2.6% to 6.7% between January 2008 and January 2010, and was above 7% for much of 2009. As of January 2010, the unemployment rate in Waterford was lower than the state average and the average annual individual income was higher than the state average.

SECTION 3: RISK ASSESSMENT

This section first explores and defines specific locations of known, historic risk within the town with a disaster and non-disaster expenditure summary. Following, a qualitative risk analysis is documented for each hazard category. The highest ranked hazards, coupled with historic data, therefore, substantiate the profiled hazards in this update.

3.1 Designated Hazard Areas

3.1.1 Flood Hazard Areas

According to the Waterford Town Plan, designated flood hazard areas exist in the town but most major infrastructure and roadways are out of harm's way. 12 residences are in the floodplain and no commercial property other than hay fields and a few hay barns exist with the 100-year flood plain. Roads most susceptible to flooding include: Simpson Brook, Hale and East Village roads. Fortunately, these are not residential roads. Designated floodplain areas include areas of the Moose River, Stiles Brook leading onto Stiles pond, the Passumpsic River and west covering a portion of the railroad and river road, Simpson Brook, Chandler Brook, Mad Brook and the Connecticut River. Stiles road, Lower Waterford Rd. (State Road 2), Hale Road (at Duck Pond Merger) have a history of flooding to the extent that residents can become isolated without means to get in or out. The Passumpsic River passes through the western corner of the town and floods almost annually. Several smaller streams have a history of overflow and resulting damage in the town. These include Simpson Brook, Chandler Brook, and Mad Brook. With strict zoning

laws regarding development in the flood hazard area and as stated in the 2013 Waterford Zoning Bylaws:

1. Development within the floodway is prohibited unless a registered professional engineer certifies that the proposed development will not result in any increase in flood levels during the occurrence of the base flood.

2. Junkyards and storage facilities for floatable materials, chemicals, explosives, flammable liquids, or other hazardous or toxic materials, are prohibited within the floodway.

The major risk for the town is road, bridge and culvert damage which can then have a secondary risk associated with resident's being isolated due to impassable roads. The state tracks and rates bridges and culverts for each town. The most recent Culvert Inventory is included in Appendix C.

3.1.2. Fluvial Erosion Hazard Areas

Simpson Brook at Hale Road is rated as Scour Critical by the State Agency of Natural Resources. With the amount of work put into this area after the May floods of 2011 however, the resilience of this area has been significantly improved. While portions of the Mad Brook have some fluvial erosion potential, the town has not seen any major increase in erosion since 2011, when repeated flooding inundated much of the state. In light of this and the potential for more severe weather events, the town remains cautious and realizes that the situation can change quickly. In support, Vermont has seen a dramatic increase in agency collaboration in recent years. The results of this enhanced cohesion has resulted in several published resources for all towns to use to guide mitigation efforts and enhance resiliency. With the recent emphasis on climate change and subsequent weather-related disasters, the town remains committed to aligning with all applicable and logistically feasible recommendations and considerations resulting from the work of State agencies. River Corridor Maps have been produced and lists associated properties and infrastructure. While there are some properties very close to the defined river corridor, very few are located within it. Appendix A includes the river corridor map for the town with properties and infrastructure indicated. This map can serve as a basis for developing mitigation strategies and/or outreach strategies.

Repetitive Loss Properties:

The town has no repetitive loss claims or properties according to the FEMA Repetitive Losses / BCX Claims spreadsheet for Vermont.

3.2 Non-designated Hazard Areas

3.2.1. 1998 Ice Storm Damage

Impacts of the January 1998 ice storm in Waterford were minimal in comparison to other areas of the state.

3.2.2. 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 runs along VT RT 105

and the Vermont Agency of Transportation along with utility providers work to keep limbs trimmed.

3.3 Previous FEMA-Declared and Non-declared Natural Disasters

Since 2007, the town has had \$587,000 in road expenses resulting from washouts and flooding. Of this amount, \$64,000 (10.9%) has been paid for by the town. The remainder has been paid for by FEMA and ERAF. Waterford has received public assistance funding from FEMA for the following natural disasters:

Table 3-1: Town of Waterford, FEMA-declared disaster Summary, 2004-2015

Disaster #	Date	Type
1559	09/23/2004	Severe Storm(s)
1698	05/04/2007	Severe Storm(s)
4001	07/08/2011	Severe Storm(s)

Table 4-2: Town of Waterford, FEMA-declared disasters and snow emergencies, 2004-2015

Disaster Number	PW Number	Application Title	Applicant ID	Damage Category Code	Project Amount	Federal Share Obligated	Total Obligated
4001	217	TIM Waterford Old County Grime	005-77125-00	C - Roads & Bridges	\$20,119.48	\$15,089.61	\$15,089.61
4001	218	TIM Waterford Simpson Brook	005-77125-00	C - Roads & Bridges	\$83,932.93	\$62,949.70	\$62,949.70
4001	222	TIM Waterford Lee Farm	005-77125-00	C - Roads & Bridges	\$10,343.86	\$7,757.90	\$7,757.90
4001	223	TMWAC12	005-77125-00	C - Roads & Bridges	\$6,385.97	\$4,789.48	\$4,789.48
4001	226	TMWAC09 E. Village Road	005-77125-00	C - Roads & Bridges	\$46,581.89	\$34,936.42	\$34,936.42
4001	317	TMWAC01 Hale Road: Lower	005-77125-00	C - Roads & Bridges	\$33,220.22	\$24,915.17	\$24,915.17
4001	364	TMWAC02	005-77125-00	C - Roads & Bridges	\$85,132.57	\$63,849.43	\$63,849.43
4001	366	TMWAC10 Valley View	005-77125-00	C - Roads & Bridges	\$35,999.25	\$26,999.44	\$26,999.44
4001	378	TMWAC06 Old County Rd (power side)	005-77125-00	C - Roads & Bridges	\$20,806.92	\$15,605.19	\$15,605.19
4001	382	TMWAC11 Mad Brook Rd.	005-77125-00	C - Roads & Bridges	\$82,983.80	\$62,237.85	\$62,237.85

4001	383	TMWAC07 Daniels	005-77125-00	C - Roads & Bridges	\$16,078.22	\$12,058.67	\$12,058.67
4001	384	TMWAC08 High Ridge	005-77125-00	C - Roads & Bridges	\$18,435.06	\$13,826.30	\$13,826.30
4001	409	PRWAB01	005-77125-00	B - Protective Measures	\$6,688.56	\$5,016.42	\$5,016.42
4001	547	TMWAC01 Hale Rd. Bank Stabilization	005-77125-00	C - Roads & Bridges	\$115,000.00	\$86,250.01	\$86,250.01
1559	81	GRAVEL ROAD AND DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$5,549.98	\$4,162.49	\$4,415.57
1559	82	GRAVEL ROAD AND DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$7,491.11	\$5,618.33	\$5,959.92
1559	83	GRAVEL ROAD AND DRAINAGE DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$14,604.78	\$10,953.59	\$11,619.58
1559	84	GRAVEL ROAD EROSION	005-77125-00	C - Roads & Bridges	\$1,863.13	\$1,397.35	\$1,482.30
1559	85	GRAVEL ROAD AND DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$17,456.61	\$13,092.46	\$13,888.48
1559	86	GRAVEL ROAD AND DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$4,935.60	\$3,701.70	\$3,926.77
1698	93	DEBRIS REMOVAL	005-77125-00	A - Debris Removal	\$12,719.65	\$9,539.74	\$10,119.75
1698	109	DONATED RESOURCES	005-77125-00	B - Protective Meas.	\$1,822.77	\$1,367.08	\$1,450.19
1559	81	GRAVEL ROAD AND DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$5,549.98	\$4,162.49	\$4,415.57
1559	82	GRAVEL ROAD AND DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$7,491.11	\$5,618.33	\$5,959.92
1559	83	GRAVEL ROAD / DRAINAGE DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$14,604.78	\$10,953.59	\$11,619.58
1559	84	GRAVEL ROAD EROSION	005-77125-00	C - Roads & Bridges	\$1,863.13	\$1,397.35	\$1,482.30
1559	85	GRAVEL ROAD AND DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$17,456.61	\$13,092.46	\$13,888.48
1559	86	GRAVEL ROAD AND DITCH REPAIR	005-77125-00	C - Roads & Bridges	\$4,935.60	\$3,701.70	\$3,926.77
1698	93	DEBRIS REMOVAL	005-77125-00	A - Debris Removal	\$12,719.65	\$9,539.74	\$10,119.75
1698	109	DONATED RESOURCES	005-77125-00	B - Protective Measures	\$1,822.77	\$1,367.08	\$1,450.19

Sources: Town Records, Project Worksheets, financial report forms and award letters.

