Town of Bennington
Hazard Mitigation Plan

September 25, 2017

Bennington, Vermont

Town of Bennington

Resolution of Adoption

A Resolution Adopting the Town of Bennington Hazard Mitigation Plan

_____ ___, 2017

Whereas, the Town of Bennington has worked with the Bennington County Regional Commission to identify hazards, analyze past and potential future losses due to natural disasters, and identify strategies for mitigating future losses; and

Whereas, the respective officials identified in the mitigation action plan are hereby directed to pursue implementation of the recommended actions assigned to them, assuming funding is available; and

Whereas, a duly noticed public meeting was held by the Town of Bennington Select Board on _____ ___, 2017 to formally adopt the Town of Bennington Hazard Mitigation Plan;

Now, therefore be it resolved that the Town of Bennington hereby adopts the Town of Bennington Hazard Mitigation Plan.

_____
Tom Jacobs, Select Board Chair

_____
Donald Campbell, Select Board Vice Chair

_____
Jim Carroll, Select Board

_____
Jeanne Conner, Select Board

_____
Jeannie Jenkins, Select Board

_____
Chad Gordon, Select Board

Table of Contents

List of Tables

List of Figures

List of Maps (follow end of document)

I. Introduction

A. Purpose

Hazard mitigation actions are designed to reduce potential losses from natural hazards such as flooding, landslides, wildland fire, and similar events. Hazard mitigation plans identify, assess and prioritize those hazards and present actions that a community can undertake to reduce risks and damage from those natural hazards (Federal Emergency Management Agency 2013a).

This plan is intended to identify, describe and prioritize potential natural hazards that could affect the Town of Bennington in Bennington County, Vermont and provide specific measures to reduce or avoid those effects. The Federal Emergency Management Agency (FEMA), within the U.S. Department of Homeland Security and Vermont Emergency Management both advocate the implementation of hazard mitigation measures to save lives and property and reduce the financial and human costs of disasters.

The format of this plan is as follows. Section II provides a profile of the Town, including a discussion of the environmental setting, demographics and settlement patterns. Section III describes the planning process along with lists of members of the planning team and dates of meetings and public and agency review. Section IV analyzes the following hazards:

- Flooding and Fluvial Erosion
- Winter Storms
- High Wind Events
- Hail
- Temperature Extremes
- Drought
- Wildfire
- Landslides
- Earthquake
- Hazardous Materials Spill
- Water Supply
- Infectious Disease Outbreak
- Invasive Species

Section V assesses vulnerability, and Section VI discusses mitigation goals and actions, including current programs and town capabilities. Section VII describes how the plan will be maintained and updated.

B. Mitigation Goals

The Town identified the following mitigation goals:

1. Reduce injury and loss of life resulting from natural disasters.
2. Reduce damage to public infrastructure, minimize disruption to the road network and maintain both normal and emergency access.
3. Establish and manage a program to proactively implement mitigation projects for roads, bridges, culverts and other municipal facilities to ensure that community infrastructure is not significantly damaged by natural hazard events.
4. Design and implement mitigation measures so as to minimize impacts to rivers, water bodies and other natural features, historic structures, and neighborhood character.
5. Increase the economic resiliency of Bennington by reducing the economic impacts incurred by municipal, residential, agricultural and commercial establishments due to disasters.
6. Incorporate hazard mitigation planning into other community planning projects, such as the Town Plan, Capital Improvement Plan, and Local Emergency Operations Plan.
7. Ensure that members of the general public continue to be part of the hazard mitigation planning process.

II. Town Profile

A. Regional Context

Bennington is located in the southwestern part of Bennington County, Vermont and is surrounded by the towns of Pownal, Woodford, Shaftsbury, and Hoosick, NY. Bennington also includes the villages of Old Bennington and North Bennington within its boundaries, though they are both separate municipal entities (Map 1). Major routes in the Town are US 7 and Vermont Routes 9, 7A, 67A, and 279. Railroads have not been used in the Town for several decades, but a railroad from New York passes through North Bennington on its way to Rutland.

B. Demography and Land Use

The population as of 2010 was 15,764, a population increase of 0.2% from 2000 (U.S. Census Bureau 2010). In Bennington, 56% of housing units are owner-occupied, 37% renter-occupied and 2% seasonal (Bennington County Regional Commission 2015).

The settlement area of Bennington lies in the north-south valley with the Green Mountains to the east, Mount Anthony (part of the Taconic Mountain Range) in the southwest, and Whipstock Hill near the state line at the western edge. Settlement also follows the Walloomsac River valley. The steep upland areas are primarily forested and have supplied important natural resources while remaining largely free from development due to poor access and unproductive soils. Bennington contains extensive lowland areas that historically have

supported important transportation corridors. Significant agricultural, residential, commercial, and industrial development also dominates the valley areas (Map 2).

C. Economic and Cultural Resources

Economic resources are best summarized by the types of uses. The grand list of property types and values describes the assessed values of different classes of properties and can be used to identify the number of tax parcels by use type (Table 1). Map 3 shows the land use designations from the 2015 Bennington Town Plan.

Table 1. Number of properties by classification.
Source: Vermont Department of Taxes 2014

Residential	3914
Commercial	581
Industrial	37
Seasonal Home	15
Mobile Home	522
Farm	18
Utilities	7
Woodland	73
Miscellaneous	369
Total	5,536

Downtown Bennington has a mix of specialty shops, art galleries, restaurants and cafes. Large-scale commercial developments including department stores, grocery stores, car dealerships, and similar uses are found north and northwest of the downtown/central business district.

A number of industrial buildings and businesses are located in land zoned for such uses northeast and northwest of the downtown. Other industrial uses occupy buildings located along the streams that were once used for power generation.

Major public buildings and service facilities are found in and around the downtown. The elementary schools and the high school are located just outside of the downtown. The middle school is further north. Southwestern Vermont Medical Center and many supporting personal service businesses are located southwest of the downtown.

Some areas adjacent to the downtown support a mix of uses that are transitional between commercial and residential. The urban mixed-use zone includes a mix of historic, commercial, residential, and industrial buildings and uses.

All of the concentrated development referred to above is located within the Urban Growth Area. The Town's rural areas are located beyond the Urban Growth Boundary, where agricultural landscapes blend with forested mountainsides. Residential development in these areas is of a much lower density and the few pre-existing commercial uses are confined to limited sites along state highways. The Green and Taconic Mountain Ranges remain forested and free of development.

Bennington has a historic district designed to provide protection for important historic buildings. Bennington also has a designated downtown through the Vermont Agency of Commerce and Community Development, which provides tax credits and other benefits to property owners to encourage economic development.

Bennington is an important economic center for southwestern Vermont and other nearby communities in New York and Massachusetts. Long-term damage to businesses in Bennington would severely impact the economy. Much of the downtown area along Main Street, as well as other major retail areas along Kocher/Northside Drive, are located in the flood hazard area and river corridor. Flooding has impacted businesses located in these areas in the past, and will continue to impact them in the future. Flood-proofing structures located in hazardous areas would be beneficial to the Town, businesses and the local economy.

D. Critical Facilities

Table 2 lists and describes critical facilities including Town facilities, utility substations, schools, shelters and sites with extremely hazardous substances. These are labeled and shown on Map 4.

The transportation system also represents a set of critical facilities. Bennington contains 99.40 miles of Town Highway (3.62 miles of Class 1, 11.52 miles of Class 2 including ramps and 84.26 miles of Class 3), and 27.93 miles of State Highway (US 7, VT Routes 9, 67A, 7A, and 279) including ramps (Vermont Agency of Transportation 2015b).

Table 2. Bennington Critical Facilities.
Source: VCGIS, Bennington Planning Team, and 2017 Local Emergency Operations Plan

Label	Name	Description
1	Bennington Recreation Center	Emergency Shelter
2	Bennington Moose Lodge	Emergency Shelter
3	Bennington Project Independence	Emergency Shelter
4	Green Mountain Christian Center	Emergency Shelter
5	Second Congressional Church	Emergency Shelter
6	Monument Elementary School	Education Facility / Emergency Shelter
7	Mount Anthony Middle School	Education Facility / Emergency Shelter
8	Bennington Town Hall	Town Office / Emergency Operations Center/Communications Tower
9	Vermont Department of Health	Public Health Facility / Emergency Operations Center
10	Bennington Water Filtration Facility	Water Filtration Facility
11	Bennington Water Treatment Facility	Water Treatment Facility
12	Morgan Spring Well	Public Water Supply Well
13	Chapel Rd Reservoir	Water Tank
14	West End Reservoir (SVC Water Tank)	Water Tank
15	Bennington Rescue Squad	EMS Station
16	Bennington Rural Fire Station (West Rd.)	Fire Station
17	Bennington Rural Fire Station (Gore Rd.)	Fire Station
18	Bennington Rural Fire Station (Orchard Rd.)	Fire Station
19	Bennington Town Fire Station (River Rd.)	Fire Station / Emergency Operations Center
20	Bennington Police Station	Law Enforcement / Emergency Operations Center
21	Southwestern Vermont Medical Center	Hospital / Medical Center

Table 2. Bennington Critical Facilities. Source: VCGIS, Bennington Planning Team, and 2017 Local Emergency Operations Plan		
Label	Name	Description
22	Bennington Town Garage (Depot St.)	Town Garage
23	Bennington Town Garage (Orchard Rd.)	Town Garage
24	WBTN Radio Station	Radio Station
25	Catamount Access Television	Television Station
26	The Home Depot	CPOD Location
27	Energizer Battery	Hazardous Material Storage Facility
28	Bennington Fish Culture Station	Hazardous Materials Storage Facility
29	NSK Steering Systems America, Inc.	Hazardous Materials Storage Facility
30	Kaman Composites	Hazardous Materials Storage Facility
31	Vishay Tansitor	Hazardous Materials Storage Facility
32	Mt. Anthony Tower	Telecommunications Tower
33	Verizon Wireless Pownal N	Telecommunications Tower
34	RCC Carpenter	Substation
35	RCC Bennington College	Substation
36	Velco Bennington	Substation
37	GMP Substation - South Bennington	Substation
38	GMP Substation - Lyons St.	Substation
39	GMP Substation - North Bennington	Substation
40	GMP Substation - Woodford Rd.	Substation
41	GMP Substation - Silk Rd.	Substation
42	GMP Substation - Mill St.	Substation
43	Bennington Town Garage (Bowen Rd.)	Town Garage

III. Planning Process

A. Planning Team

The Bennington County Regional Commission began discussions with the Town on developing a hazard mitigation plan in 2015. The Bennington Planning Commission decided to initiate planning in January 2016. This is the first stand-alone hazard mitigation plan for Bennington, though the Town was part of a multi-jurisdictional plan that expired in 2010. The hazard mitigation planning team consisted of members listed in Table 3 below.

Table 3. Planning team members	
Name	Affiliation
Dan Monks	Assistant Town Manager, Planning Director
RJ Joly	Road Foreman
Terry Morse	Water Resources Superintendent
Larry McCloud	Fire Marshal, Building Inspector, Health Officer
Michael Harrington	Economic Development Director

B. Public Involvement

Bennington started the planning process in January 2016 and held several planning team meetings. These meetings were warned according to the Vermont Open Meetings Law, and dates are listed in Table 4. No residents were present at any of the meetings.

Table 4. Dates of planning meetings and public and agency review	
Meeting	Date(s)
Planning Commission initiates planning process	January 4, 2016
Planning team meeting	March 22, 2016
Planning team meeting	July 17, 2017
1st Draft recommended for circulation by Select Board	July 17, 2017
Select Board authorizes planning team to send to surrounding communities and then to VEM pending comments from surrounding communities	July 24, 2017
Public Meeting	September 18, 2017
Select Board adoption of FEMA approved plan	

The plan was posted on the Town website and on the website of the Bennington County Regional Commission. The plan was also available to the public at the Bennington Free Library. The plan was sent to the Trustee Chairs of the Village of North Bennington and Village of Old Bennington, the Select Board Chairs of the surrounding towns of Shaftsbury, Woodford, Pownal and Hoosick, New York, and to the Chair of the Local Emergency Planning Committee 7.

Each were asked to share the plan with appropriate staff and officials. Comments were requested by email, phone or letter and were to be sent to Dan Monks of the Planning Commission, or Allison Strohl at the Bennington County Regional Commission. No comments were received.

C. Hazard Assessment

The following sections provide a detailed assessment of each of the hazards identified by the planning team based on data from the following sources listed in Section VIII References:

a. Local knowledge.
b. The National Climate Data Center (NCDC) storm events database (most recent data from their FTP site).
c. FEMA lists and descriptions of past disaster declarations.
d. The Vermont Department of Forests, Parks and Recreation data on wildfires.
e. HAZUS runs on potential earthquake damage.
f. Cooperative weather observer data and station normals where available.
g. Palmer Hydrologic Drought Index calculated from 1985 to 2014 from the National Oceanographic and Atmospheric Administration (NOAA).
h. Hazardous materials spills from the Vermont Agency of Natural Resources (VT ANR).
i. Infectious disease outbreaks listed from the Vermont Department of Health.

j. Observations of invasive species compared to the state and federal lists of noxious species.
k. The Vermont Hazard Mitigation Plan (2013).
l. New England Weather, New England Climate (Zielinski and Keim 2003), Vermont Weather Book (Ludlum 1996).
m. Federal Emergency Management Agency 2010 Flood Insurance Study, Bennington County, Vermont and Incorporated areas, Federal Emergency Management Agency Study Number 5003CV000A.
n. National Weather Service 2015. Advanced Hydrologic Prediction Service, stream gauge information for the Walloomsac River near North Bennington. Available via: http://water.weather.gov/ahps2/hydrograph.php?wfo=aly&gage=bntv1.
o. Spatial Hazard Events and Losses Database (SHELDUS) records which were not as complete as NCDC and, therefore, not used.
p. Fuel types and potential for wildfire from LANDFIRE (http//:www.landfire.gov) and the Vermont Department of Forests, Parks and Recreation.
q. Vermont Agency of Natural Resources and Vermont Agency of Agriculture, Food and Markets on invasive species.
r. Identification of ranking of the potential for landslides by Josh Duncan (2015), a student at Green Mountain College using a modified protocol based on Clift and Springston (2012).

With respect to NCDC data, there have been numerous changes to that database in just the last few years. While NCDC data goes back to 1950, there was a dramatic change in 1996 in the way data were collected. The number of events recorded in years prior to 1996 is far fewer than from 1996 onward. Therefore, for the best reliable data, we used only data from 1996 onwards. We have also looked at the other sources of historical weather data. The cooperative weather observers for Peru, Sunderland and Pownal in Vermont have the most consistent long-term data, though some data was available from the North Adams, MA observer, and precipitation (rain) data was available from the Bennington Morse State Airport Station. The only stream gauge for Bennington County is in Bennington near the New York border on the Walloomsac. There are no weather stations that record or keep long-term data records in Bennington except for the cooperative weather stations listed above that record daily observations, but not the specifics of storm events.

We have communicated with USGS, which is working on models of areas impacted by different storm events using Lidar and stream gauge data, but they are not working in Vermont yet, as far as we know. We looked at the USGS high water marks for Irene (Medalie and Olson 2013). In Bennington, they were located along portions of the Roaring Branch and Walloomsac in Bennington. However, we relied mostly on the updated special flood hazard maps for potential flooding extent.

Finally, we reviewed several studies on potential impacts of climate change developed by the Intergovernmental Panel on Climate Change (Christensen et al 2013), the Vermont Agency of Natural Resources (Tetra Tech 2013), the University of Vermont (Galford et al 2014),

the Global Climate Change Research Program (Horton et al 2014), and the U.S. Forest Service (Rustad 2012). The relationship between climate change and the frequency and extent of natural hazards is a developing science, and we described, where appropriate, how climate change might affect hazards in the future.

IV. Hazard Assessment

A. Flooding and Fluvial Erosion

1. Description

a. Flooding

Flooding and associated fluvial erosion are the most frequent and damaging natural hazards in Vermont. The National Weather Service (2010) defines a flood as "any high flow, overflow, or inundations by water which causes or threatens damage." A flash flood is …"a rapid and extreme flow of high water into a normally dry area, or a rapid water rise in a stream or creek above a predetermined flood level." These are usually within six hours of some event, such as a thunderstorm, but may also occur during floods when rainfall intensity increases, thereby causing rapid rise in flow. The NWS uses the following impact categories:

- Minor Flooding - minimal or no property damage, but possibly some public threat.
- Moderate Flooding - some inundation of structures and roads near stream. Some evacuations of people and/or transfer of property to higher elevations.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.
- Record Flooding - flooding which equals or exceeds the highest stage or discharge observed at a given site during the period of record keeping.

Floods may reach these magnitude levels in one or more reaches, but not necessarily all. Runoff from snowmelt in the spring, summer thunderstorms, and tropical storms and hurricanes can all result in flooding in Bennington. Ice jam flooding can occur on Vermont rivers when substantial ice forms followed by several days of warmth, snowmelt and any rainfall leading to ice breakup. As the ice breaks up on the rivers, chunks of ice form jams which cause localized flooding on main stem and tributary rivers. Ice jams are most prevalent during the January thaw (late January) and in March and April as spring approaches.

Flash floods can occur after spring melt of mountain snow, following large storms such as Tropical Storm Irene, or after significant thunderstorms. Digital flood zone maps (DFIRMs) became effective December 2, 2015 and were adopted by Bennington. Map 5 shows the location of both flood hazard areas and river corridors (formerly fluvial erosion hazard zones). See Section A. 3. for more information on flood hazard areas and river corridors.

Much of Bennington's development is located along the Roaring Branch and Walloomsac rivers, with many buildings in the flood hazard area and river corridor. Most of the downtown occupies an alluvial fan, with fan-shaped deposits of clay, silt and gravel left by the river as it decreases in velocity. Braided streams are common hydrologic features of alluvial fans. Portions of Barney Brook, Walloomsac, Furnace Brook and the Roaring Branch are on the alluvial fan and are either old braded streams or are currently braided, according to the Phase 1 Geomorphic Assessment of the Walloomsac River Watershed in Southwestern Vermont, conducted by the Bennington County Conservation District. These streams can transport huge and devastating volumes of water and sediment through the alluvial fan. In response to past flooding, the Walloomsac has been riprapped and the Roaring Branch has been bermed, walled and dredged in areas. These types of modifications were performed decades ago, sometimes causing damage downstream. Today, the threat of flooding on these rivers still remains.

Since the 2005 Bennington County Multi-Jurisdictional Hazard Mitigation Plan, eleven buildings have been built or have been structurally improved in the flood hazard area. This does not increase the vulnerability of the town, as there are almost 500 buildings located in the flood hazard area (see Table 7 for buildings located in the flood hazard area).

In addition, a new project is pending development in downtown Bennington called the Putnum Block. This project is located in the flood hazard area. Flood-proofing measures are not currently available, as the project is still in the design phase.

There are eight dams located in Bennington; two are not in service. Along the Roaring Branch is the Vermont Veterans Home dam, which is privately owned by the North Branch Realty Trust and was completed in 1890. This dam is considered to be of low hazard potential, according to the Vermont Dam Inventory, managed but the Department of Environmental Conservation and Hydrology Section (http://geodata.vermont.gov/datasets?q=dams). The National Inventory of Dams, based on information from the US Army Corps of Engineers, lists 1987 as the last year this dam was inspected (U.S. Army Corps of Engineers 2015).

The following information was all found in the Vermont Dam Inventory, managed by the Department of Environmental Conservation and Hydrology Section.

The Bennington Water Supply dam is located along the Walloomsac River and is owned by the Town of Bennington. The completion date is unknown. The Southern Vermont Orchard dam is located along Jewitt Brook and was completed in 1963. It is privately owned by Southern Vermont Orchards. The Beech Street dam is located along South Stream, has an unknown completion date and is privately owned. The Vermont Tissue dam is located along the Walloomsac River, has an unknown completion date and is privately owned. There is an unnamed dam located on a tributary of the Walloomsac River with an unknown completion date. It is privately owned and the status is breached. The Bennington Reservoir dam and the Bennington Reservoir Lower dam are both owned by the Town of Bennington. One is drained and the other is not in use. Neither has a completion date. All of these dams have unknown last inspection dates and are considered to be of low hazard potential.

b. Fluvial Erosion

In Vermont, most rivers flow through relatively confined valleys, but still meander over time across the floodplain. River corridors provide an area within which a river can move across the landscape as it dissipates energy and transports and deposits sediments. Where rivers are constricted by bridges and other structures, or rip rap, the water moves at higher velocity, resulting in downcutting and collapse of the banks. This may undermine structures within the corridor.

2. Previous Occurrences

Ludlum (1996) describes numerous storm events that have affected Vermont since settlement, but the local impacts of these are difficult to trace. The 1927 flood was the largest recorded disaster in the history of the state. The state received over six inches of rain, with some areas receiving 8-9 inches. Following a rainy October, this storm occurred from November 2nd through the 4th causing extensive flooding. Two storms occurred in March of 1936. Heavy rains and snowmelt caused significant flooding. Two years later, the 1938 hurricane caused both flooding and extensive wind damage.

In addition to these events, the Bennington Evening Banner, the local newspaper at the time, recorded three more flood events. The 1869 flood occurred after nearly 36 hours of violent rainfall and flooded downtown Bennington. A storm in 1948 caused downtown Bennington to flood and rendered the North Street and River Street bridges impassable. Lastly, the newspaper mentioned a storm in 1973 that claimed lives, caused property damage and flooded several communities in Vermont (Department of the Army 1975).

Table 5 shows a total of 49 flood events in Bennington County from 1996 to 2015, using NCDC data. These have been primarily minor and affected either specific streams, such as the Walloomsac and Batten Kill, or specific towns or villages.

Hurricanes and tropical storms that form in tropical waters have historically affected New England, but are relatively infrequent. Besides the 1938 storm, Tropical Storm Belle brought significant rains to Vermont in 1976 and Hurricane Gloria brought rain and wind damage in 1985. Bennington has been

Table 5. Total number of flood events by type and year for Bennington County. Source: National Climate Data Center 2015

Year	Flash Flood	Flood	Total
1996	3	6	9
1997			
1998	1	3	4
1999	2		2
2000	4	1	5
2001			
2002	1		1
2003		2	2
2004	1	5	6
2005		5	5
2006		1	1
2007	1	1	2
2008			
2009	2		2
2010			
2011	3	3	6
2012			
2013	4		4
2014			
2015			
Totals	22	27	49

subjected to two major tropical storms in the past twenty years. Hurricane Floyd was a Category 4 storm before hitting North Carolina, and then was reduced to a tropical storm when it reached southern New England. Tropical Storm Irene was the remnant of Hurricane Irene, which was a Category 1 hurricane. A category 1 storm has winds of 74-95 miles per hour and could damage roofs, down shallow-rooted trees and damage power lines (http://www.nhc.noaa.gov/aboutsshws.php).

The following describes 25 moderate and extreme events that have occurred since 1996, using the National Weather Service (2010) categories, which affected Bennington or nearby areas. These events were described in the National Climate Database records (2015). It should be noted that only the three events occurred in the winter, with all other events in the spring, summer or fall. Ice jam flooding also occurs and one instance is discussed below.

January 19-20, 1996 (DR-1101 1/19 to 2/2 1996): An intense area of low pressure which was located over the Mid-Atlantic region on Friday morning January 19 produced unseasonably warm temperatures, high dewpoints and strong winds. This resulted in rapid melting of 1 to 3 feet of snow. In addition to the rapid snowmelt 1 to 3 inches of rain fell as the system moved northeast along the coast. This resulted in numerous road washouts and the flooding of several homes across the county. *Note that this was also categorized as a High Wind event.

April 24, 1996: Significant rains on Tuesday evening April 23 resulted in flooding along the Walloomsac and Batten Kill Rivers. The Walloomsac River crested 1.5 feet over flood stage at North Bennington and the Batten Kill crested 1 foot over flood stage at Arlington. The flooding resulted in several road closures but much of the flooding was minor.

May 1, 1996: Heavy rain on Tuesday evening April 30 caused the Walloomsac River to flood. Flooding occurred at Paper Mill Village in Bennington.

May 11-12, 1996: A low pressure system tracked across New York State and New England during May 10 and 11. On May 12 the system moved to the east coast and intensified, this prolonged the period of precipitation. Rainfall in excess of 2 inches fell during this period over much of western New England. This resulted in flooding along the Walloomsac River. The river crested 2.5 feet over flood stage. Route 67 in Bennington was flooded during the morning hours of May 12. A Cooperative Weather Observer in Pownal recorded 2.10 inches of rain on May 12.

December 2, 1996: Rainfall during the late fall season resulted in flooding across parts of Bennington County. The Walloomsac River flooded in North Bennington. Several homes were flooded along with Route 67A. The Batten Kill at Arlington flooded with several homes affected.

January 24, 1999: The combination of rain and very mild temperatures produced rapid snowmelt in southern Vermont. This runoff and ice jams triggered flooding on the upper Batten Kill near Arlington and on the Walloomsac River near Bennington. The Bennington Morse State Airport recorded 0.69 inches of rain and melted snow.

September 16-17, 1999 (DR-13079/16-21 1999): The remnants of Hurricane Floyd brought high winds and heavy rainfall (3-6 inches) to southern Vermont. Many smaller tributaries reached or exceeded bankfull. Estimated wind gusts exceeded 60 mph, especially over hill towns. Power outages occurred across southern Vermont. A Cooperative Weather Observer recorded 4.60 inches of rain in Pownal and 2.94 inches at the Bennington Morse State Airport.

July 14-17, 2000 (DR- 1336 7/14-18 2000): Thunderstorms caused torrential rainfall with flash flooding washing out sections of roadways in northeast Bennington County and southern Bennington County. Route 7 was closed due to flooding and rockslides and 67 was closed due to flooding. Numerous other roads were closed, some even washed out. This rain produced enough runoff to cause the Batten Kill to exceed the six-foot flood stage by about one foot at Arlington, a 47-year high. The swelled river flooded the Batten Kill Canoe Company and adjacent river property. Specific amounts included 3.00 inches at Bennington. Lightning from a thunderstorm struck a man while he was jogging in Bennington, injuring him. The Bennington Morse State Airport recorded 2.79 inches of rain.

May 28, 2002: Scattered thunderstorms developed along a quasi-stationary front on the afternoon of May 28. These storms were slow moving and contained torrential rainfall across southern Vermont. Rainfall amounts reached around three inches in a couple of hours in Bennington County. The result was localized flash flooding in Pownal. Routes 346 and sections of Route 7 were flooded in Pownal.

March 29, 2003: An area of low pressure, moving along a slow moving cold front on March 29 and 30, produced up to 2 inches of rainfall across extreme southern Vermont. The rain, combined with seasonably mild temperatures, melted much of the remaining snow pack across this area and produced a significant runoff. Both the Walloomsac and Batten Kill Rivers briefly went above flood stages in sections. The Walloomsac gage at Bennington crested at 8.19 feet, compared to the flood stage of 7.5 feet. The Batten Kill gage at Arlington crested at 6.3 feet, 0.3 feet above its flood stage.

July 21 to August 18, 2003 (DR-1488 7/21-8/18 2003): Severe storms and flooding affected Vermont including Bennington County. (Note: this event does not appear in the NCDC data.) Both the Bennington Morse State Airport and the Cooperative Weather Observer in Pownal recorded sporadic and sometimes large amounts of precipitation during this period.

March 31 to April 2, 2004: As much as 3 inches of rain fell between March 31 through April 2 across southern Vermont. This rain combined with the last of the snowmelt produced an excessive runoff of water. As a result, flooding took place in Bennington at the Paper Mill Village along the Walloomsac River.

May 25, 2004: The Walloomsac River exceeded its flood stage of 7.0', cresting at 7.75' at the gage in Bennington.