Non-Declared Disaster Summary:

As with any municipality, maintaining transportation routes through road, bridge and culvert repair and replacement is ongoing and requires fiscal, environmental, communication and engineering planning to be successful. The work accomplished in Waterford since 2010 that was not directly related to a declared disaster is included below. Important to note is the fact that many of the sites listed are in designated hazard areas (highlighted in **bold**).

Table 3-3: Major Road Repairs not due to Disaster

year	project name	work done	total cost	state pay	town pay
2010	Hale Road Culvert	box culvert	59,487.62	53,538.86	5,948.76
	Higgins Hill Rd	resurfacing			6,533.45
	Lower Waterford Rd paving	paving			8,342.14
	Moore Dam Rd	reclaiming			29,675.59
2011	Lower Waterford Rd paving	paving	176,121.04	140,000.00	27,121.04
2012	Daniels Farm Rd	resurfacing	29,297.44		29,297.44
	Riverside Cemetery Rd	culvert	57,451.50		
	Gravel Resurfacing		44,418.94		44,418.94
	Ditch & Culvert		25,489.28		25,489.28
2013	Hale Road	resurfacing			37,086.93
	Duck Pond Rd	paving			8,877.08
	(used Duck pond Road fund)				
2014	Lower Waterford Rd	paving	205,502.94	140,000.00	65,502.94
	River Road	concrete over bad culvert			7,350.46
	Simpson Brook Rd	d&c & resurfacing			17,679.58
	High Ridge Rd	Undercut, new base & top at jct			15,569.11

Note: Total cost is included in “town pay” when total cost and state pay are blank

3.4 Future Events

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 the fall 2015. This analysis assigns numerical values to a hazard’s affected area, expected consequences and probability. 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. Although all assets may be affected by hazards, some assets are more vulnerable because of their physical characteristics or socioeconomic uses. This section provides an overall summary of the town’s vulnerability to the identified hazards. 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:

1. Health and Safety Consequences
2. Property Damage
3. Environmental Damage
4. Economic Disruption

Probability of Occurrence: Scored from 1-5, estimates the anticipated frequency of occurrence.

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.

3.4.1. Natural Hazards

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

- Severe Winter Storm (32)
- Flooding (44)
- High Winds (24)
- Lightning (25)

Flooding remains the most likely event to incur the most cost for the town based on historical analysis and disaster declaration-related funding since 2004 has all been a result of severe rain storms. Given the magnitude of damage to such few areas during DR 4001, the realization that a major flooding event can result in major expense is evident, lending support that that flooding is likely to have a significant impact over a smaller area while a severe winter storm tends to affect the entire town. As with most Vermont towns, there is almost an inherent resilience to winter weather events because they are expected. However, as severity increases and consequences mount (e.g. power outage, road closures, etc.), the risk for health and safety also increases. High wind and lightning events happen and have the potential to disrupt functionality of the town but the town is not at any increased risk in comparison to other areas of the state but the sum area impacted and probability of occurrence raise these two events in the hazard analysis methodology.

3.4.2. Technological Hazards

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

- Power Loss (32)
- Major Transportation Incident (25)
- Hazardous Materials Incident (16)

Waterford 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, northeast communities as a whole must address the potential of a long term outage and plan accordingly. With the relationship between the natural hazards of lightning and high winds and power outages, these hazards (and vulnerabilities) are closely linked and will be addressed as such in later sections. Due to the amount of high-accident locations in the town, a major transportation incident, especially if combined with a hazardous materials incident could pose a hazard to the town in terms of environmental damage and risk to health and safety of the residents, including response personnel. A hazardous materials incident resulting in a school evacuation is possible but the likelihood is diminished greatly by the fact that the highest volume of traffic (e.g. asphalt trucks from Pike Industries) occurs during the summer months when school is not in session.

3.4.3. Societal Hazards

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

- Epidemic (8)
- Terrorism (7)

The likelihood of an epidemic is difficult to gauge, but its consequences could be severe and felt over the entire state and most likely, nation-wide. The largest organizations in the town (and the ones with the highest populations on any given day) would be most susceptible to becoming zones of high attack rates and the town would look to State Health Department recommendations on closure notices. The risk of animal-borne epidemics has increased for the region with another rise in cases of avian influenza. The financial consequence of a major disruption in the Vermont poultry industry, all the way down to a small farm producing for its community could be drastic. Because of the rural nature of the town, there are few societal hazards that are a main concern aside from the potential breach of the Moore Dam caused by any act (including domestic or foreign terrorism). But the risk of a breach is very small despite having large consequences.

Table 3-5: Societal hazards risk estimation matrix

Waterford Hazard & Risk Analysis: SOCIETAL HAZARDS		<i>Crime</i>	<i>Civil Disturbance</i>	<i>Terrorism</i>	<i>Epidemic</i>	<i>Economic Recession</i>	<i>Key Employer Loss</i>
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	1	1	1	4	2	1
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	1	1	2	2	0	0
<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	1	1	1	0	0	0
<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	0	0	2	0	0	0
<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	1	1	2	2	2
Sum of Area & Consequence Scores		4	4	7	8	4	3
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	1	1	1	1	1
TOTAL RISK RATING							
	Total Risk Rating =						
	Sum of Area & Consequence Scores	4	4	7	8	4	3
	x Probability of Occurrence						

3.5 Hazard Summary

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

1. Flooding
2. Severe Winter Storm
3. Power Loss (as result of snow, ice, lightning and/or high winds)
4. Telecommunications Failure
5. Major Transportation Incident
6. Epidemic

It should be noted that two natural hazards on the list—severe winter storm and flooding—could be the cause of the highest-rated technological hazards, power loss and telecommunications failure. Flooding is highest rated hazard for Waterford, due in large part to their widespread nature and frequent occurrence. A severe winter storm is expected and while the town is well-equipped to handle winter storms, the resilience of its residents is dependent on effective town emergency planning when intervention strategies are required.

SECTION 4: VULNERABILITY ASSESSMENT

Vulnerability refers to the potential impact of a specific loss related to an identified risk. Waterford 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 vulnerability is low as all critical facilities are not in the SFHA. There are roads, bridges and culverts vulnerable to flooding and those are identified below. The hydroelectric plant (Moore Reservoir) is a concern solely because dams are identified targets for malicious activity (terrorism) and the impact of such activity could be catastrophic but the town does not manage the Dam. Additionally, loss of fire and rescue services due to equipment issues (unrelated to profiled hazards however) makes the town vulnerable in several ways.

Of the profiled hazards, the following vulnerability rating (high, moderate, low) is given below. This vulnerability rating is based on the disaster case history for the town and when the greatest financial impact was seen due to the disaster. 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 Waterford residents, workers or travelers.

Severe winter storm: Moderate

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. Since 2005, there has been no major development that

has impacted vulnerability to severe winter storms. However, routine maintenance and an evolving road improvement process has made mitigating snow-covered roads safer and more efficient with improved crowing and reduction of inconsistencies in road surface that can damage plowing equipment.

Power loss: Low

Summary: Infrastructure and people are vulnerable to power loss during extreme cold due to potential of pipes freezing and maintaining safe body temperatures. While this remains a risk for the entire state, every year, case history does not substantiate a high or even moderate vulnerability at this time.

Flooding: High

Summary: The greatest vulnerability for the town is flooding and this is specific to transportation routes and infrastructure more-so than buildings and people. However, a dam failure would have catastrophic implications on homes, buildings, people and equipment. The magnitude of financial resources devoted to flood-related damage in the town equates to high vulnerability.

Telecommunications failure: Low

Summary: With increased reliance on cell phones and that cell service is less than ideal within the town, the vulnerability is low. Residents in need of notifying rescue, fire or police services are vulnerable during a failure.

Major transportation incident: Low

Summary: Vulnerability exists for town-level rescue and fire services when responding to highway accidents where risk for injury is significantly enhanced. The town is vulnerable to this hazard on a likelihood of event level due to high accident locations of state highways running through the town. With this, town equipment is vulnerable to damage during response as well.

Epidemic: Moderate

Summary: All residents are vulnerable to an epidemic with increased vulnerability at high attack-rate locations (e.g. school, senior living/group homes).

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.” *Map 4-1* shows the geographic distribution of some critical facilities and utilities. *Table 4-1* identifies critical facilities in Waterford, excluding critical facilities designated as hazardous materials storage sites. As mentioned in the summaries above, some critical facilities have increased vulnerability during specific hazard events. However, there is no evidence to suggest that any critical facility is highly vulnerable during any hazard event.