September 18, 2004: The Walloomsac River exceeded its flood stage of 7.0', cresting at 7.21' at the Bennington gage.

October 9, 2005: North Bennington Road at Bennington closed due to flooding.

November 30, 2005: On November 30, the Walloomsac River had minor flooding at Bennington. The river crested at 8.51 feet.

January 18-19, 2006: High wind and 1 to 2 inches of rain fell across eastern New York and western New England. Flooding occurred on the Walloomsac River at Bennington on January 18 and January 19. Flood stage is 7.0 feet; the river crested at 8.00 feet.

April 16-17, 2007 (DR-1698 4/15-21 2007): An intense coastal storm spread heavy precipitation across southern Vermont, starting as a mixture of snow, sleet and rain which changed to all rain. Liquid equivalent precipitation totals ranged from 3 to 6 inches leading to minor flooding across portions of southern Vermont. A Cooperative Weather Observer recorded 2.20 inches of rain in Pownal and the Bennington Morse State Airport recorded 1.41 inches from April 15 to 17.

June 15, 2009: Numerous thunderstorms developed across southern Vermont, many of which contained large quantities of hail. Some thunderstorms were slow moving, and produced locally very intense rainfall rates. This led to flash flooding in some areas. Cars were reported stalled in floodwaters in downtown Bennington due to flash flooding from heavy rainfall.

June 30, 2009: Torrential rain from thunderstorms produced flash flooding in Bennington. Several vehicles were disabled in high water on South Street in Bennington.

August 28-29, 2011 (DR-4022 8/27-29 2011): Tropical Storm Irene produced widespread flooding, and damaging winds across the region. Rainfall amounts averaged 4 to 8 inches and fell within a twelve-hour period. A Cooperative Weather Observer recorded 4.70 inches of rain in Pownal and the Bennington Morse State Airport reported 4.23 inches of rain from August 27 to 28. In Bennington County, widespread flash flooding and associated damage was reported countywide, with many roads closed due to flooding and downed trees and power lines. Strong winds also occurred across southern Vermont, with frequent wind gusts of 35 to 55 mph, along with locally stronger wind gusts exceeding 60 mph. The combination of strong winds, and extremely saturated soil led to widespread long duration power outages. In Bennington County, approximately 5,000 customers were affected by power outages. Record flooding occurred on the Walloomsac River. The Walloomsac gage exceeded its seven foot flood stage at 8:48 am EST on August 28th, its nine foot moderate flood stage at 9:50 am, its 11 foot major flood stage at 11:46 am, crested at a record 12.82 feet at 2:30 pm, and fell below flood stage at 5:32 am on August 29th. Route 9 was closed from Bennington to Brattleboro due to numerous reports of flooding. Portions of Route 9 remained closed after the floodwaters receded due to damage.

During Irene, the main water source to Bennington was cut off to the Town for several days after a bridge collapsed in Woodford damaging the Town water line. During this time, the

secondary water source was used to supply the Town with drinking water. Many residents and businesses were without power. Storm drainage issues occurred along Northside Drive causing the flooding of several businesses. The wastewater treatment plant was operating near maximum load and couldn't have handled much more water.

September 7, 2011: Large amounts of moisture from the remnants of Tropical Storm Lee interacted with a frontal system producing heavy rainfall with total rainfall amounts ranging from 3 to 7 inches led to widespread minor to moderate flooding across southern Vermont. A Cooperative Weather Observer in Pownal recorded 6.70 inches of rain between September 5 and 9, and the Bennington Morse State Airport recorded 3.49 inches from September 4 to 8. Minor flooding occurred on the Walloomsac River at Bennington. The Walloomsac gage exceeded its seven-foot flood stage at 11:48 am EST September 7, crested at 8.57 feet at 2:15 pm (moderate flood stage is nine feet), and fell below flood stage at 5:54 pm September 7.

May 22, 2013: Heavy rainfall from showers and thunderstorms reportedly caused flash flooding along Route 67A in North Bennington. Law enforcement reported that the road was temporarily closed due to flooding. The Bennington Morse State Airport recorded 3.43 inches of rain from May 21 to 22, and a Cooperative Weather Observer in Pownal observed 3.70 inches of rain.

May 29, 2013: Flash flooding was reported as a result of heavy rainfall from thunderstorms in Bennington on North Branch Street. South Street (Route 7) was also reported to be closed due to flooding on the roadway.

June 2, 2013: Showers and thunderstorms developed across the region. These thunderstorms were aided by very strong winds aloft and a few storms became severe across southern Vermont, producing large hail and wind damage. The thunderstorms also produced very heavy rainfall, which caused flash flooding within the Town of Bennington. Amateur radio operators reported that 8 to 10 inches of water was flowing across streets in downtown Bennington.

3. Extent and Location

The primary damages from past events have been from flooding and fluvial erosion with secondary damage from wind. Bennington has been a part of the National Flood Insurance Program (NFIP) since 1986. There are 221 flood insurance policies in effect, 32 total claims since 1986 and no NFIP-designated repetitive losses within Bennington. FEMA records indicate that there have been two repetitive loss structures in Bennington, but this is incorrect. Those repetitive losses were located in the Village of North Bennington. In past events, areas along the Roaring Branch and Walloomsac rivers, from the Town of Woodford to the Henry Covered Bridge (almost to the New York border), have flooded and caused the banks to erode. These rivers flow near various commercial areas along Northside Drive and through downtown Bennington, affecting businesses and residents.

Table 6. Months where rainfall exceeded the 90th percentile (precipitation totals, in inches, in parentheses) of monthly precipitation at the Peru, Pownal and Sunderland Cooperative Observer Stations from 1990 to 2013.			
Sunderland		Pownal	Peru
Month	Year	Year	Year
January	1990, 1998, 1999 (5.98")	1996, 1998, 1999 (4.29")	1990, 1999 (5.79")
February	2002, 2008, 2011 (3.58")	1990, 2008 (3.53")	2000, 2002, 2008 (4.93")
March	2001, 2007, 2008 (5.35")	1999, 2001, 2007 (4.42")	2001, 2008 (6.15")
April	1993, 1996, 2002, 2007, 2011 (4.74")	1990, 1993, 1996 (4.76")	1996, 2007 (5.95")
May	1990, 2000, 2006 (6.31")	1990, 2013 (6.50")	1990, 2012 (7.70")
June	1998, 2002, 2006 (7.67")	1998, 2000, 2002, 2013 (7.27")	1998, 2006, 2011, 2013 (8.94")
July	1996, 2004, 2008 (6.87")	2004, 2010 (6.34")	1996, 2000, 2013 (7.41)"
August	1990, 2003, 2011 (7.38")	1990, 1991, 2003, 2011 (7.24")	1990, 2003, 2011 (8.65")
September	1999, 2003, 2011 (5.75")	1999, 2004, 2011 (6.13")	1999, 2003, 2011 (7.13")
October	2005, 2007, 2010 (7.05")	1995, 2003, 2010 (5.46")	1995, 2005, 2006, 2010 (8.30")
November	2002, 2004, 2005 (5.28")	2005 (5.36")	2002 (6.37")
December	1996, 2003, 2008 (6.42"(	1990, 2003, 2011 (4.62")	1996 (7.18")

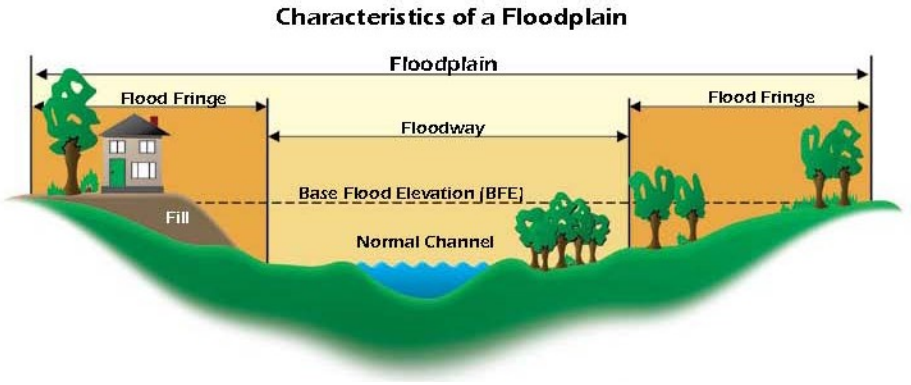
After Tropical Storm Irene, there were 19 high water marks located and mapped in Bennington by the USGS. Seven were located along the Walloomsac and twelve along the Roaring Branch (Medalie and Olson 2013). All but six high water marks were located within the flood hazard area in Bennington, one along the Walloomsac and five along the Roaring Branch. The marks that were not in the flood hazard area were only slightly outside and not enough to be noteworthy. In other words, the FEMA DFIRMs appear to be accurate because flooding was, for the most part, in line with the flood hazard area.

In addition to the above events, the Peru, Pownal and Sunderland Cooperative Observer recorded precipitation. Table 6 shows those months by year where that value exceeded the 90th percentile, which varies by site and month. Several events of that magnitude have occurred where flooding was not recorded in NCDC records or local knowledge, but this does provide additional information on potential flooding extent.

The average annual precipitation in Vermont has increased 5.9" since 1960. This trend is predicted to continue so that Vermont streams will have higher flows and possibly experience more frequent and greater flooding events (Galford et al 2014).

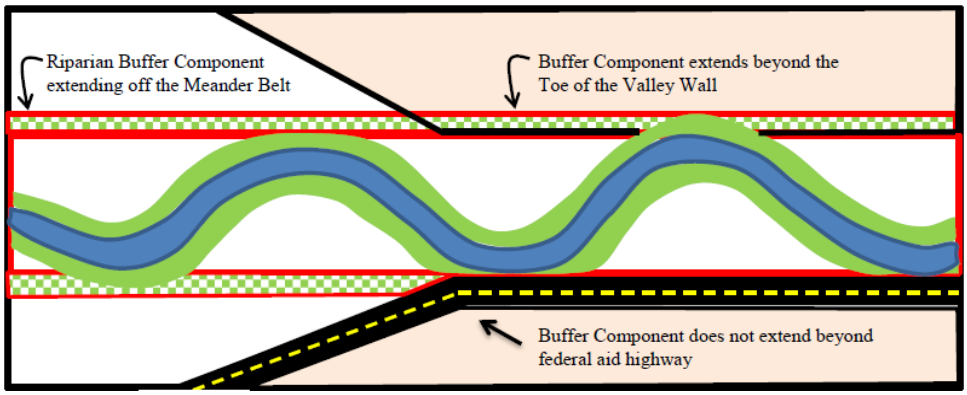
Special Flood Hazard Areas: these are areas mapped by FEMA and using the LIDAR derived zones that were adopted in late 2015. Table 7 shows the number of structures, by type, in the special flood hazard area and river corridors, and both areas are shown in Map 5. Figure 1 below shows the parts of a typical floodplain.

Figure 1. Typical floodplain



River Corridors: River corridors (Figure 2) have been mapped by the Vermont Agency of Natural Resources using geospatial data and will be modified by VT ANR river scientists using available field data. The data were used to calculate the "meander belt width" or area within which a river would move across the valley. As rivers shift their location both vertically and horizontally, erosion of adjacent lands can occur and threaten properties that may be outside of special flood hazard areas (Vermont River Management Program 2010).

Figure 2. River corridors



The maps developed by VT ANR show the potential extent of fluvial erosion in Bennington. This is the only information available that shows the amount of fluvial erosion that could occur. Therefore, these maps provide the best data to determine extent of fluvial erosion.

4. Probability, Impact, and Vulnerability

Based on data from 1996 to 2015, 25 moderate or major flood events have affected areas within or near Bennington resulting in a 100% chance of such an event occurring in any

given year. Probability and impact percentages were determined by an assessment of current available data.

Table 7. Structures by type in flood hazard areas in Bennington, VT. Source: Vermont Center for Geographic Information http://geodata.vermont.gov

Type	Number in Special Flood Hazard Area	River Corridor
Single-Family	122	198
Multi-family	119	69
Mobile Home	11	13
Other Residential	1	14
Commercial with Residence	5	
Government	3	2
Law Enforcement	1	
Fire Station	1	
Educational Building	4	1
Community/Recreation Facility	1	
Health Clinic	1	
House of Worship	2	
Commercial	183	58
Commercial Farm		1
Other Commercial	1	1
Industrial	3	1
Wastewater Treatment Plant		1
Warehouse	1	1
Camp		1
Other	31	21
Totals	490	382

Table 7 tallies the number of structures by type within the special flood hazard area and river corridor. Bennington has a total of 3,649 single-family residences, 664 multi-family dwellings, 504 mobile homes, 126 other residential buildings, 15 commercial with residential buildings, 555 commercial/industrial establishments, 9 health clinics and 2 veterinary clinics, 25 lodging establishments, 7 camps, and 66 government, church and school establishments.

As shown in Table 7, there are 490 structures in the special flood hazard area and 382 in the river corridor recently mapped by VT ANR. Therefore, the potential proportion damaged within the Town from severe flooding would range from 1-10% with injuries of 1-10%. Most services recover in less than seven days, though help for specific property owners may take significantly longer.

B. Winter Storms

1. Description

Winter storms are frequent in Vermont. Winter storms may consist of heavy snow, mixed precipitation, or ice storms and all may be accompanied by strong winds. Potential damages can include power outages, traffic accidents, and isolation of some areas. For example, the October 4, 1987 storm stranded travelers in the area and knocked out power for several days. The "Blizzard of ’93," one of the worst storms on record, virtually shut down Vermont on the weekend of March 13-14, forcing the closure of roads and airports. Snowfall amounts ranged from 10 to 28 inches across the state.

In rare cases, the weight of snow may collapse roofs and cause other structural damage. Wind accompanying snowstorms can increase the effect of the snow damages. In addition to snow, ice storms occur when the lower levels of the atmosphere and/or ground are at or below freezing, and rain is falling through warmer air aloft. The precipitation freezes upon contact with the ground, objects on the ground, trees and power lines.

Table 8. Total number of winter storm events by type and year for Bennington County.
Source: National Climate Data Center 2015

Year	Blizzard	Heavy Snow	Ice Storm	Winter Storm	Winter Weather	Totals
1996		5		2		7
1997		1		7	2	10
1998				2	1	3
1999				4		4
2000		1		6		7
2001				6		6
2002				5		5
2003				5		5
2004				2		2
2005	1	3		2		6
2006						
2007		3	1	6	4	14
2008		4	1	1	11	17
2009		3		1	10	14
2010		3		1	2	6
2011				5	5	10
2012				4	2	6
2013		2		1	4	7
2014		2		4		6
2015		2			6	8
Totals	1	29	2	64	47	143

2. Previous Occurrences

Table 8 summarizes the 143 winter storm events that have occurred in Bennington County since 1996. As can be seen, a high number of events occurred in 1997, 2007, 2008, 2009 and 2011. Using NCDC data, we categorized the extent of each storm with storms ranked as "High" if they produced more than twelve inches of snow or were categorized by the NCDC as producing heavy or record snows or blizzards or significant icing. The Blizzard of 1993 was categorized as "Extreme." The NCDC also reports numerous storms producing one to over three feet of snow in the Green Mountains, but these were not listed as they did not affect major population centers. The following is a summary of significant events.

January 2 to 3, 1996 Heavy Snow: A major winter storm developed over the Gulf coast states on January 2 and tracked northeast along the eastern seaboard during January 3. Heavy snow fell across southern Vermont with the average snowfall ranging from 10 to 12 inches.

November 26, 1996 Winter Storm: Over Bennington and Windham Counties, snow and heavy freezing rain downed trees and power lines and caused numerous accidents. Across southern Vermont, approximately 10,000 customers lost power.

December 7 to 8, 1996 Winter Storm: Heavy wet snow fell across southern Vermont resulting in 20,000 customers losing power. Twelve inches of snow were recorded in Shaftsbury and eleven in Pownal. Downed trees caused road closures and some were without power for several days. A Cooperative Weather Observer in Pownal recorded 14.5 inches of snow during this event.

March 31 to April 1, 1997 Winter Storm: A nor'easter formed bringing rain that changed to snow with totals of 12 inches in Shaftsbury. The wet snow caused power outages and road closures.

December 29 to 30, 1997 Winter Storm: Wet snow and strong winds combined to down trees and power lines causing scattered power outages. Route 7 was closed for several hours to clear debris. In Bennington, a 60-foot by 30-foot section of a cinema roof was peeled off by gusting winds. Strong winds ripped the metal skirting off several mobile homes at the Willows Mobile Home Park. Snowfall totals generally ranged from 5 to 10 inches across Bennington and Windham Counties.

January 14 to 15, 1999 Winter Storm: Heavy snow fell across eastern New York and southern New England with 5 inches reported by a Cooperative Weather Observer in Pownal. The storm was accompanied by extremely cold conditions with reported temperatures of -9 F.

December 30 to 31, 2000 Winter Storm: A general swath of 6 to 12 inches of snow fell across the region with locally higher amounts across the hills. Specific amounts included 13 inches in Pownal, and 8 inches in Bennington.

February 5 to 6, 2001 Winter Storm: A swath of heavy snowfall accumulating of a foot or more fell across southern Vermont. In Bennington County, specific accumulations included 12 inches in Bennington and 14 inches in Pownal.

March 5 to 6, 2001 Winter Storm: An extended period of moderate to heavy snow resulted in 26 inches of snow in Pownal. This was one of the largest snowfalls in southern Vermont since the Blizzard of 93.

January 6 to 7, 2002 Winter Storm: Two storm systems managed to produce a swath of snow in excess of a foot across southern Vermont. In Pownal, 15 inches of snow fell.

December 6 to 8, 2003 Winter Storm: The first major snowstorm of the winter resulted in 20.5 inches of snow reported in Pownal.

January 15 to 16, 2007 Ice Storm: Freezing rain and sleet resulted in widespread downed trees and power lines with accompanying widespread power outages. Significant icing, with ice accretions of ½ inch up to 1 inch, occurred from the freezing rain.

February 14, 2007 Heavy Snow: Snowfall in excess of two feet across portions of Bennington County resulted in closed schools and businesses. Strong winds created near blizzard conditions during parts of the event.

April 15 to 16, 2007 Winter Storm: Heavy, wet snow, ranging from 8 to 12 inches, downed trees and power lines causing widespread outages.

December 16 to 17, 2007 Winter Storm: Snow, heavy at times, mixed with sleet Sunday afternoon and evening. Total snow and sleet accumulations ranged from 10 to 14 inches, with 14 inches reported at Woodford. The combination of strong winds, and the extra weight of heavy wet snow on tree limbs also downed trees and power lines in portions of Bennington County during Sunday. The heavy snow and sleet resulted in numerous school and business closings Monday morning, and also created treacherous travel conditions for the morning commute.

February 12 to 13, 2008 Winter Storm: Snow accumulated to 4 to 7 inches and was accompanied by freezing rain with ¼ to ⅓ of an inch of ice.

December 11 to 12, 2008 Ice Storm: Rainfall in rates of ¼ to ⅓ of an inch per hour fell creating ice accumulations of ½ to ¾ of an inch. Snow and sleet mixed in some areas. An estimated 15,000 customers lost power and businesses and schools were shut for several days. Very cold temperatures followed the storm. Numerous warming shelters were setup to assist those who were without power and heat.

January 1 to 3, 2010 Heavy Snow: A strong storm brought 10 inches to over two feet of snow across Bennington and Windham counties. Over this three-day period, a Cooperative Weather Observer reported 13 inches of snow.

February 23 to 24, 2010 Heavy Snow: Heavy snow totaling one to two feet fell across southern Vermont with highest amounts at elevations above 1500 feet. A Cooperative Weather Observer in Pownal reported 9.7 inches of snow on February 24.

February 26 to 27, 2010 Heavy Snow: Just after the storm described above, a second storm brought one to two feet in higher elevations with lesser amounts below 1000 feet in elevation. A Cooperative Weather Observer in Pownal reported 13.4 inches of snow from February 25 to 27.

December 26 to 27, 2010 Winter Storm: Heavy snow falling at rates of 1 to 3 inches per hour resulted in 1 to 2 feet of snow. Winds were strong and gusted to 35-45 mph. A Cooperative Weather Observer in Pownal reported 20 inches of snow on December 27.

January 12, 2011 Winter Storm: A strong storm resulted in 14 inches to 3 feet of snow falling at rates of 3 to 6 inches per hour. A Cooperative Weather Observer in Pownal reported 20.6 inches of snow from January 12 to 13.

February 1 to 2, 2011 Winter Storm: Snowfall was generally 10-18 inches but ranged to 25 inches in some areas.

February 25, 2011 Winter Storm: Snow fell at rates of 1 to 2 inches/hour with totals of 12 to 17 inches across southern Vermont.

October 29 to 30, 2011 Winter Storm: While not yet winter and with trees with much of their foliage still on, 5 to 14 inches fell across Bennington County. Trees and power lines came down due to the weight of the wet snow. A Cooperative Weather Observer in Pownal reported 9.3 inches of snow on October 30.

December 14 to 15, 2013 Heavy Snow: Snow fell at rates in excess of 1 inch per hour over much of the region and snow rates locally were as high as up to 3 inches per hour at times. In addition, gusty southeast winds occurred during the late night hours, with a few gusts of 40-55 mph. The highest snowfall amounts occurred across the higher peaks of the southern Green Mountains, with up to 18 inches occurring in Woodford.

February 13 to 14, 2014 Winter Storm: Snow fell at rates of up to 3 inches per hour. Over the two days of the storm, 8 to 21 inches fell in southern Vermont. At times, winds gusted to 40 mph as the storm left the area.

November 26 to 27, 2014 Winter Storm: An early storm affected southern Vermont over the Thanksgiving period with 8 to 15 inches of total snow accumulation.

February 2, 2015 Heavy Snow: Most areas received 9 to 15 inches, although some areas within the high terrain of the southern Green Mountain saw up to 19 inches.

February 7 to 10, 2015 Heavy Snow: Snow amounts between 1 and 2 feet, with the highest amounts across the high terrain of the southern Green Mountains.

3. Extent and Location

The average annual snowfall in Bennington County is 64.4 inches, with December, January, February and March as the primary months for snowfall. Extreme snowfall events for one, two and three day events have ranged from 12 to over 20 inches. The skill of road crews in Vermont means that only the heaviest snowstorms (>12 inches) or ice storms affect the populations.

Increasing temperatures that are predicted to occur will likely reduce total winter snowfall. If precipitation falls as rain in the winter, river flows will be higher due to the lower

evapotranspiration in the winter. Freezing rain may become more frequent, with resulting impacts to the transportation and power systems (Galford et al 2014).

4. Probability, Impact and Vulnerability

There is a 100% probability of a moderate or greater snowstorm affecting Bennington County, including Bennington in any given year. These are large-scale events, though local impacts may vary greatly. Power lines and roads are most vulnerable, with traffic accidents the most likely to create injuries. Power outages could be short term (a few hours) or last seven or more days. Some roads may remain impassable for long periods as well.

C. High Wind Events

1. Description

High wind events can occur during tropical storms and hurricanes, winter storms and frontal passages. Thunderstorms can produce damaging winds, hail and heavy rainfall, the latter potentially producing flash floods. The NCDC recorded 69 thunderstorms with damaging winds in Bennington County since 1996.

Tornadoes are formed in the same conditions as severe thunderstorms. Intense, but generally localized damage can result from the intense winds. The primary period for tornado activity in New England is mid-summer (Zielinski and Keim 2003). Tornadoes will generally follow valleys in the northeast and dissipate in steep terrain. The NCDC recorded three tornadoes in Bennington County since 1990.

2. Previous Occurrences

Table 9 below summarizes the total number of significant wind events including thunderstorms, strong winds, and tornadoes from 1996 to 2015. The 1998 tornado registered F2 on the Fujita damage scale. The 2002 tornado in Bennington County registered F1 while the 2003 tornado was an F0 to F1 (National Climate Data Center 2015). The Fujita scale is based on wind speed and typical damage. An F0 tornado has winds of less than 73 miles per hour and could damage chimneys, branches and down shallow rooted trees. An F1 tornado has winds of 73-112 miles per hour and could damage roofs, push mobile homes off foundations and blow cars off of roads. An F2 tornado has winds of 113-157 miles per hour and could tear off roofs, destroy mobile homes and snap trees (http://www.spc.noaa.gov/faq/tornado/f-scale.html).

Wind speed data is not available for wind events due to the lack of weather stations. NCDC data (2015) rarely included estimates of wind speed. Generally, wind speeds of greater than 55 miles per hour are considered damaging (National Oceanographic and Atmospheric Administration 2006). Events that occurred in or near Bennington are described below.

Table 9. Summary of wind events in Bennington County. Source: National Climate Data Center 2015						
Year	High Wind	Strong Wind	Thunderstorm Wind	Tornado	Funnel Cloud	Totals
1996	5					5
1997	2	2	6			10
1998	1		8	1		10
1999	2		4			6
2000	1		1			2
2001			3			3
2002	1		3	1		5
2003	1			1		2
2004						
2005	1		3			4
2006	6		4			10
2007	3		6			9
2008		3	5			8
2009	2		1			3
2010	5		3		1	9
2011	1		8			9
2012	2		3			5
2013			6			6
2014			3			3
2015			2			2
Totals	33	5	69	3	1	111

February 24 to 25, 1996 High Wind: Damaging winds downed many trees across southern Vermont and produced scattered power outages.

March 19 to 20, 1996 High Wind: Damaging winds downed three utility poles north of Bennington on Route 7. In Shaftsbury, trees fell on two homes and there were numerous reports of trees and wires down.

December 1, 1996 High Wind: In Bennington and Pownal, wind downed numerous trees and power lines.

May 31, 1998 Thunderstorm Winds and Tornado: Strong thunderstorms generated an F2 tornado in New York, which became an F1 after crossing into Vermont. The tornado followed Route 67 through North Bennington and South Shaftsbury.

September 7, 1998 Thunderstorm Wind: A derecho downed trees in Woodford.

July 6, 1999 Thunderstorm Wind: Destructive thunderstorm winds brought down trees and power lines in Pownal and Stamford.

August 13, 1999 Thunderstorm Wind: A storm knocked down numerous trees and wires in Bennington. Downed trees blocked various roadways. A downed tree gashed a hole in the roof of a house on Gore Road in Bennington. A tree also fell on a Ford Explorer bringing considerable damage to the vehicle.

September 16 to 18, 1999 (DR-13079/16-21 1999): Remnants of Hurricane Floyd (see flooding and flash flooding) brought winds gusting to over 60 mph and downed trees and power lines in southern Vermont.

November 2, 1999 High Wind: Localized high wind gusts occurred in the Green Mountains during the evening hours. A wind gust of 66 mph was recorded at the Bennington Automated Surface Observing System (ASOS) site, located at the Bennington Morse State Airport.

August 3, 2000 Thunderstorm Wind: A severe thunderstorm blew numerous trees down in Bennington.

December 12, 2000 High Wind: Strong winds downed trees and power lines across Bennington County.

August 9, 2001 Thunderstorm Wind: Scattered severe weather caused trees to be blown down in Bennington as well as in Arlington.

June 5, 2002 Thunderstorm Winds and Tornado: Thunderstorms originating in New York produced an F1 tornado that touched down in Woodford Hollow. Tornado winds were estimated between 125 and 150 mph. Non-tornadic thunderstorm winds blew some trees down in the Town of Pownal. Lightning struck a home in North Bennington causing a very small fire with minimal damage to the structure of the house.