Table 5-1: Critical facilities in the Town of Waterford

Facility Type	Number of Facilities
Education Facility	1
Fire Station	1

Emergency Shelters	2
Emergency Operations Center	1
Government	1
Hydroelectric plant	1

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

The following is a statistical overview of roads in the Town of Waterford. These tables show the range of road types within the town, from highways to unpaved roads. The different road types have different hazard vulnerabilities. Unpaved roads are more vulnerable to being washed out in a flood or heavy storm, while traffic incidents are more likely to occur on large, arterial roads.

Table 4-2: Town highway mileage by class, Town of Waterford

Class 1	Class 2	Class 3	Class 4	State Hwy	Fed Hwy	Interstate	Total 1, 2, 3, State Hwy
0	10.5	30.51	9.01	13.88	0	0	63

Source: data derived from VTrans GIS data –Waterford Town Plan

4.2.2. Bridges, Culverts, and Dams

Bridges:

Scour is by far the primary cause of bridge failures in the United States. Regionally, the vulnerability of bridges to flood damage became evident from the damage seen to Vermont bridges in the 2011 Tropical Storm Irene. Successfully mitigating scour-related problems associated with bridges depends on the ability to reliably estimate scour potential, design effective scour prevention and countermeasures, design safe and economical foundation elements accounting for scour potential, and design reliable and economically feasible monitoring systems. (*Scour Damage to Vermont Bridges and Scour Monitoring: UVM Transportation Research Center Report 15-002 June 10, 2015*).

There are five bridges in the town:

1. Higgins Hill
2. Lower Waterford Road
3. Mad Brook
4. Shadow Lake
5. Simpson Brook

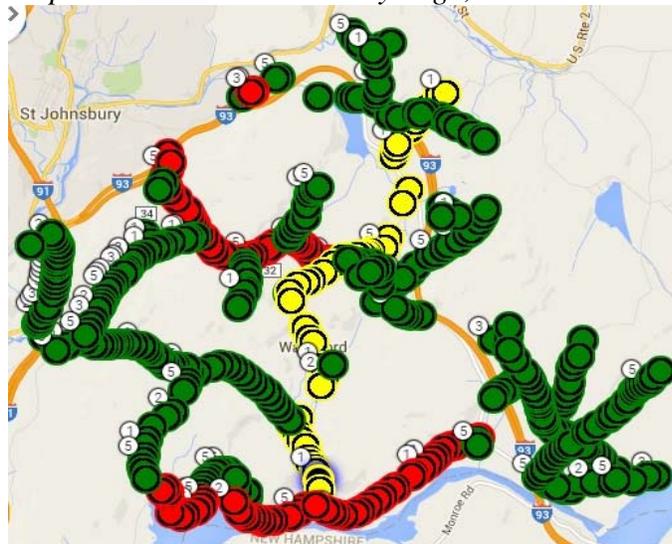
According to the VTCulverts.org, only the Lower Waterford Road Bridge (Latitude: 44.344768648230264 Longitude: -71.98973389894846) is considered “High Importance”. Unfortunately, information on the condition rating for these bridges was not available during the development of this plan. Bridges are expensive and the Lower Waterford Road and the Simpson Brook bridges are most vulnerable due to geographical location and prior history of damage in the area but specifically to the bridges themselves.

The entire Bridge Inventory with maps for the town can be found on the state site: <https://vtculverts.org/bridges#list>

Culverts:

The Town maintains a culvert inventory that assesses over 500 culverts with data on length, overall condition, size and location. This data guides the town’s culvert maintenance and replacement plan. High Risk Culvert areas (Red dots) include: Daniels Farm Rd., Lower Waterford Rd and one location on I93. Duck Pond: Medium Risk are indicated by yellow dots and low risk in green. Appendix B includes a comprehensive and current list of all culvert locations, material and condition. Since 2005, the culvert maintenance program has succeeded in reducing vulnerabilities for road washouts during flood events. The PA funding and listed projects provided in this plan explain, specifically, the work that was accomplished to reduce vulnerability to the areas of road listed. The work accomplished as result of the May 2011 flood events have had the greatest impact on reducing vulnerability for town roads as proven by the reduction in damage during the September 2011 flood event.

Map 3-1: Culvert locations by High, Medium and Low Risk of Flooding



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

Dams:

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.” TransCanada Hydro Northeast Inc. (“TransCanada”), owner and operator of the *Moore and Comerford Dams* is required to update

and reprint its Emergency Action Plan for the dam every five years pursuant to requirements under the Federal Regulatory Commission (FERC). In 2011, TransCanada chose to perform a wholesale update including development of a new dam breach model, a new river routing model, new EAP inundation mapping including GIS data, and added their emergency management system (Incident Command System) for response procedures into the EAP document. In the maximum inundation model, Waterford would experience significant (if not catastrophic) flooding. Security systems are in place and the town, itself, does not maintain responsibility for the dam or its security but is very vulnerable to a dam failure regardless of cause. The TransCanada plan assesses the following structures within potential inundation areas:

- Schools
- Hospitals
- Structures
- Railroads
- Bridges
- Roads
- Municipal Boundaries

The plan also maps Breach and Non-Breach Conditions that may occur during a probable maximum flooding event.

Water, Wastewater and Natural Gas Service Areas

The Town currently has no water, wastewater or natural gas service areas. Water and sewer systems are the sole responsibility of the property owner and they are required to meet state and federal regulatory standards. Vulnerability is low for the town.

Electric Power Transmission Lines and Telecommunications Land Lines

High-tension electric transmission run through the Town of Waterford, running along VT RT 105. Vulnerability is low for the town.

4.3 Estimating Potential Losses in Designated Hazard Areas

Flooding: 12 residences and 0 commercial/industrial structures are located within the 100-year floodplain. Assuming the most recent median grand list value, the estimated potential losses due to a major flood event inundating the floodplain is less than 1%. This estimate only takes structures into account, it does not account for personal property or business losses. In regards to town roads, losses can and have been substantial. With an approximate total cost of \$500,000 to repair damages incurred during DR4001 and with a substantial percentage of damage occurring in the designated hazard areas, the town's entire yearly road budget could be exhausted with one event. Fortunately, the town has no repetitive loss properties.

Severe winter storm: While the town could lose equipment during response to a major storm and/or a building and while the loss would be great, the likelihood of this occurrence is considered low enough to not devote further investigation and equipment/building insurance would mitigate the loss.

Telecommunications failure: Negligible loss for the town

Epidemic: An epidemic impacting the region, state or country could have catastrophic financial implications for the town. Lower tax base due to mass death of population along with reduction in work force to keep operations of town going are concerns. The likelihood of this occurrence is considered low enough to not devote further investigation.

Major transportation incident: The town is aware of its response vehicle value and any loss during response would be covered by insurance.

Power loss: Negligible loss for the town

4.4 Land Use and Development Trends Related to Mitigation

The land use plan represents a broad policy statement of the desired future land uses in Waterford and as such is a summation of all the other surveys, inventories, analyses, and categorical plans which have preceded it. It is also based on surveys of existing conditions and trends and capabilities relative to land use. It is intended to work as a guide to public officials and private citizens in coordinating the future development of the town. It is the document upon which the Town's Zoning Bylaw is based. As a participating municipality in the NFIP, the town is committed, through its zoning laws, to minimize flood vulnerability to the greatest extent possible. There have been no changes in development in hazard prone areas that have impacted vulnerability since 2005.

4.4.1. Future Development and Housing

The 2013 Waterford Zoning Bylaws hold to the recommended practices under the NFIP and all continued compliance and participatory requirements are managed by the town Zoning Administrator. The Planning Commission has, as part of the mitigation planning process, discussed implementing regulations that simply will not allow development of any kind within the defined flood hazard area. As a participating community in the NFIP, the following graph represents the currently available information regarding properties with Flood Insurance (two residential, single family properties). There are no repetitive loss properties in the town.

Table 4-2: NFIP Policies in Waterford

Community:		WATERFORD, TOWN OF		State:		VERMONT		
County:		CALEDONIA COUNTY		CID:		500200		
Overview	Occupancy	Zone	Pre/Post FIRM					
Policies in Force				Premium	Insurance in Force	Number of Closed Paid Losses	\$ of Closed Paid Losses	Adjustment Expense
Single Family			2	\$872	\$700,000			
2-4 Family			0	\$0	\$0			
All Other Residential			0	\$0	\$0			
Non Residential			0	\$0	\$0			
Total			2	\$872	\$700,000	0	\$0.00	\$0.00
Policies in Force				Premium	Insurance in Force	Number of Closed Paid Losses	\$ of Closed Paid Losses	Adjustment Expense
Condo			0	\$0	\$0			
Non Condo			2	\$872	\$700,000			
Total			2	\$872	\$700,000	0	\$0.00	\$0.00

Source: <http://bsa.nfipstat.fema.gov/reports/reports.html>

4.4.2. Housing

The majority of Waterford's housing stock has been rated in "sound" condition with 20 mobile homes, the majority of which are occupied full time. The town maintains the ruling that *"dilapidated houses that are standing vacant should be condemned and removed by public order, as they pose potential problems to public health and safety."* (Waterford Town Plan).

Additional housing regulations that support mitigation in a primary and/or secondary sense are as follows:

"3. Mobile and modular homes are recognized as a form of housing and it is intended that provision be made for their use in the Town. Mobile and modular homes will be permitted anywhere in Town that conventional single-family dwellings are permitted. Regulations pertaining to mobile and modular homes should be incorporated into the Zoning Bylaw requiring them to have permanent foundations.

4. Recreational vehicles should not be allowed for use as a dwelling unit for more than 30 days in any calendar year without special approval by the Development Review Board, and recreational vehicles and campgrounds should only be allowed in the Rural Residential District and only after site plan approval by the Development Review Board.

5. Large housing developments (five lots or more) should not be permitted unless they are proven to be completely self-contained in terms of services and facilities open space, new road construction and maintenance, and only upon site plan approval by the Development Review Board.

6. It is the Town's desire to: 1) retain its presently dispersed settlement pattern; 2) retain the pristine quality of environment waters and prevent soil erosion; 3) protect its resources, agricultural and forest land, historic and scenic areas, natural resources; and 4) retain a balance between town revenue and town expenses."

4.4.3. Roads

The town has listed the following recommendations regarding future town road plans in its Town Plan:

- No new construction of roads is necessary
- The present classification system should remain as is, and there should not be any up grading of classifications
- It is recommended that Route 18 be maintained at its present level as a Class 1 primary highway and not be downgraded

The town has identified the following sites as priority in its 2015 Road Erosion Site Inventory:

- River Road (Culvert Failure)
- Lower Waterford Road (Concrete failure)
- Mad Brook Road (Vulnerable Culvert)
- Duck Pond Road (Pipe upgrade needed)
- Hale Road (Needs box culvert upgrade)
- Old County Road (Undersized Culvert)

SECTION 5: MITIGATION STRATEGIES

5.1 Waterford Town Goals and Policies that support Hazard Mitigation

5.1.1. Flood Resilience Goals:

- a. Continue supporting state standards with local, POS water/sewer sources.
- 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 whereby 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. Formalize the planning commission stance on not allowing development in known flood hazard areas.
- e. Mitigate Waterford's flood hazards in the most cost-effective manner possible.
- f. Minimize the risk exposure and associated expense to Waterford tax payers.
- g. Ensure the Town and its facilities are prepared to meet the demands of the next flood.
- h. Ensure the Town can receive the maximum outside assistance in the event of the next Federally declared disaster.
- i. Identify and protect natural flood protection assets, including floodplains, river corridors, other lands adjacent to streams, wetlands, and upland forested cover.
- j. Review and evaluate river corridor information to protect property and natural flood protection measures.
- k. Consider adopting regulations that will protect erosion prone areas for additional development and encroachment.

5.1.2. Capital Improvement Goals

- a. Provide services and facilities deemed necessary for the orderly and rational development of the Town.
- b. Assure that the Highway Department has enough funding to fulfill the goals of the following year and in adjunct, increase awareness on eligibility requirements for infrastructure projects under the Hazard Mitigation Grant Program (HMGP).

- c. Continue to meet or exceed 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.
- d. Continue to update the Town's transportation infrastructure information in the Vermont Online Bridge and Culvert Inventory Tool (vtculverts.org).
- e. Replace undersized and failing culverts.

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 LEPC meetings, drills and exercises to increase awareness, enhance planning and promote resilience in the community.

5.1.4. Regulatory Devices Goals

- a. Continue to amend and enforce zoning bylaws that promote flood protection.
- b. Continue participation in the National Flood Insurance Program (NFIP) and reflect or exceed recommendations for best practices accordingly in Zoning Bylaws.

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 protect public health, safety, and welfare by preventing or minimizing hazards to life and property due to flooding, and to ensure that private property owners within designated flood hazard areas are eligible for flood insurance under the National Flood Insurance Program (NFIP).
- b. Follow recommendations associated with a "No Adverse Impact" methodology in land use decisions.

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 in this plan.
- c. The Planning Commission should work with the NVDA 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. The Planning Commission shall also be an active participant in the local management plans for Waterford's Natural Areas.
- e. With recent FEMA guidance on Climate Resilient Mitigation Actions funded under the HMA program, the town will incorporate recommendations accordingly. In line

with the VTrans 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 town 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

f. 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

5.1.6. Policies

- a. Through both town and state-level management, 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 the Town Capitol Budget and Road Plan
 - Identify and manage pollution, flooding and fluvial erosion hazards along rivers and streams as they arise

5.1.7. Transportation

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 to keep traffic at appropriate speeds and timely maintenance, 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.
- e. Ensuring that owners and managers of recreational areas provide and maintain adequate and safe parking facilities.
- f. Continuing long term access opportunities to gravel and sand deposits for future road maintenance use.
- g. Consider implementation of a formal tracking mechanism by-which all infrastructure work is accounted for on a site-by-site basis. The purpose of this is to open funding possibilities under the HMGP.
- h. Continue to enhance understanding of the Incident Command Structure (ICS) as means to achieving enhanced communications during a response phase where significant increases in highway department responsibilities are required.
- i. Using ICS as a foundation, develop a Standard Operating Procedure for enhanced Highway Department activity (snow and/or flood related) that details the relationship and responsibilities of the Road Commission (Selectboard), Road Foreman and employees that is based on best practices and needs through a collaborative effort.

5.1.8. Utilities and Facilities Goals

- a. Maintain current relationships with the Vermont State Police and rescue for police and emergency medical services, respectively.
- b. Identify effective locations for tanker truck access to water in portions of town that currently do not have adequate supplies.
- c. Promote high-speed internet access throughout town to assist and encourage local businesses to reside in Waterford.
- d. Identify resources/grant programs that can serve to enhance the equipment resiliency of the fire department.

5.1.9.1 Educational Facilities

- a. 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.

5.2 Existing Town of Waterford 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 town has successfully pursued funding to address needs as evidenced by the Total Highway Revenue for 2014 at \$752,584.89 (\$496,130.00 from taxes) and budgets nearly \$700,000 for the Highway Department and approximately \$70,000 for its fire department with slightly over \$90,000.00 in Fire Department Revenue in 2014. Using Better Back Roads, Structures Grants, FEMA funding streams and its own resources, the town has been able to enhance its transportation resilience and overall preparedness. By and large, road improvement projects remain the primary focus for the town and the areas identified in the 2015 Road Erosion Site Inventory 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. The town will seek local, state and federal resources to address these sites systematically and as new priorities arise in the next five years. Along these lines, the town has adopted Road and Bridge Standards that meet or exceed the 2013 standards. The town is in process of updating its Town Plan and has updated its Local Emergency Operations Plan. The town participates in the NFIP and has Zoning Regulations that reflect its commitment to mitigating flood risk. The towns Emergency Management Coordinator is active in attending drills and exercises and the school has a crisis planning team and the technology to alert residents of emergencies related to school operations and potentially, all-hazards. Table 5-1 further identifies existing mitigation actions with suggestions for next steps, when applicable.