July 21, 2003 Tornado: A supercell, that originated in the Mid-Hudson Valley of New York and producing a long lived significant tornado, spawned a second twister which touched down in the Town of Pownal. The twister cut a swath longer than 25 miles and up 150 yards wide. After touching down in Pownal, the tornado moved northeast into Bennington, then continued into the Green Mountain State Forest in extreme western Windham County where it caused significant forest damage. Most of the destruction was to trees. There was also some structural damages in Bennington County. A tree collapsed onto a house. Another massive pine slammed into a 100-year-old house's roof in Pownal. A steakhouse in Bennington suffered damage that closed it for a couple of days, including shattered windows and water damage due to an open roof. An awning had been blown from the deck of the structure, all the way across Route 7A. The owner was slammed against a wall while venturing outside on the open deck but received no injuries. During the height of the storm, power was knocked out to over 2,000 customers in extreme southern Vermont.

February 17, 2006 Thunderstorm Wind: A wind gust of 66 mph was measured during a thunderstorm at Bennington Morse State Airport.

May 30, 2006 Thunderstorm Wind: A thunderstorm blew down trees in Bennington late in the afternoon.

October 29, 2006 High Wind: Strong winds, some reaching 60 mph, blew from the evening of October 28 through parts of October 29.

December 1, 2006 High Wind: A measured wind gust of 58 mph was recorded by the Bennington ASOS. Trees were reported down in Shaftsbury due to thunderstorm winds.

March 2, 2007 High Wind: High winds were recorded, along with snow and freezing rain. Winds at Bennington Morse State Airport reached 59 mph.

July 15, 2007 Thunderstorm Wind: Wires were reported down in Shaftsbury due to strong thunderstorm winds.

August 3, 2007 Thunderstorm Wind: Numerous showers and strong thunderstorms developed across eastern New York and western New England. Some thunderstorms became severe during this time period. Numerous trees and wires were reported down in Bennington.

August 25, 2007 Thunderstorm Wind: Scattered strong to severe thunderstorms developed across eastern New York and western New England. Trees and wires were reported down in North Bennington due to strong thunderstorm winds.

December 16, 2007 High Wind: A snowstorm brought 8 to 14 inches of snow along with strong winds that combined to down trees and powerlines. A tree reportedly fell on a trailer located on Chapel Road, in Bennington. This occurred at approximately at 15:45 LST, due to the combination of high winds, and the accumulation of heavy wet snow on tree branches. In addition, several thousand power outages were reported throughout Bennington County Sunday afternoon, also due to the combination of high winds and heavy snowfall.

May 31, 2008 Thunderstorm Wind: Trees and wires were reported down in Bennington as a result of strong thunderstorm winds.

June 30, 2009 Thunderstorm Wind: A wind gust of 59 mph was recorded by the Bennington ASOS.

December 9, 2009 High Wind: Power outages were reported due to high winds across Bennington County affecting the towns of Bennington, Pownal, Shaftsbury, Sunderland, Sandgate, Manchester and Dorset. A measured wind gust of 59 mph was recorded at the Bennington Morse State Airport.

June 5, 2010 Thunderstorm Wind: Trees and limbs were reported down in Bennington due to strong thunderstorm winds.

July 17, 2010 Funnel Cloud: A funnel cloud was reported on Route 279 in Bennington.

August 22, 2010 High Wind: Strong winds formed during passage of a cold front. Downed trees and wires were reported in Arlington, Bennington, Shaftsbury and Sunderland.

September 30 to October 1, 2010 High Wind: A low pressure system and remnants of Tropical Storm Nicole off shore created winds gusting to over 55 mph with power outages reported. Eighty-two power outages were reported across Bennington County due to high winds.

December 1, 2010 High Wind: Strong wind gusts downed trees and power lines resulting in power outages. Generally, 1½ to 3 inches of rain fell across the area resulting in some urban and small stream flooding. Trees and power lines were reported down in various locations around Bennington due to strong and gusty winds. Some downed trees were blocking roads.

April 26, 2011 High Wind: Trees and wires were reported down due to high winds along East Road in Bennington.

May 26, 2011 Thunderstorm Wind: Trees were reported down on Cedar Hill Road in Pownal due to strong thunderstorm winds. Trees were also reported down on Hidden Valley Road and a tree was reported down on a house on Jackson Cross Road in Pownal. Hundreds of branches were reported down on roads throughout the Bennington area due to strong thunderstorm winds.

June 9, 2011 Thunderstorm Wind: A pre-frontal trough formed a line of severe thunderstorms that moved across eastern New York and southern Vermont.

August 21, 2011 Thunderstorm Wind: There were two distinct rounds of strong to severe thunderstorms, which created damaging winds. Trees were reported down in Bennington, and on Route 9 just east of Bennington, due to strong thunderstorm winds.

August 28-29, 2011 (DR-4022 8/27-29 2011): Along with flooding described above, Tropical Storm Irene brought 35-55 mph winds with gusts exceeding 60 mph resulting in downed trees and powerlines.

September 4, 2011 Thunderstorm Wind: The Automated Surface Observing System at the Bennington Morse State Airport measured a wind gust of 64 mph. Trees were reported down in Bennington due to strong thunderstorm winds.

September 8, 2012 Thunderstorm Wind: Multiple trees and wires were reported down due to thunderstorm winds in Bennington.

October 29 to 30, 2012 High Wind: Superstorm Sandy brought strong winds of 40-60 mph, with a gust of 41 mph recorded at the Bennington Morse State Airport. The highest wind gust in southern Vermont occurred in Woodford, where a wind gust of 58 mph was reported.

December 21, 2012 High Wind: A tree was reported down in Bennington due to high winds.

June 2, 2013 Thunderstorm Wind: Showers and thunderstorms developed across the region aided by very strong winds. A few storms became severe, producing large hail and wind damage. The thunderstorms also produced very heavy rainfall, which caused flash flooding in Bennington. Multiple trees were reported down and one tree fell on two parked trucks as a result of the thunderstorm winds.

June 23, 2015 Thunderstorm Wind: Trees were reported down in Bennington due to thunderstorm winds.

July 1, 2015 Thunderstorm Wind: A large tree was downed in Bennington as a result of thunderstorm winds.

3. Extent and Location

Damaging winds, including the previous occurrences described above, are those exceeding 55 miles per hour (National Oceanographic and Atmospheric Administration 2006 and undated). During a December 2009 event, winds were measured at 59 mph at the Morse Airport in Bennington. Higher winds were likely created during the two tornadoes. High wind events can strike anywhere. Where storms are funneled up the valleys, damage can be significant, but most likely less than 10% of structures would be affected. Again, power outages could last up to seven or more days. There are no weather stations nor any records of wind data in Bennington.

4. Probability, Impact and Vulnerability

Wind events causing moderate or greater damage occur almost every other year (40-50%) in Bennington County, and can range from localized events from thunderstorms to wide ranging events from larger storms. The primary vulnerability would be power outages from downed trees and lines and the potential expected probability would be 10-100% in Bennington.

D. Hail

1. Descriptions

Hail is frozen precipitation that forms in severe thunderstorms. Hailstones can range in size from ¼" (about the size of a pea) to over four inches (grapefruit sized), though most hail is in the smaller categories of less than 1.5 inches. The strong up and downdrafts within thunderstorms push to freeze and down to collect water and this repeated cycle results in accumulation of ice until gravity pulls the hailstone to Earth.

2. Previous Occurrences

The National Climate Data Center has 28 reports of hail storms in Bennington County between 1996 and 2015, all associated with thunderstorms. The following were within Bennington or nearby towns.

May 31, 1998 Thunderstorm Winds and Tornado and Hail: Strong thunderstorms generated an F2 tornado in New York, which became an F1 after crossing into Vermont. The tornado followed Route 67 through North Bennington and south Shaftsbury. Hail was reported in Shaftsbury.

July 18, 2000 Hail: Hail was reported in Bennington.

June 27, 2002 Hail: One inch hail was reported in North Bennington.

August 3, 2007 Hail: Ping pong ball sized hail was reported in Shaftsbury.

June 24, 2008 Hail: Quarter size hail was reported near Pownal during a thunderstorm.

June 15, 2009 Hail: Quarter size hail was measured at the Bennington Morse State Airport during a thunderstorm. In addition, nickel to quarter size hail was also reported in the Town of Bennington.

July 7, 2009 Hail: Penny size hail was reported in Bennington during a thunderstorm.

July 17, 2010 Hail: Quarter size hail was reported during a thunderstorm in Bennington.

July 21, 2010 Hail: Quarter size hail was reported during a thunderstorm in Bennington.

June 1, 2011 Hail: Multiple reports of large hail were reported during a thunderstorm in Shaftsbury. Hail stones of 3.25 inches and 2.75 inches in diameter were measured. Hail the size of a golf ball was reported. Hail sizes of greater than one inch in diameter were common, with reports of greater than baseball size hail, 3 inches, being reported. Quarter size hail was reported near Bennington during this thunderstorm.

June 2, 2013 Hail: Quarter size hail was reported during a thunderstorm in Bennington.

3. Extent and Location

Hail can cover wide areas and has the potential for damaging crops, automobiles or glass within structures, as well as causing injury. Generally, however, hail storms affect relatively small areas as they form in thunderstorms, which are localized. Storms with the largest hail stones near Bennington were in Shaftsbury in 2007 and 2011. Ping pong size hail was reported in 2007, and multiple large size hail, from golf ball size to greater than 3 inches, was reported in 2011.

4. Probability, Impact and Vulnerability

Hail storms are generally local, affecting subareas within the Town, though a group of thunderstorms can cause hail in multiple locations over a wide area. From past occurrences, about one thunderstorm per year generates hail that was recorded. So, the possibility of hail occurring in North Bennington could range from 10-100%. The potential vulnerability would be localized to damage to structures or automobiles, though there could also be damage to vegetation. In general, these impacts would be localized.

E. Temperature Extremes

1. Descriptions

Temperature extremes entail periods of either excessive heat or extreme cold. Excessive heat is generally defined as periods when the normal high temperature is exceeded by ten degrees. So, in the summer, this would equal approximately 88 degrees in Bennington (Table 10). Excessive heat is recorded at other times, but does not have the health consequences of summer periods. In addition, the heat index, which factors in the high relative humidity levels of summer, is also a factor.

Extreme cold is not well defined. For those involved in outdoor activities, extreme cold, accompanied by wind, is when exposed skin would be subject to frostbite. However, for periods of power outages that might accompany winter storms, extreme cold could be thought of as when temperatures fall below freezing as that would not only affect personal health and the health of household animals, but could result in pipes freezing, and the loss of water supplies and perishables.

Table 10. Pownal normal temperatures and precipitation for 1981 to 2010.
Source: National Climate Data Center: http://www.ncdc.noaa.gov/land-based-station-data/climate-normals/1981-2010-normals-data

Month	High Temperature (^{0}F)	Low Temperature (^{0}F)	Mean Temperature (^{0}F)	Precipitation (in)
January	28.8	10.6	19.7	2.98
February	32.1	13.5	22.8	2.52
March	40.9	21.4	31.2	3.25
April	55.3	33.2	44.3	3.51
May	66.1	42.9	54.5	4.12
June	74.1	51.7	62.9	4.86
July	78.2	56.2	67.2	4.58
August	76.5	54.8	65.6	4.15
September	69.8	47.4	58.6	4.06
October	58.1	37.4	47.7	4.29
November	46.0	29.1	37.5	3.90
December	34.3	18.8	26.6	3.11
Annual	55.0 (Avg)	34.8(Avg)	44.9	45.33

The station normal report for the Cooperative Weather Observer in Pownal indicates an average of one day per year when the maximum temperature would equal 90 degrees, 54 days when the maximum temperature would be less than 32 degrees and 156 days when the minimum temperature would be less than 32 degrees.

2. Extent and Location

Extreme temperature is a widespread phenomenon. The populations affected could be small if one is considering outdoor workers or the entire Town in a power outage. The highest recorded temperature from the Pownal Cooperative Weather Observer was 97 degrees on July 6, 2010 and July 18, 2012. The coldest recorded temperature from the Pownal Cooperative Weather Observer was -26 degrees on January 27, 1994.

Average temperatures in Vermont have risen 2.7 degrees since 1941 with an increase of 1.5 degrees since 1990. Winter temperatures have risen more than summer temperatures. If these trends continue, the number of days above 88 degrees will likely increase and minimum temperatures also increase (Galford et al 2014).

3. Probability, Impact and Vulnerability

Extreme heat is relatively rare with occurrences of approximately less than one day per year. Extreme cold, here defined as less than freezing temperature, is a frequent phenomenon in Vermont. Impacts of either type of event could be widespread, and vulnerability is dependent on the populations exposed.

F. Drought

1. Description

There are several types and definitions of drought: meteorological, climatological, atmospheric, agricultural and hydrological. The latter is based on stream flow and groundwater availability and is probably most important from a natural hazard assessment perspective. Reductions in precipitation over long enough periods, particularly during the growing season when plants take up moisture, can result in hydrologic drought.

Table 11. Years and number of months when the PHDI indicated severe or extreme droughts from 1985 to 2015.
Source: National Climate Data Center. Source: ftp://ftpncdd.noaa.gov/pub/data/cirs/climdiv/ (Richard Heims, personal communication)

Year	Extreme	Severe
1907		1
1908	2	1
1909	1	2
1910		2
1911	5	4
1912		2
1913		5
1914		5
1915	3	1
1921		2
1922		1
1930		1
1931		4
1941		5
1942		2
1949		1
1953		2
1957		1
1959		1
1963		3
1964	1	6
1965	8	1
1995		2
1999		1
2001	2	1
2002	1	1
Totals	23 months; 8 years	58 months; 26 years

2. Past Occurrences

The Palmer Hydrologic Drought Index (PHDI) is an indicator of potential surface and groundwater availability based on climatic conditions. The categories of drought include moderate drought, severe drought and extreme drought. Table 11 shows periods when the index showed severe and extreme droughts using data from 1985 to 2015. No drought conditions were recorded from 2003 through 2015.

3. Extent and Location

The National Climate Data Center calculates this index back to 1895. Since then, severe droughts occurred in 26 years or 21.7% while extreme droughts occurred in 8 years or 6.7%. Severe and extreme droughts have been of short duration, except occurrences in the early 1960s. Mild to moderate droughts have been more frequent. Severe and extreme droughts are likely to affect those properties with shallow wells. Based on well data from the Vermont Center for Geographic Information, there are a total of 652 wells in Bennington. Of these wells, 75 of them have depths of less than or equal to 100 feet.

There are twenty-seven public water wells, many of which serve motels and restaurants. The town well serves the population of Bennington. Southern Vermont College also has three wells for their campus. Other public wells are for various institutions and private establishments.

Map 6 shows surface and groundwater protection areas. One surface water protection area is primarily in Stamford and Glastenbury. The groundwater areas are in the eastern and southern parts of the town for several public water wells. There are also three groundwater classification areas, all Class IV indicating waters can't be used for drinking but are suitable for industrial or agricultural uses.

4. Probability, Impact and Vulnerability

Based on the Palmer Drought Severity data, there is a 21.7% chance of a severe or extreme drought occurring in any one year. The public wells are associated with two schools and a business. Except for long-term droughts, most wells should supply sufficient water, though structures with shallow wells are most likely to be affected. Droughts may affect the potential for wildfire, which is discussed below. Increasing temperatures or changes in precipitation patterns due to climate change may affect the frequency, length and degree of a drought.

The primary source for the Town's public drinking water is Bolles Brook, a surface water source located in Woodford. The water filtration plant is also located in Woodford. There can be issues with silt and erosion upstream during heavy rain or snow, which causes a lot of debris to flow into the filtration plant.

The secondary source for drinking water is Morgan Spring, located in Bennington. This spring has a ground water pumping station and withdrawal facility. This spring could be used if the main public water supply became compromised.

Weather related damage to the public water supply would most likely be from flooding. The damage could cause a blockage to the system due to excess silt and debris. If a clog occurred, the water supply could be shut down for a few days. If this were to happen, Morgan Spring would be used to supply the town water. Both the water filtration plant and the wastewater facility are prepared for power outages, as both facilities have generators to provide backup power.

G. Wildfire

1. Description

Wildfire or wildland fire is any unplanned fire affecting open lands including forests, grasslands or other features. The potential for wildland fire is dependent on fuel types, which vary with vegetation, topography and weather. Fire intensity, measured by the amount of

energy released in a fire and exhibited by the length of flames and rates of spread dictate the degree of wildland fire hazard and methods of control. Table 12 shows how wildfires can be categorized based on size.

Table 12. Wildland fire size classes.
Source: National Wildfire Coordinating Group 2011

Magnitude (Size)	Description	Probability
Class A	< ¼ acre	High
Class B	¼ to 10 acres	High
Class C	10 to 100 acres	Moderate
Class D	100 to 300 acres	Low
Class E	300 to 1000 acres	Very low
Class F	1000 to 5000 acres	Very low
Class G	>5000 acres	Very low

In Vermont, forests tend to be dominated by northern hardwood species such as sugar maple (*Acer saccharum*), birch (*Betula* spp.), white pine (*Pinus strobus*) and hemlock (*Tsuga canadensis*). These species tend to create relatively low flammability fire, so that surface fires have low intensity and rates of spread, thereby limiting fire hazard (Anderson 1982). Most of the land area in Bennington is covered by broadleaf litter fuels that exhibit fires of low intensity and slow rates of spread (U.S. Forest Service 2010).

In both forested and open settings, structures may be threatened by even small wildfires. These wildland-urban interface areas are the most likely areas where resources will be needed to suppress wildland fire and to reduce potential hazards.

Fire behavior is most extreme during periods when the relative humidity is low, generally less than 35-45%. These conditions are most prevalent in the spring, following snowmelt, between March and late May or early June. After that, vegetation becomes increasingly green, and the resulting moisture in the live vegetation (fuel) reduces flammability significantly. Precipitation and evapotranspiration increase ambient relative humidity levels so that fires in the summer are generally rare and limited in size.

Fall again brings drying fuels and weather conditions increasing fire hazard. However, relative humidity levels increase after dark, and shorter days also limit the amount of time for fuels to dry and intense, fast moving fires to occur (North Central Research Station 2005).

Bennington likely has some structures within the “wildland urban interface,” which represents areas where structures are directly adjacent to wildland fuels (Federal Register 2001). These areas have not been mapped.

2. Past Occurrences

According to records from the Vermont Department of Forests, Parks and Recreation, from 1992 to 2015, 179 wildfires occurred in Bennington County, 43 occurred in Bennington.

3. Extent and Location

Of the 43 fires from the Vermont Department of Forests, Parks and Recreation records, 23 were Class A, 19 were Class B and one was Class C. The largest fire was 21 acres. Most fires were caused by burning brush, wood, and trash or from campfires.

4. Probability, Impact and Vulnerability

Map 7 shows wildfire risk, as determined by the Vermont Department of Forests, Parks and Recreation (2010) and mean fire return interval from LANDFIRE. The fire return interval in forested areas in Vermont is generally greater than 100 years, meaning that the natural return interval is relatively long. This return interval is shorter for areas dominated by herbaceous vegetation in the fields within valleys. Given the number of fires that have occurred, there is a 100% probability of a wildfire occurring in Bennington, in any given year, but these are most likely to be small.

The area's deciduous and coniferous forests create litter that is relatively low in flammability so that wildfires have relatively low intensity and rates of spread. The main hazard is for wildland fire fighters working in steep terrain. The natural fire return intervals in most forests in Vermont are greater than 50 years (Malamud et al 2005) though fires can be more frequent in old fields (Map 7). Recurrence is likely related to precipitation rather than the buildup of fuels, so drought recurrence is already factored into these interval estimates. Therefore, the potential for large fires is very limited due to the fuel characteristics and the relatively urbanized land cover of Bennington.

H. Earthquake

1. Description

Vermont has no active faults, but has experienced minor earthquakes. Table 14 below shows the most recent occurring within the state, though there have been others located outside the state that have been felt in Vermont (Springston and Gale 1998). The U.S. Geological Survey predicts a two percent probability of an earthquake causing considerable damage in Vermont sometime in the next 50 years (Springston and Gale 1998).

2. Past Occurrences

Data from the Weston Observatory at Boston College (Northeast Earthquake Maps and Catalog) was used to identify earthquakes occurring within 100 miles of Bennington since 1990. No earthquakes occurred in either Bennington or Bennington County during that period. Figure 3 below plots the number of earthquakes by year by magnitude.

Figure 3. Plot of earthquakes and magnitude for occurrences within 100 miles of Bennington, Vermont. Source: Northeast Earthquake Maps and Catalog 2015

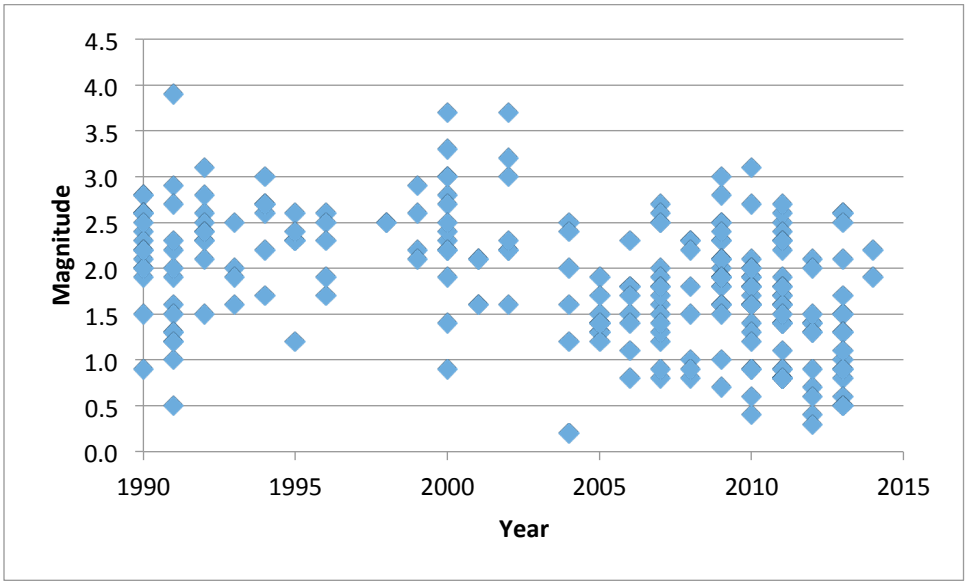


Table 13. Earthquake Magnitude and intensity scale descriptions. Source: http://earthquake.usgs.gov/learn/topics/mag_vs_int.php		
Magnitude	Modified Mercalli Intensity	Description
1.0-3.0	I	**I**. Not felt except by a very few under especially favorable conditions.
3.0-3.9	II-III	**II**. Felt only by a few persons at rest, especially on upper floors of buildings. **III**. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
4.0-4.9	IV-V	**IV**. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. **V**. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5.0-5.9	VI-VII	**VI**. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
6.0-6.9	VII-IX	**VII**. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. **VIII**. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. **IX**. Damage considerable in specially designed structures; well-designed

Table 13. Earthquake Magnitude and intensity scale descriptions.
Source: http://earthquake.usgs.gov/learn/topics/mag_vs_int.php

Magnitude	Modified Mercalli Intensity	Description
		frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VIII or higher	**VIII**. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. **IX**. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. **X**. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. **XI**. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. **XII**. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Table 14. Earthquakes in Vermont. Source: Vermont Geological Survey (Ebel et al 1995) http://www.anr.state.vt.us/dec/geo/EBEL.htm consisting of excerpts from: A Report on the Seismic Vulnerability of the State of Vermont by John E. Ebel, Richard Bedell and Alfredo Urzua, a 98 page report submitted to Vermont Emergency Management Agency in July, 1995.

Location	Date	Magnitude	Mercalli Intensity
Swanton	July 6, 1943	4.1	Felt by nearly everyone; many awakened with some dishes and windows broken and unstable objects overturned
Brandon	March 31, 1953	4.0	Felt indoors by many, but by few outdoors. Sensation would be similar to a heavy truck striking a building
Middlebury	April 10, 1962	4.1	Felt by nearly everyone; many awakened with some dishes and windows broken and unstable objects overturned

3. Extent and Location

Table 14 shows earthquakes that have occurred in Vermont based on the 1995 report. No earthquakes have been recorded in Bennington or in Bennington County. Those occurring within 100 miles have ranged in magnitude from barely registered to 3.9, with most in the range of 0.5 to 3.0 (Figure 3). No damage was recorded in any of these in Bennington. In 2003, the Vermont Geological Survey completed simulations using FEMA HAZUS software of potential damage within Bennington County from a 500-year recurrence earthquake centered in Middlebury, VT, Tamworth, NH and Goodnow, NY. The results indicated minimal damage and injury from any of these events in Bennington (Kim 2003).

4. Probability, Impact and Vulnerability

Based on the 2003 HAZUS analyses, both the probability and impact of an earthquake occurring with a magnitude large enough to cause substantial damage in Vermont is low. However, earthquake prediction science is very limited.

I. Landslide

1. Description

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is the force driving landslide movement. Factors that allow the force of gravity to overcome the resistance of earth material to landslide movement include saturation by water, steepening of slopes by erosion or construction, and alternate freezing or thawing. Table 15 shows how landslides can be categorized.

Table 15. Landslide and debris flow types.
Source: U.S. Geological Survey 2006

Magnitude	Description	Probability
Localized	Falls: abrupt movements of rocks and boulders, generally on steep slopes	Low to moderate
Topples	Topples: movements involving some forward rotation as material moves downhill	Low to moderate
Flows	A range of land movement generally involving a mass of loose soil, rock, organic matter, air and water moving downhill rapidly and possibly covering a wide area One form called creep involves slow movement of material and is often recognizable by trees growing so as to remain vertical while bent near the ground as they grow to keep up with the slow material flow.	Highly variable but can be fairly common.

2. Past Occurrences

No landslides were reported during Tropical Storm Irene and none have been reported from previous or subsequent events. Eleven rockfall areas were identified (Map 8) by the Vermont Agency of Transportation (Eliason and Springston 2007).

3. Extent and Location

Using a protocol developed for the Vermont Geological Survey (Clift and Springston 2012), Dale (2015) used geographic information system data and analyses to develop a potential landslide map for Bennington. Map 8 shows two large areas with moderate potential for landslides. One area is located along the steep Green Mountains, spanning the majority of the eastern border of Bennington. The second area surrounds the steep slopes of Mount Anthony in the southwestern corner of Bennington. There are various other areas in the valley that show potential for low and moderate landslides, though these cover a much smaller land

area. There are also a few valley and mountain areas that show high potential for landslides, but these are very small areas as well. There have been no reported landslides in Bennington.

4. Probability, Impact and Vulnerability

The probability of the identified areas in affecting settled areas is low, as there are few buildings located in these areas. In addition, given past events, the probability is low that a landslide will occur, and therefore the potential impact and vulnerability are both low.

J. Invasive Species

1. Descriptions

Invasive species are organisms that are not native to a geographic area and which can or do cause economic or environmental harm. Invasive species are characterized by organisms that spread rapidly, can displace native species, and have few or no predators to keep their populations in check. At the same time, they have characteristics that may reduce the value and use of natural resources. For example, Japanese knotweed colonizes stream banks, and does not hold soil well, leading to increased streambank erosion. Bush honeysuckle can become a dominant shrub in some forests, reducing the potential for tree regeneration (Vermont Invasives 2016).

Vermont has two invasive species lists: Class A species are on the Federal Noxious Weed List but are not known to occur in Vermont. These are listed in 7 C.F.R. 360.200, a section of the Code of Federal Regulations. Class B species are known to occur in the state and are considered a threat (Table 16).