Table 5-1: Existing municipal actions that support hazard mitigation

Type of Existing Protection	Description /Details/Comments	Issues or Concerns	Responsible Party
Emergency Response			
Police Services	Vermont State Police/ Caledonia County Sherriff	None at this time	n/a
Fire Services	Waterford VFD	The Rescue Truck needs to be replaced.. Funding assistance required in the short-term, budgetary planning required in the long-term	Selectboard, WVFD
Fire Department Personnel	Waterford VFD	Proper training to respond to major highway accidents that may involve hazardous substances.	See above
Fire Department Mutual Aid Agreements	Northeast International Mutual Aid (19 participants)	None at this time	See above
EMS Services	Calex	Consider outreach or a community advisory board to increase perceptions and scopes of service to residents	Calex
Other Municipal Services			
Highway Services	Town Highway Department	ICS training. Establish SOP with Road Commission in times of heightened response	Road Commission/Foreman
Highway personnel	3 FTE field personnel		See above
Water / Sewer Department	None	None at this time	n/a
Planning and Zoning personnel	Yes	None at this time	Planning Commission/ZA
Residential Building Code / Inspection	No	None at this time	n/a
Emergency Plans			
Local Emergency Operations Plan (LEOP)	2015	Assure sheltering plans and contact information are up to date and vulnerable populations addressed.	Selectboard. EMD, NVDA
School Emergency/Evacuation Plan(s)	2015	Increased collaboration (with town staff, LEPC, NVDA), knowledge of roles and drills are next step. Investigate logistics of using school notification for all-hazard notification.	School Crisis Team, selectboard
Municipal HAZMAT Plan	None	Not required but enhanced knowledge via HMEP funded transportation study through LEPC would benefit town and fire.	Selectboard, EMD, WVFD
Dam Emergency Plans	Great Bay Hydro has shared its comprehensive Emergency Response Plan with the Town.	Invite representatives to LEPC and town to increase collaboration. Assure understanding of risk and associated protocol for residents and impacted town infrastructure (if any). Develop notification protocol with potential use of school call down system	Great Bay Hydro, WVFD, EMD
Shelter, Primary	Waterford School	Work with ARC with Sheltering Initiative to obtain training and supplies. Include volunteer staff in planning communication and schedule drills to test efficacy.	EMD, NVDA, Selectboard
Replacement Power, backup generator	Yes, installed	None at this time	See above
Shelter, Secondary:	Union Baptist Church	Assure continued communication lines are open and contacts are correct.	See above
Replacement Power, backup generator	Fire Dept. owns portable generator and can supply church	Need to verify connections, confirm which circuits are powered and have periodic load tests.	See above, WVFD

Municipal Plans			
Town / Municipal Comprehensive Plan	2008	Update in Process	Planning Commission, NVDA
Town of Waterford Road Erosion Site Inventory	2015	Update as required and track all work expenditures.	Road Commission, Foreman
Hazard Specific Zoning (slope, wetland, conservation, industrial, etc.)	Yes, 2013 Zoning Bylaws address	Consider formal adoption of no development in SFHA	Planning Commission, ZA
Participation in National Flood Insurance Program (NFIP) and Floodplain/Flood Hazard Area Ordinance	Yes	Continue best practices and a no-adverse-impact policy approach to development.	ZA
Culvert and bridge Inventory	2015	https://vtculverts.org/map https://vtculverts.org/bridges#list Keep up to date.	Road Commission, Foreman

5.3 Town of Waterford All-Hazards Mitigation Goals

- Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
- Mitigate financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
- 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.
- 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.
- Maintain existing municipal plans, programs and ordinances that directly or indirectly support hazard mitigation.
- Formation of a resource and information source for inclusion in the municipal comprehensive plan as described in 24 VSA, Section 4403(5). The mechanism (action) by which this will proceed will be developed by the Planning Commission, Selectboard and NVDA so that integration (as annexes) until the next formal update occurs, where a section devoted to mitigation planning will be integrated into the town plan
- Provision of detailed information and mitigation actions that will be used in 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.

- Support long-term solutions over short-term fixes to community needs and problems
- Promote collaboration and cooperation through working partnerships between governments, non-profits, institutions, and businesses

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, after considering the basic and generalized format of the 2005 plan, decided to adopt this approach for this update and all future mitigation work. For each mitigation action to follow, an indication of group will be given with the abbreviation:

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 and Need for Mitigation Actions

The Town Plan's goals and policies that support hazard mitigation and existing mitigation actions, demonstrate the variety of policies and actions forming the foundation of this All Hazards Mitigation Plan Update. As stated, the previously approved plan failed to find direct, sustainable integration into other town planning documents or initiatives. Generally, the Town considers its existing capabilities are adequate to address the identified priority hazards in this Plan. Since the 2005 plan, which included a single mitigation action: "Road and Culvert Upgrade" (p. 12 Table 3-b in the 2005 Town of Waterford All-Hazards Mitigation Plan), the town has consistently monitored and replaced culverts as needed. The two highest ranked risks requiring mitigation actions in 2005 were: "*flooding around the Connecticut River and a hazardous materials incident on Interstate 91, 93 and Route 18 that may damage the St. Johnsbury water supply*". While insult to the water supply is no longer perceived as a high risk and flooding along the Connecticut is less of a concern than other, smaller bodies of water in the town, flooding and accidents (including hazardous materials spills due to traffic incidents) remain top mitigation priorities for the town. The following information summarizes the current status of the town related to hazards requiring mitigation. In the mitigation actions list, a narrative on the status and progress (when known), since the 2005 plan is given. However, with only a single mitigation action listed in the 2005 plan, the majority of information presented reflects the new awareness derived from this updates planning process and disaster case history since 2005. With that, there hasn't been a change in priorities so much as an addition of priorities stemming from experiences and events since 2005. While flooding remains a priority for the town, enhanced understanding of the magnitude of vulnerable infrastructure has occurred since the historic flooding event of 2011.

Priority Hazard Narrative:

- 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 storms are often the cause of the power loss and telecommunications failure. An SOP in addition to current Winter Operations Emergency Plan could benefit the operational capacity of both the Road Commission and Highway Department in addition to building institutional awareness of the principles of ICS and adhering to this structure as deemed necessary in events exceeding normal operations. The Road Commission and Road Foreman are responsible for this endeavor with an opportunity to use planning consultant to draft the plan.
- 2) Power Loss – The private service provider which owns and operates the electric utility is responsible for restoring service. Tree trimming and vegetation management, coupled with maintaining adequate repair vehicles and personnel are the primary means of mitigation.
- 3) Flooding – Major infrastructure that has seen repeated damage due to flooding is a concern. The Town will investigate establishing a Flood Hazard Overlay District to include all designated flood hazard areas with the upcoming acquisition of a software and mapping system that has the capability to accomplish this task. An SOP in addition to current Highway Department functionality could benefit the operational capacity of both the Road Commission and Highway Department in addition to building institutional awareness of the principles of ICS and adhering to this structure as deemed necessary in events exceeding

normal operations. The Road Commission and Road Foreman are responsible for this endeavor with an opportunity to use planning consultant to draft the plan.

- 4) Major Transportation Incidents – Given the magnitude of high accident locations, the town is concerned about a transportation-related chemical spill in addition to capabilities of fire department and rescue to adequately respond. 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. Investigation of funding opportunities and training to support emergency services are needed.
- 5) Telecommunications Failure – The private service providers which own and operate landline and cellular services are responsible for restoring service. As with the electric utilities, tree trimming and vegetation management, coupled with maintaining adequate repair vehicles and personnel are the primary means of mitigation.
- 6) Epidemic – In part, the Town relies on epidemic education provided by the state Health Department and the school regarding human illness and the Agency of Agriculture for livestock illness. Medical facilities are located in nearby communities. The Mitigation Action on public awareness of hazards provides an opportunity to address all pandemic hazards, preparedness and mitigation.

5.4.2. 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.

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	Evaluate capabilities of existing road and storm water management infrastructure. Continue and improve highway, culvert and bridge maintenance programs.	5	4	5	2	5	4	4	5	4	38
3	Maintain and improve resilience to severe winter storms	2	5	5	4	5	5	4	5	2	37
5	Reduce risk and impact of Major Transportation Incidents	3	2	4	2	3	2	2	3	3	24
6	Reduce vulnerability to telecommunications failure	3	4	5	2	5	3	3	5	1	27
4	Increase knowledge of livestock and human epidemic mitigation factors	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
7	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

Table 5-2: Waterford Action Evaluation and Prioritization Matrix

5.4.3. Specific Mitigation Actions

Action #1: Evaluate capabilities of existing road and storm water management infrastructure. Continue and improve highway, culvert and bridge maintenance programs

Group: SP, NRP, PP

Status: Ongoing

Lead Responsible Entity: Town of Waterford 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: 2016 – 2021

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. River Road: Replace 2 culverts with one box culvert
 2. Lower Waterford Road: Replace culverts with 8'Wx6'Hx50L section of concrete and remove 2 current pipes
 3. Mad Brook Road Culvert: Replace with 8Wx6Hx40'L box culvert
 4. Duck Pond Road: Upsize to larger pipe (36' steel corrugated)
 5. Hale Road: Remove both pipes and install 4x12 box culvert
 6. Old County Road: Remove both pipes and install 4x12 box culvert
- 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 basic 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

Status: Ongoing

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

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

Timeframe: 2016 – 2021

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. Waterford Elementary School has been identified as the primary emergency shelter. The school does have an emergency generator. The Union Baptist Church 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 risk and impact of major transportation incidents

Group: PEA, PP

Status: Ongoing

Risk or Hazard Addressed: Given the magnitude of high accident locations, the town is concerned about a transportation-related chemical spill in addition to capabilities of fire department and rescue to adequately respond. 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. Investigation of funding opportunities and training to support emergency services are needed.

Progress: The town has addressed the need for a strategic plan to support its Fire Service and has had a Selectboard meeting on the issue where the Fire Department presented current problems. The Fire Department has four primary pieces of equipment; the “Engine” is three years old and was purchased new. The “Pumper” is almost 11 years old and is scheduled for replacement in seven – eight years, The “Brush Truck” is five years old and was purchased with a FEMA grant. The “Rescue Truck” is the only piece of equipment that currently requires replacement.

Primary Responsible Entities: Town of Waterford, Calnex Rescue,

Potential Partner Entities: VTrans, state police

Timeframe: 2016 –2021

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

Specific Identified Tasks:

- 1) Develop a strategic plan for major Fire Department purchasing and identify funding streams with timelines for application for Fire Equipment.
- 2) Require continued training of Fire Department staff
- 3) Collaborate with VTrans on developing accident-reduction plan based on national best practices.
- 4) Collaborate with regional LEPC on a HMEP grant to identify hazardous substances being transported in town (namely on roads and highways with high-accident location status).

Rationale / Cost-Benefit Review:

The Fire Department requires the proper equipment and provisions and plans need to be in place to assure this. The nature of rural EMS and recent changes at the state and national level regarding scopes of service and best practices can be communicated with residents to improve perceptions and understanding of this essential service at very little cost. Investigating funding sources for fire equipment can reduce the financial burden on the town and fiscal planning can help to assure the necessary funds will be in place when future, projected needs arise.

Action #4: Reduce vulnerability to telecommunications failure

Group: PP, PEA,

Status: Ongoing

Primary Responsible Entities: Town of Waterford, NVDA

Timeframe: 2016-2021

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

Progress: While processes to reduce mechanical insult to telephone lines is ongoing and independent to town function, increasing dependable, consistent cellular services remains a challenge. However, the school is equipped with a telephone emergency notification system but this is assuming telecommunication lines are open.

Specific Identified Tasks:

- 1) Investigate broad band opportunities and the steps required to enhance cellular service
- 2) 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 on how to address this potential hurdle. Utilize resources for mobile home residents to enhance resilience to major weather-related emergencies. Begin discussion and what the town can do with domestic animals during a sheltering event.
- 3) Risk Reduction Techniques: Work with phone service providers to understand action steps that the town can accomplish to reduce risk
- 4) Increase Awareness: Participate in regional telecommunication meetings/drills and exercises to enhance awareness of solution-based strategies.

Rationale / Cost-Benefit Review:

Communication resilience is a crucial facet to mitigating health and safety risk to residents and town officials during a crisis. While much of the labor and cost associated with improved resilience falls on outside entities, the town can maintain a proactive approach in moving this goal forward.

Action #5: Increase knowledge of livestock and human epidemic prevention

Group: NRP, PEA

Status: Ongoing

Primary Responsible Entities: Town of Waterford, NVDA, VDH, VAAF, VT Agricultural Agency

Timeframe: 2016-2021

Funding Requirements and Sources: Implementation through existing programs.

Progress: This hazard, while existing prior to 2005 was not seen as high risk. But events since that time in Vermont and globally have increased awareness and the risk for a human and/or animal epidemic that could pose a major threat to health and safety and economic resilience of area farmers. Because of this, many national and state agencies have produced guidance and recommendations but awareness at the town-level needs improvement.

Specific Identified Tasks:

- 1) Maintain Communications: Assure communication pathways are established with responsible agencies, residents and businesses on procedures and risk factors
- 2) Develop Information Exchange: Work with residents to promote understanding of mitigation actions related to human/livestock epidemics
- 3) Develop and Maintain Policy: Develop an implementation calendar that serves to define an annual education and outreach campaign for residents in line to best practices suggested by the state.

Rationale / Cost-Benefit Review: Improved coordination could potentially significantly reduce the loss of life and property damage and increases the coordination and resilience of the town. By creating a systematic process by which an educational outreach campaign occurs, the town can mitigate the consequences of a lack of awareness and ensure that its efforts are consistently and deliberately maintained through policy within the town plan and accessory plans (e.g. LEOP).

Action #6: Raise public awareness of hazards and hazard mitigation actions

Group: PEA

Status: Ongoing

Lead Responsible Entities: Town of Waterford Selectboard and Emergency Management Director, Waterford Fire Chief.

Timeframe: 2016 –2021

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. In addition, the Fire Department annually conducts fire preparedness programs and school and family programs related to hazard awareness and disaster preparedness, including providing information at Town Meeting. 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) Dam Preparedness – TransCanada has the inundation maps and their own notification procedures which they shared with the town. The town should consider developing an outreach strategy based on likely scenarios and the subsequent properties that would be affected. Consider involving state agencies in planning and/or exercises that focus on the logistical considerations after dam breach.
- 7) 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 (see action 5)

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 watersystem 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 #7: 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 Waterford Planning Commission.

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

Timeframe: 2016–2021

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.

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 Waterford. 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 Waterford. 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.

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's Selectboard chair 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's Selectboard chair 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 Selectboard Chair
- 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

The Plan update will be led by the Selectboard Chair and Town Clerk. 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 Waterford 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 following table is intended to aid municipal officials in implementing the mitigation actions for Waterford, and to facilitate the annual monitoring of the plan.

Table 5-3: Waterford All-Hazards Mitigation Plan Implementation Matrix

Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
Continue fluvial geomorphology assessments and develop strategies in response to identified risk.	VT DEC, TransCanada, NVDA, VT ANR	2017-2018	Fluvial Geomorphic Assessments and assessment-based mapping/action	Continue Phase I and Phase II fluvial geomorphic assessments on streams and waterways in Waterford.	DEC has a comprehensive and interactive database for Basin 15 and TransCanada has done some of this work in the past that the town can build from.
	NVDA, VT ANR	2018-2019	Fluvial Erosion Hazard Mapping	Rate the fluvial erosion hazard for each assessed reach and develop a fluvial erosion hazard map for the waterway using SGAT. Create map of all assessed reaches. Submit to VT ANR for QA/QC.	The town will have CAI software capabilities starting in 2016 and can enhance knowledge and bases for policy with mapping abilities.
	Planning Commission and Selectboard	2017-2018	River Corridor Management Plans	Where Phase I and II assessments are complete, develop a River Corridor Management Plan.	Zoning Administrator has taken the lead in suggesting a no-development policy in SFHA and River Corridor.
	Waterford Planning Commission	2019-2020	Fluvial Erosion Hazard Mitigation Implementation	Develop strategies to mitigate losses from identified fluvial erosion hazards.	Major infrastructure enhancement has occurred on Simpson Brook (Hale Road) that withstood Irene.
	Waterford Planning Commission	2020	Flood Insurance Rating Map Updates	Review draft FIRM data. Update floodplain regulations/zoning.	CAI software can be used to update FIRM data with new information.
Evaluate capabilities of existing road and storm water management infrastructure. Continue and improve highway, culvert and bridge	Road Foreman, Commission	2017-2018	Infrastructure Assessment for Storm water Vulnerability	Assess the vulnerability and operational capability of municipal roads, culverts and storm water infrastructure.	Town has developed a Road Erosion Site Inventory with problem, priority and estimated budget. With great institutional memory of town infrastructure, the highway department is well-equipped to assess, monitor and prioritize needs.

maintenance programs.	Road Foreman, Commission	2018-2019	Infrastructure Assessment for Fluvial Erosion/Landslide Vulnerability	Assess the vulnerability and operational capability of municipal roads, culverts, bridges and other infrastructure to fluvial erosion.	Road and Bridge Standards adopted and meet or exceed 2013 standards.
	Road Foreman	2017-2022	Culvert Upsizing	Upsize culverts and ditching along roads to mitigate against repeated damages from storm water or spring snowmelt.	VTCULVERTS.ORG Culvert and Bridge Inventory has been populated. Town has developed a Road Erosion Site Inventory with problem, priority and estimated budget.

Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
continued	Selectboard, Road Foreman	2017-2018	Develop SOP for emergency events	Building on current Emergency Operations Plans for the Highway Department and Road Commission, and SOP can help clearly define expectations, roles and responsibilities. Develop understanding of eligibility criteria for HMGP projects.	Communication between Highway Department and Road Commission is ongoing.
	Road Foreman	2017-2022	Road Improvements and tracking system	Consider re-engineering certain road sections to lower overall maintenance costs, improve snow plowing speeds and improve overall capability of roads to handle current and projected traffic volumes. Develop process by which all Highway Department actions and expenses are documented.	ongoing
	Road Foreman	2018-2022	Erosion/Landslide Mitigation	Undertake erosion or landslide mitigation projects where roads regularly incur damage from adjacent rivers/streams and hillsides.	ongoing

Maintain and improve resilience to severe winter storms	Emergency Management Director	2017-2018	Improve Existing Shelter Capability	Maintain and improve on capabilities of existing emergency shelter capability, including emergency generator functionality	The School has a generator. Explore other sheltering options and secure funding for emergency power if required.
	Emergency Management Director	2017-2018	Investigate Alternate Shelters	Investigate capabilities of other buildings sufficient to serve as smaller shelters.	See Above
Reduce risk and impact of major transportation incidents	Waterford Selectboard, Fire Department	2017-2018	Develop strategic plan to assure funding for Fire Department	Fire Truck will need to be replaced in the near future.	Potential funding sources have been identified.
	Calex Rescue, Selectboard	2017-2018	Enhance community understanding of the scope of service of EMS with sustainable outreach program	The role of rural EMS is changing, increasing community understanding of scopes and best practices can enhance functionality and resiliency.	Response data has been developed by Calex and can be used by the town and Calex to guide outreach strategy.

Action	Primary Responsible Entity	Timeline	Task	Brief Description	Progress
	Waterford Selectboard, Fire Department	2017-2022	Enhance training and skills for response to major highway accidents	The unique relationship between Waterford Fire and the Interstate requires frequent responses to highway accidents which increase considerations for safety. Assuring proper training can increase department preparedness and safety	Ongoing but in need of further consideration
Reduce vulnerability to telecommunications failure	Emergency Management Director, Waterford Fire Chief	2018-2022	Evacuation and Sheltering Exercises	Conduct evacuation drills or exercises and evaluate performance.	Ongoing but in need of further consideration
	Emergency Management Director,	2017-2019	Evacuation and Sheltering Plans	Review evacuation, sheltering, and relocation plans based on results of	Ongoing but in need of further consideration

	Waterford Fire Chief			drills, exercises, and actual incidents.	
Reduce vulnerability to telecommunications failure	Emergency Management Director, School Principal, Waterford Fire Chief, NVDA, Selectboard	2017-2018	Maintain Communications and assure plans are coordinated and tested for efficacy	Maintain good communication between school and town officials regarding plans and safety issues, so that any changes are known to all parties. The school emergency notification system can be used for an all-hazards notification system.	Ongoing. Developing the school notification system is in discussion after a recent exercise at the Moore Dam.
	Emergency Management Director, School Principal, Waterford Fire Chief	2017-2022	Monitor Exercises and build on resilience to meet all-hazard-based scenarios	When evacuation drills and other exercises are carried out, monitor coordination between school and town officials. The town should think about scenarios that may not be included in basic school evacuations and include these in future drills.	None at this time
Raise public awareness of hazards, hazard mitigation and disaster preparedness.	Emergency Management Director; Waterford Fire Chief	2017-2022	Residential Programs	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.).	New
	Emergency Management Director; Waterford Fire Chief	2017-2022	Family Programs	Continue family programs, such as car safety seat and bike safety programs, to raise family awareness of hazards, safety, preparedness and prevention.	Ongoing
	Emergency Management Director; Waterford Fire Chief	2017-2022	Fire Prevention Programs	Continue National Fire Prevention Week and other programs to raise public awareness of fire hazards, safety, preparedness and prevention.	Ongoing

Emergency Management Director; Waterford Fire Chief	2017-2022	Other hazard awareness programs	Develop public awareness programs, based on all-hazards needs.	Ongoing
Emergency Management Director; Waterford Fire Chief, School, Selectboard	2017-2018	Moore Dam Preparedness	Use inundation maps to develop emergency notification procedures in line with those of TransCanada based on likely breach scenarios by using the school system.	In progress

APPENDICES

Appendix A: River Corridor Map: Town of Waterford

Appendix B: Community Reports (Flood Ready Vermont)

Appendix C: Culvert Locator: Town of Waterford

Appendix D: FEMA Guide P-956: Living with Dams

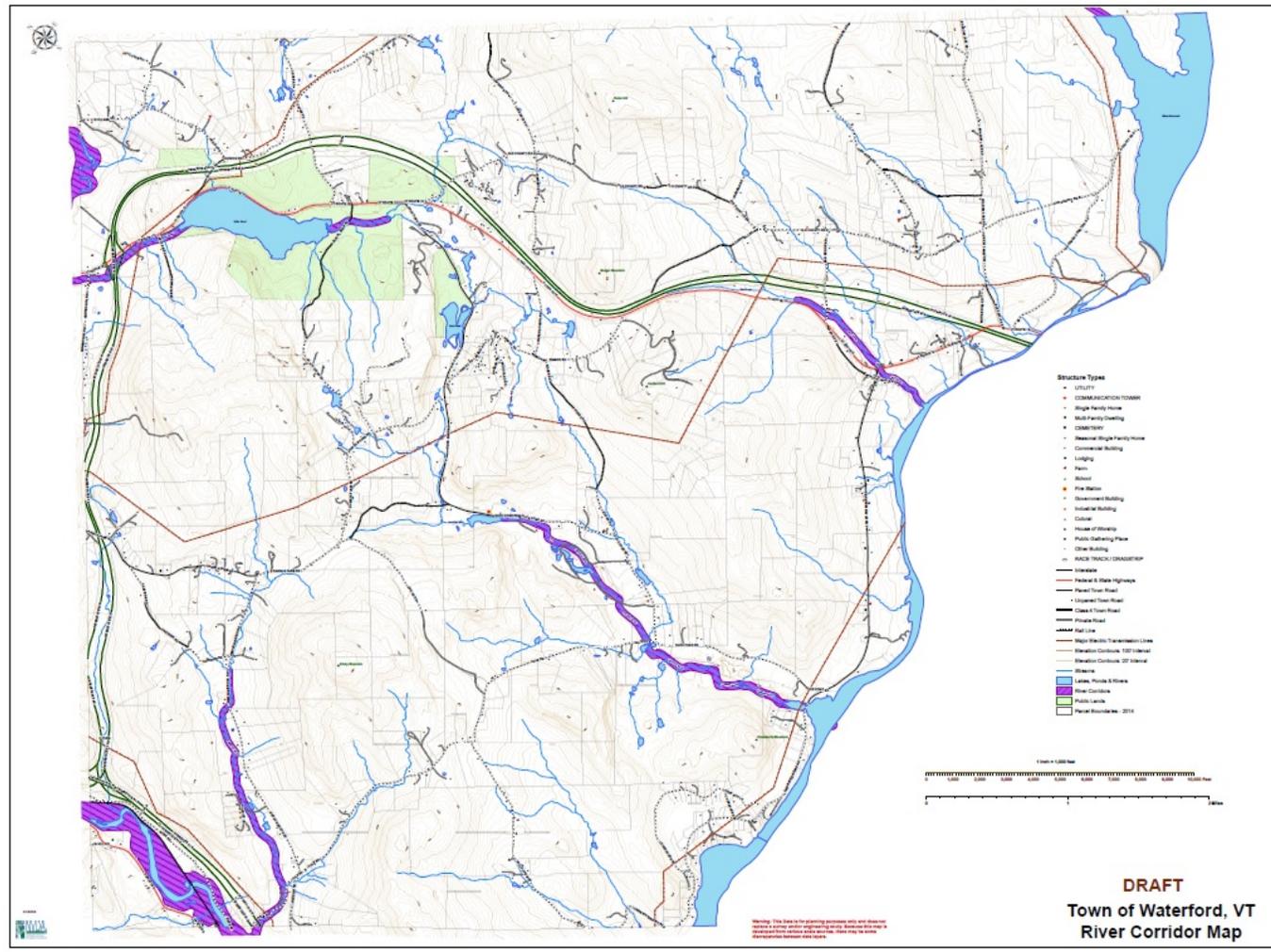
Appendix E: No Adverse Impact Floodplain Management Fact Sheet (ASFPM)

Appendix F: Farm Structures in Designated Flood Hazard Area Planning Checklist (VAAFMM)