Table 16. Designated Class B noxious weeds in Vermont.
Source: Vermont Agency of Agriculture, Food and Markets: http://agriculture.vermont.gov/plant_pest/plant_weed/invasive_noxious_weeds/noxious_weeds_list
Those with a * have been identified in Bennington County. Source: Early Detection and Mapping System: http://www.eddmaps.org/tools/query/
Those marked with an (A) are also on the aquatic invasive species list (Table 17)

Scientific Name	Common Name
*Acer ginnala**	Amur maple
*Acer platanoides**	Norway maple
*Aegopodium podagraria**	Bishop's goutweed or goutweed
Ailanthus altissima	Tree of heaven
*Alliaria petiolata**	Garlic mustard
*Berberis thunbergii**	Japanese barberry
*Berberis vulgaris**	Common barberry
Butomus umbellatus (A)	Flowering rush
*Celastrus orbiculatus**	Oriental bittersweet
*Euonymus alatus**	Burning bush
*Fallopia japonica**	Japanese knotweed
Hydrocharis morsus-ranae (A)	Frogbit

Table 16. Designated Class B noxious weeds in Vermont. Source: Vermont Agency of Agriculture, Food and Markets: http://agriculture.vermont.gov/plant_pest/plant_weed/invasive_noxious_weeds/noxious_weeds_list Those with a * have been identified in Bennington County. Source: Early Detection and Mapping System: http://www.eddmaps.org/tools/query/ Those marked with an (A) are also on the aquatic invasive species list (Table 17)	
Scientific Name	Common Name
*Iris pseudacorus** (A)	Yellow flag iris
Lonicera japonica	Japanese honeysuckle
Lonicera maackii	Amur honeysuckle
*Lonicera morrowii**	Morrow honeysuckle
*Lonicera tatarica**	Tartarian honeysuckle
*Lonicera x bella**	Bell honeysuckle
*Lythrum salicaria** (A)	Purple loosestrife
*Myriophyllum spicatum** (A)	Eurasian watermilfoil
Najas minor (A)	European naiad
Nymphoides peltata (A)	Yellow floating heart
*Phragmites australis** (A)	Common reed
Potamogeton crispus (A)	Curly leaf pondweed
*Rhamnus cathartica**	Common buckthorn
*Rhamnus frangula**	Glossy buckthorn
*Trapa natans** (A)	Water chestnut
Vincetoxicum nigrum	Black swallow-wort

Table 17 shows aquatic invasive species listed by the Agency for Natural Resources.

Table 17. Aquatic invasive species in Vermont. Source: Watershed Management Division, Department of Environmental Conservation: http://dec.vermont.gov/watershed/lakes-ponds/aquatic-invasives/gallery	
Scientific Name	Common Name
Dreissena polymorpha	Zebra mussel
Alosa pseudoharengus	Alewife
Orconectes rusticus	Rusty crayfish
Didymosphenia geminata	Didymo
Bythotrephes longimanus	Spiny Waterflea
Corbicula fluminea	Asian clam
Didymosphenia geminata	Didymo[1]
Nitellopsis obtusa	Starry Stoneword
Myriophyllum heterophyllum	Variable-leaved Watermilfoil

2. Past Occurrences

Invasive species are present and represent a continuous hazard that will vary with their abundance and their impacts on structures and infrastructure.

[1] Recently this species has been determined to be native, but that status may change.

3. Extent and Location

The extent of invasive plants in Bennington and in Bennington County has not been fully mapped. Though, the planning team mentioned that honeysuckle is found in many areas around Bennington and is a nuisance because it increases the tick population in the areas it grows. Japanese knotweed was also identified as being a problem and is found along most river corridors.

In addition to the species listed in the above tables, the following are potential invasive species:

Pastinaca sativa (Wild parsnip) is abundant along roadsides and can cause skin burns when chemicals in the plant on exposed skin interact with sun, which can harm those who work on or along roads or utility rights of way. *Anthriscus sylvestris* (cow parsnip or wild chervil) also dominates roadsides and can invade meadows. *Phalaris arundinacea* (reed canary grass) can invade wetlands and crowd out native plants. The bush honeysuckles (*Lonicera* spp.) have also been observed along roadsides. It is likely that buckthorn (*Rhamnus cathartica*) and barberry (*Berberis thunbergii*) have invaded forests and wetland edges and that Japanese knotweed (*Fallopia japonica*) has invaded stream banks and other disturbed areas.

Insects and pathogens have the potential for dramatically altering the composition and structure of forests as well as affecting trees in settled areas. Hemlock wooly adelgid (*Adelges tsugae*) has dramatically reduced hemlock trees south of Vermont and was recently found in Pownal, Vt. Emerald ash borer (*Agrilus planipennis*) is a significant threat to forests as it kills all ash species. Borers are often dispersed through movement of firewood.

In addition to the above insects, there are other insects and pathogens that are affecting Vermont forests. These may constitute an emerging hazard (Schultz et al 2015). Climate change may increase the abundance and ranges of forest pest species such as hemlock wooly adelgid and invasive species currently found in more southerly locations (Rustad 2012).

4. Probability, Impact and Vulnerability

The likelihood of increased abundance of invasive species is 75-100% and potential impacts to forested areas are very high. Invasive insects that can cause tree death, particularly the emerald ash borer, could result in road closures, power outages and property damage. Increases in the abundance of invasive plant species could limit regeneration of native trees and shrubs and affect the long-term integrity of the forests (Vermont Department of Forests, Parks and Recreation 2010, Vermont Invasives 2016).

K. Hazardous Material Spill

1. Descriptions

Hazardous wastes are materials that are flammable, corrosive, toxic, or labeled with warning or caution labels. These materials are used in industry, in the home or on farms and are transported regularly.

2. Past Occurrences

The Vermont spill site list indicates there have been 293 spills reported in Bennington since 1990.

3. Extent and Location

All of the spills affected small sites or areas. The main highways that would be affected by a spill would be VT Route 279, VT Route 9, US Route 7, VT Route 7A, and VT Route 67A. These roads carry substantial traffic, so a spill could affect many properties and travelers. An incident along VT Route 9, or near the intersection of VT Route 9 and US Route 7 (Main Street, North Street and South Street) through the center of Bennington, or along US Route 7 or VT Route 67A could cause severe impacts, as these routes are the main arteries through Town.

One particular concern in any hazardous materials spill would be the impact on water resources. Various waterways flow under or are adjacent to the main roads through Bennington. A hazardous materials spill could easily contaminate any waterway within reach (see Map 9).

Hazardous roads and intersections have been identified by the Vermont Agency of Transportation and the planning team. Accidents have occurred on many roads in Bennington, but the roads where accidents were most frequent, according to the VTrans Public Crash Data Query Tool from 2012 to 2017 (http://apps.vtrans.vermont.gov/CrashPublicQueryTool/#), were Northside Drive/VT Route 67A (from Water Street to Park Street), Main Street/VT Route 9 (from Monument Avenue to Burgess Road), Benmont Avenue (from Main Street to Northside Drive) and North Street/South Street/US 7 (from Merson Street to Northside Drive). The intersections with the most accidents were Main Street at North Street/South Street/US 7, Safford Street at Main Street, Depot Street at Main Street, Benmont Avenue at Main Street, Benmont Avenue at County Street, Northside Drive/Kocher Drive at North Street/US 7 and County Street at North Street/US 7. In addition, the planning team identified the intersection of Silk Road and VT Route 67A as a hazardous intersection. Roads with average grades greater than 10% also present hazards, particularly when roads are wet or during winter storms.

4. Probability, Impact and Vulnerability

Hazardous materials spills occur more than annually, though typically affect small areas. Bennington has a lot of truck traffic, which can increase the possibility of a major spill. Many areas are vulnerable due to the extensive transportation system and proximity of surface and groundwater resources to roads. Most hazardous materials are transported via VT Route 279 and US Route 7, according to a Commodity Flow Study conducted by the Local Emergency Planning Committee 7 in 2015. However, all local roads carry materials that could spill and affect aquatic resources as well as individual wells.

The Bennington Fire Department has the ability to respond to small hazardous materials spills and has a Hazardous Materials Response Team team for larger spills. If the spill were too large for the local fire department, the State Hazardous Materials Response Team would be called to assist.

The overall likelihood of a hazardous materials spill on an annual basis is 96%, since spills have occurred in 25 out of 26 years. Injuries, except in the case of direct injuries from a traffic accident, are likely low. However, the long-term impacts of a spill could be extensive if aquatic resources and/or water supplies were affected.

L. Water Supply

1. Descriptions

Bennington is served by a public water system from the Water Filtration Plant in Woodford, approximately 1.35 miles east from the Bennington border. Properties not connected to the public water system rely on private wells. Both public water systems and private wells are vulnerable to contamination. If the public water system were contaminated, it would affect more people in the Town, but private wells are more susceptible to contamination due to chemical spills. In addition, public water systems have routine water testing requirements they must follow, but there are no requirements for the testing of private residential wells. This means that a property could have contaminated water from their private well for an extended period of time without knowing it. (See Map 6 and discussion in IV. F.)

2. Past Occurrences

At the beginning of 2016, concerns were made regarding the groundwater in North Bennington and the former Chemfab property, which was a manufacturing business that produced Teflon-coating for fabrics. The Department of Environmental Conservation (DEC) was contacted to test five private wells in North Bennington. The private wells were analyzed for perfluorinated compounds as well as volatile organic compounds. Each of the five wells showed the presence of perfluorooctanic acid (PFOA) at concentrations above the Vermont Department

of Health drinking water health advisory limits of 20 parts per trillion (ppt). PFOA was not found in the Bennington public water source or system but was found in some private wells.

PFOA is a manufactured chemical used to make products that resist heat and chemical reactions, and repel oil, stains, grease, and water. PFOA does not break down easily and can persist in the environment for a very long time, especially in water. Its toxicity and persistence in the environment means it is a potential danger to human health and the environment.

After the initial wells tested positive to PFOA, more wells were tested in Bennington and North Bennington. In a map developed by the Vermont Department of Environmental Conservation, the wells that have been tested since August 30, 2016 are shown, as are the findings (http://dec.vermont.gov/commissioners-office/pfoa/communities). This is the first water contamination issue for Bennington and North Bennington but likely not the last, as very few chemicals are regulated and monitored.

3. Extent and Location

Since September 26, 2016, the DEC has received sampling results from 541 private wells in Bennington and North Bennington, of which 266 had PFOA concentrations greater than 20 ppt, 76 wells had PFOA less than 20 ppt, and 199 had no detections. The radius, which was first established at 1.5 miles, has been expanding to include various other areas of Bennington.

4. Probability, Impact and Vulnerability

The probability of another water contamination issue arising is high. PFOA had been contaminating the groundwater in North Bennington and Bennington for several years before it was detected. Currently, there could be other contaminants in the groundwater that are not showing up in tests because the DEC doesn't know to test for them yet.

Bennington and other communities with current or previous manufacturing industries are all vulnerable to water contamination. The likelihood of water contamination issues arising in any given year is 100%, since there could be other chemicals already in the groundwater that have not been detected. The impact could vary from a few wells in the direct vicinity of the problem area, to a whole municipality and beyond.

M. Infectious Disease Outbreak

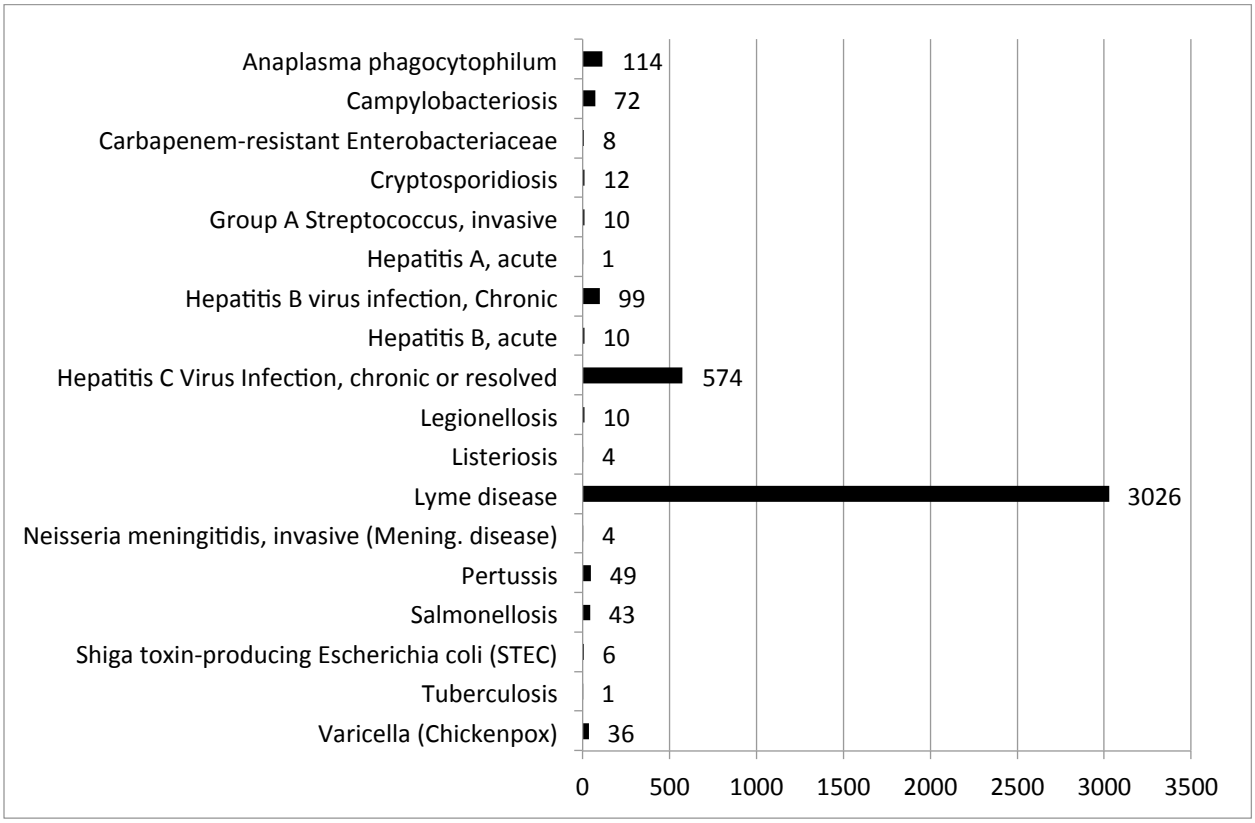
1. Descriptions

Infectious diseases are caused by bacterial infections, viruses, fungi and other organisms that can spread through the human population.