Appendix G: Town of Waterford Road Erosion Site Inventory

Note: Appendices B-F not included in state submission or for FEMA review

Appendix A: River Corridor Map: Town of Waterford



Appendix B: Community Survey:

**Waterford 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!

Resident, Employee or Business Owner (please circle all that apply)

Community Concerns:

- 1. As a resident, business owner or employee of the Town of Waterford, 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?**

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

Appendix G: Town of Waterford Road Erosion Site Inventory

Town of Waterford – Road Erosion Site Inventory July 2015			
Site #1: River Road			
Site Location: River Road			
Priority	#1		
Nearest Body of Water	Passumpic River		
Distance to Body of Water:	.16 miles		
Current Condition:	Poor: Top of culvert has failed		
Proposed Solution:	Replace 2 culverts with one box culvert		
Estimated Costs to Improve/Repair			
Culvert, Ditching and Bank Stabilization			
Materials	Box Culvert	Cost	\$40,000
Materials	Guardrail	Cost	\$9,000
Materials	Engineering	Cost	\$3,000
Materials	Excavator for three days (1,200/day)	Cost	\$3,600
Materials	Dump truck for three days (950/day)	Cost	\$2,850
Machinery	Site work back fill	Cost	\$1,920
Materials	Type II stone 60cy & 30cy	Cost	\$1,800
Total Culvert, Ditching and Bank Stabilization Costs:			\$62,170
Crowning and Re-grading Roads			
Materials	¾” crusher run – 41 cy - 21.45 cy	Cost	\$880
Materials	Grader- 140 (2 hrs)	Cost	\$240
Materials		Cost	
Materials		Cost	
Materials		Cost	
Machinery		Cost	
Labor		Cost	
Total Crowning and Re-grading Roads Costs:			\$1,119.45
Total Costs:			\$63,289.45
Town of Waterford – Road Erosion Site Inventory July 2015			
Site #2: Lower Waterford Road			
Site Location: #245/245 Map 15			
Priority	#2		
Nearest Body of Water	Connecticut River		
Distance to Body of Water:	.3 mile		
Current Condition:	Fair: Concrete section beginning to separate		

Proposed Solution:	Replace with 8'Wx6'Hx50L section of concrete and remove 2 current pipes		
Estimated Costs to Improve/Repair			
Culvert, Ditching and Bank Stabilization			
Materials	Box Culvert	Cost	\$60,103.00
Materials	GBF 180cy	Cost	\$1,663.20
Materials	Type II Ledge	Cost	\$5,000
Materials	Misc.	Cost	\$1,000
Materials	Guardrail	Cost	\$15,000
Machinery	Excavator	Cost	\$10,750
Labor	Engineering and labor	Cost	\$15,000
Total Culvert, Ditching and Bank Stabilization Costs:			\$98,516.20
Crowning and Re-grading Roads			
Materials	3'' stone 30cy	Cost	\$626
Materials	¾'' crusher run	Cost	\$643
Materials	100' 1/2 pavement	Cost	\$4,500
Materials	100' 3/8 pavement	Cost	\$4,500
Materials	Grader for three hours	Cost	\$360.00
Machinery		Cost	
Labor		Cost	
Total Crowning and Re-grading Roads Costs:			\$10,630
Total Costs:			\$109,145.
Town of Waterford – Road Erosion Site Inventory July 2015			
Site #3: Mad Brook Road			
Site Location: .3mile off from Route 18			
Priority	#3		
Nearest Body of Water	Connecticut River		
Distance to Body of Water:	.5mile to larger stream (unnamed) that runs 2miles before reaching Connecticut River		
Current Condition:	Fair		
Proposed Solution:	Replace with 8Wx6Hx40'L box culvert		
Estimated Costs to Improve/Repair			
Culvert, Ditching and Bank Stabilization			
Materials	Box culvert	Cost	\$56,623.00
Materials	Guardrail	Cost	\$9,000
Materials	Type II Ledge 60 cy	Cost	\$1,800
Materials	Misc.	Cost	\$1,000
Materials	Back fill 60cy GBF	Cost	\$831
Machinery	Excavator for three days	Cost	\$6,450
Labor	Engineering/labor	Cost	\$5,000
Total Culvert, Ditching and Bank Stabilization Costs:			\$80,705
Crowning and Re-grading Roads			

Materials	¾" crush run 41 cy	Cost	\$879.45
Materials		Cost	
Machinery	Grader for 2hrs	Cost	
Labor		Cost	\$240
Total Crowning and Re-grading Roads Costs:			\$1,119.45
Total Costs:			\$81,824.00
Town of Waterford – Road Erosion Site Inventory July 2015			
Site #4: Duck Pond Road			
Site Location: Upper end of Duck Pond Road (#67-Address 0.00)			
Priority	#4		
Nearest Body of Water	Stiles Pond (running stream)		
Distance to Body of Water:	1 mile		
Current Condition:	Good		
Proposed Solution:	Upgrade to larger pipe (36' steel corrugated)		
Estimated Costs to Improve/Repair			
Culvert, Ditching and Bank Stabilization			
Materials	36"x60" Steel corrugated pipe	Cost	\$3,000
Materials	Type #1 stone: 30CY	Cost	\$900
Materials	Dump truck: 2 days	Cost	\$2,000
Materials	GBF-100 31CY	Cost	\$644
Materials	Type II stone 30CY	Cost	\$900
Machinery	Excavator: 2 days	Cost	\$2,400
Labor	2 men for 2 days	Cost	\$1,000
Total Culvert, Ditching and Bank Stabilization Costs:			\$13,320
Crowning and Re-grading Roads			
Materials	¾" crusher run: 30CY	Cost	\$644
Materials	Repave with .5" 1.5 base	Cost	\$2,000
Materials	Pavement ¾" 1.5 top	Cost	\$2,000
Materials	Sub-base gravel: 60CY	Cost	\$1,674.
Materials		Cost	
Machinery	Grader	Cost	\$110
Labor		Cost	
Total Crowning and Re-grading Roads Costs:			\$6,427.50
Total Costs:			\$19,797.50
Town of Waterford – Road Erosion Site Inventory July 2015			
Site #5: Hale Road			
Site Location: #121/122 .001/.002 MAP#10			
Priority	#5		

Nearest Body of Water	Brook flows into Connecticut River
Distance to Body of Water:	2 miles
Current Condition:	Fair
Proposed Solution:	Remove both pipes and install 4x12 box culvert

Estimated Costs to Improve/Repair

Culvert, Ditching and Bank Stabilization

Materials	Box Culvert	Cost	\$65,413
Materials	GBF:50CY	Cost	\$832
Materials	Guardrail	Cost	\$12,000
Materials	Type 2 Ledge	Cost	\$4,500
Materials	Misc.	Cost	\$1,000
Machinery	Excavator/truck/roller	Cost	\$13,500
Labor	Engineering/Labor	Cost	\$5,000
Total Culvert, Ditching and Bank Stabilization Costs:			\$102,244.60

Crowning and Re-grading Roads

Materials	¾’’ crusher run:41CY	Cost	\$879
Materials	Sub-base gravel:82CY	Cost	\$2,287.80
Materials		Cost	
Materials		Cost	
Materials		Cost	
Machinery	Grader	Cost	\$240
Labor		Cost	

Total Crowning and Re-grading Roads Costs:

\$3,407

Total Costs:

\$105,652

Town of Waterford – Road Erosion Site Inventory July 2015

Site #6: Old County Road Culvert

Site Location: Structure # 309: Map page 17

Priority	#6
Nearest Body of Water	Connecticut River
Distance to Body of Water:	2.5miles
Current Condition:	Good but undersized
Proposed Solution:	Replace with 10Wx6’Hx40’L Box Culvert

Estimated Costs to Improve/Repair

Culvert, Ditching and Bank Stabilization

Materials	Box Culvert	Cost	\$59,357
Materials	Guardrail	Cost	\$9,000
Materials	GBF	Cost	\$3,170

Materials	Misc.	Cost	\$1,000
Materials	Type II Ledge	Cost	\$4,500
Machinery	Excavator and Truck (4 days)	Cost	\$11,000
Labor	Engineering and labor	Cost	\$5,000
Total Culvert, Ditching and Bank Stabilization Costs:			\$93,027
Crowning and Re-grading Roads			
Materials	¾" crusher run: 41CY/21CY145	Cost	\$879
Materials	Sub-base gravel:82CY	Cost	\$2,288
Materials		Cost	
Materials		Cost	
Materials		Cost	
Machinery	Grader	Cost	\$240
Labor		Cost	
Total Crowning and Re-grading Roads Costs:			\$3,407.25
Total Costs:			\$96,439.25