2. Past Occurrences

The most prevalent infectious disease in Bennington County, tracked by the Vermont Department of Health, has been Lyme disease, carried by and transmitted by ticks. The symptoms can range from minor to very severe, and are a clear threat to anyone in the Town. Figure 4 shows the diseases tracked by the Vermont Department of Health.

Figure 4. Disease cases in Bennington County from 2006 to 2015. Source: Chelsea Dubie, Vermont Department of Health



3. Extent and Location

In general, individuals and families are most affected by infectious diseases, but schools and businesses could be affected as well.

4. Probability, Impact and Vulnerability

Given past history, there is a low probability of a disease affecting a large portion of the Town, but high probability of continued, isolated occurrences. Lyme disease and other tickborne diseases could affect residents and those using recreational trails and visiting natural areas.

V. Vulnerability Assessment

A. Prioritization of Hazards

The information described above was used to prioritize hazards using criteria from the Vermont Hazard Mitigation Plan as described in Table 18 below.

Table 18. Vulnerability assessment factors (Vermont Hazard Mitigation Plan 2014)
Frequency of Occurrence: Probability
1 = Unlikely <1% probability of occurrence per year
2 = Occasionally 1–10% probability of occurrence per year, or at least one chance in next 100 years
3 = Likely >10% but <100% probability per year, at least 1 chance in next 10 years
4 = Highly Likely 100% probability in a year
Geographic Area Affected: How large an area would likely be affected?
1 = Community-wide
2 = State-wide
3 = Region-wide
Warning Time: Amount of time generally given to alert people to hazard
1 = More than 12 hours
2 = 6–12 hours
3 = 3–6 hours
4 = None–Minimal
Potential Impact: Severity and extent of damage and disruption
1 = Negligible Isolated occurrences of minor property damage, minor disruption of critical facilities and infrastructure, and potential for minor injuries
2 = Minor Isolated occurrences of moderate to severe property damage, brief disruption of critical facilities and infrastructure, and potential for injuries
3 = Moderate Severe property damage on a neighborhood scale, temporary shutdown of critical facilities, and/or injuries or fatalities
4 = Major Severe property damage on a metropolitan or regional scale, shutdown of critical facilities, and/or multiple injuries or fatalities

B. List of Priority Hazards

The planning team assessed each of the hazards thoroughly then scored the hazards based on the criteria in Table 18 to determine which hazards would need mitigation actions. Table 19 shows the results of the scoring, with Flood and Flash Floods, Winter Storms, High Wind Events, Drought, Hazardous Materials Spills, Infectious Diseases and Invasive Species ranked highest. The planning team determined that, while earthquakes ranked high, the score was likely due to the short warning time and, therefore, was not an accurate representation of the threat of this hazard.

Table 19. Vulnerability assessment						
Hazard	Number of Events	Frequency of Occurrence	Geographic Area Affected	Warning Time	Potential Impacts	Total Score
Floods and Flash Floods	49 events from 1996 to 2014	2	3	2	4	11
Winter Storms	143 events from 1996 to 2015	4	3	1	3	11
High Wind Events	111 events from 1996 to 2015	3	1	3	3	10
Hail	28 events from 1996 to 2015	2	1	4	1	8
Temperature Extremes	Annual >90 F: 1 day on average Annual maximum <32 F: 54 days Annual minimum < 32 F: 156 days	2	2	1	1	6
Drought	Severe droughts have occurred in 25 years from 1895 to 2014	3	3	1	2	9
Wildfire	43 events from 1992 through 2015	2	1	4	1	8
Landslides and Debris Flows	No records	1	1	4	1	7
Earthquake	No events causing damage	1	3	4	2	10
Hazardous Materials Spills	293 events from 1990 to 2016	4	1	4	2	11
Water Supply	1 event in 2016	1	1	4	2	8
Infectious Disease Outbreak	Annual	3	3	1	3	10
Invasive Species	Ongoing	3	3	1	2	9

Map 9 is a composite map showing special flood hazard areas, river corridors, roads with medium or high erosion potential, damages documented during Tropical Storm Irene, and areas identified by the planning team as vulnerable to flooding, difficult areas for snow plowing, steep grades, and areas needing major culvert upgrades. Other priority hazards such as invasive species or infectious diseases were not mapped either as adequate surveys have not been completed, or they could affect the entire Towns.

There are some concentrations of vulnerable populations. There are several senior housing facilities located downtown, north and west of the Town. Senior housing residents may need more assistance during a disaster. In addition, mobile home parks are located mostly on the east side of Bennington, though there are a few located in the northern and western areas.

Mobile home dwellers are often the most vulnerable to natural hazards (Vermont Department of Housing and Community Development 2013).

VI. Mitigation Measures

A. Hazard Mitigation Goals

As part of the planning process, Bennington identified the following mitigation goals:

1. Reduce injury and loss of life resulting from natural disasters.
2. Reduce damage to public infrastructure, minimize disruption to the road network and maintain both normal and emergency access.
3. Establish and manage a program to proactively implement mitigation projects for roads, bridges, culverts and other municipal facilities to ensure that community infrastructure is not significantly damaged by natural hazard events.
4. Design and implement mitigation measures so as to minimize impacts to rivers, water bodies and other natural features, historic structures, and neighborhood character.
5. Increase the economic resiliency of Bennington by reducing the economic impacts incurred by municipal, residential, agricultural and commercial establishments due to disasters.
6. Incorporate hazard mitigation planning into other community planning projects, such as the Town Plan, Capital Improvement Plan, and Local Emergency Operations Plan.
7. Ensure that members of the general public continue to be part of the hazard mitigation planning process.

B. 2005 Hazard Mitigation Plan

Bennington was one of 13 jurisdictions in Bennington County that adopted a multi-jurisdictional hazard mitigation plan in 2005. In that plan, Bennington identified hazardous materials, power shortage/failure, flooding, structure fire and winter storms as threats. This hazard mitigation plan addresses hazardous materials spills, power shortage/failure (in the winter storm and extreme temperature sections), flooding and winter storms. However, structure fire was not included, as this plan focuses more on natural threats and hazards.

The table below lists actions identified in the 2005 Bennington County Multi-Jurisdictional Hazard Mitigation Plan and the status of the actions as of October 2016. As described below, the Town has been addressing many of the actions listed in the 2005 plan.

Table 20. Mitigation actions listed in the 2005 Bennington County Multi-Jurisdictional Hazard Mitigation Plan Annex for Bennington					
Priority Score	Mitigation Action	Who Is Responsible	Approximate Time Frame & Potential Funding Sources	Initial Implementation Steps	Status of Actions as of June 2017
33	Update Rapid Response Plan at least annually	Select Board & Emergency Management Director	• Short Term • Local Resources	Technical assistance from BCRC	The Town annually updates their Local Emergency Operations Plan, which replaced the Rapid Response Plan. This action will remain in the plan as: Maintain a current Local Emergency Operations Plan.
29	Upgrade flood drainage structures	Select Board w/ support from Road Foreman	• Short to Long Term • Local & State Resources • PDM-c Funds	Conduct "needs assessment"; Technical assistance from BCRC & VEM	Flood drainage structures and culverts are upgraded when necessary. The Town is also working on stormwater management. This action will remain in the plan as: Complete inventory of road network to assess whether road segments connected to surface waters through ditches, culverts or other drainage structures meet the new stormwater standards currently under development by the DEC Municipal Roads Program.
30	Flood-proof (fix by appropriate method, including rip rap) River Road, Silk Road, Kocher Drive, Morse Road, and North Street	Select Board, Road Foreman, & Community	• Med. to Long Term • Local Resources • PDM-c Funds	Conduct assessment & explore options	Flood-proofing projects on River Road, Silk Road, and Kocher Drive have all been completed. This action will not remain in the plan because three of the areas have been completed, and the other two do not require any flood-proofing at this time.

Table 20. Mitigation actions listed in the 2005 Bennington County Multi-Jurisdictional Hazard Mitigation Plan Annex for Bennington					
Priority Score	Mitigation Action	Who Is Responsible	Approximate Time Frame & Potential Funding Sources	Initial Implementation Steps	Status of Actions as of June 2017
28	Flood-proof structures located in Flood Hazard Areas	Select Board, Other Agencies, Community	• Med. to Long Term • Local & State Resources • PDM-c Funds	Conduct assessment & explore options	It would not be possible for the Town to flood-proof all structures in the flood hazard area. However, all new structures must be elevated above the base flood elevation. Flood-proofing measures are described in the Land Use and Development Regulations, amended in 2016, and the Town will continue to support flood-proofing efforts. This action will not remain in the plan because the Town does not have the ability to flood-proof all the structures in the flood hazard area.

As noted in the Status of Actions as of June 2017 column in Table 20, the Town priorities have changed slightly since the 2005 multi-jurisdictional plan. Two of the actions listed in the 2005 plan will not be include because they are already completed or are not feasible. These actions are:

1. Flood-proof River Road, Silk Road, Kocher Drive, Morse Road, and North Street (already completed)
2. Flood-proof structures located in Flood Hazard Areas (not feasible)

The other two remaining actions from the 2005 plan are still priorities of the Town and have been included in this plan but with changes to the wording to reflect the current or more specific terminology used in Vermont. These actions are:

1. Update Rapid Response Plan at least annually (changed to current terminology)
2. Upgrade flood drainage structures (changed to more specific terminology)

C. Town Plan

The 2015 Bennington Town Plan (Bennington Town Plan 2015) includes several objectives that support hazard mitigation. These objectives focus on flood hazard areas, upland forests and wetland protection, and stormwater management. The Town Plan also supports the development of a hazard mitigation plan.

The plan states that development in floodplain and fluvial erosion hazard areas is inherently dangerous and is subject to strict regulation under the Town's Flood Hazard Area Zoning Regulations. There is no development other than agriculture and forestry allowed in these areas without approval by the Development Review Board, after showing that specific engineering and construction standards have been satisfied. Development in fluvial erosion hazard areas is restricted to prevent damage from erosion in much the same way that development in flood hazard areas is restricted to prevent damage from inundation.

The Town Plan explains that the Flood Hazard Area Zoning Regulations control development in areas prone to flood inundation, enable Bennington to participate in the National Flood Insurance Program and, through that program, for property owners to have access to flood insurance. The Town also has adopted regulations to protect mapped FEH areas within river corridors. The plan states that new municipal and state infrastructure should be located outside any of these hazard areas, or when that is impossible (as with the case of some highway, bridge, and water treatment facilities) that it be properly designed and constructed.

The plan also discusses the importance of protecting upland forests and wetlands. Upland forests help to retain water during storms and minimize the erosive forces that would add sediment and debris to river channels. Wetlands, particularly those in floodplain areas, retain stormwater and protect water quality during and after heavy rains. The Town has taken steps to preserve upland forests and wetlands by supporting public land ownership and restricting permanent development on Mount Anthony and in the Green Mountains, and by acting to preserve key wetland complexes such as the Walloomsac Headwaters Park.

Lastly, stormwater management is discussed. In the plan, it states that the Town should develop effective stormwater regulations to ensure the protection of water resources. The capacity of the sewage disposal system can be strained when excess stormwater flows into the system. The Town must continue efforts to reduce infiltration and separate sources of stormwater discharge from the system to maintain and improve its capacity. Surface water resources are to be protected through comprehensive watershed planning that includes erosion and stormwater control and by maintaining undisturbed buffers between development and stream banks and shorelines. The plan also adds that new development projects must plan for adequate and environmentally sound stormwater discharges and may be required to participate in necessary upgrades of subsurface drainage facilities.

D. State and Regional Plans and Programs

1. Vermont Hazard Mitigation Plan (2013)

The Vermont Hazard Mitigation Plan (Vermont Division of Emergency Management and Homeland Security 2013) identified a series of hazards shown in Table 21 along with those we considered in this plan. The Bennington plan follows the state plan except some hazards are combined and a few, including nuclear plant accident, were not considered.

Table 21. Comparison of hazards considered in the draft Vermont Hazard Mitigation Plan vs. the Bennington Hazard Mitigation Plan	
VT Hazard Mitigation Plan	Bennington Hazard Mitigation Plan
Atmospheric Hazards	**Natural Hazards**
Drought	Drought
Earthquake	Earthquake
Flooding	Flooding and Fluvial Erosion
Fluvial Erosion	See Flooding and Fluvial Erosion
Hail	Hail
High Winds	High Winds
Hurricane/Tropical Storm	See High Winds and Flooding and Fluvial Erosion
Ice Storm	See Severe Winter Weather/Ice Storm
Ice Jams	See Flooding and Fluvial Erosion
Infectious Disease Outbreak	Infectious Disease Outbreak
Landslide/Debris Flow	Landslide/Debris Flow
Severe Thunderstorm	See High Winds and See Flooding and Fluvial Erosion
Severe Winter Weather	Severe Winter Storms
Temperature Extremes	Temperature Extremes
Tornado	See High Winds
Wildfire	Wildfire
Technological Hazards	**Technological Hazards**
Dam Failure	See Flooding and Fluvial Erosion
Hazardous Materials Spill	Hazardous Materials Spill
Invasive Species	Invasive Species
Nuclear Power Plant Accident	Not addressed
Rock Cuts	See Landslide
Terrorism	Not addressed

The Vermont Hazard Mitigation Plan identified flooding and fluvial erosion, winter storms, high winds and severe thunderstorms as high risk for Bennington County and radiological accident risk and hazardous materials spills as moderate risk.

2. Bennington Regional Plan Policies and Actions (adopted March 19, 2015)

The Bennington Regional Plan lists the following policies and actions supporting hazard mitigation including several policy recommendations emphasizing protecting natural resources, maintaining village and urban centers and avoiding development on sensitive lands including areas of steep slope and wetlands along with the protection of surface and groundwater resources and forested lands (Sections VII and VIII). The regional plan also includes a flood resilience section (IX) as required by Vermont statute that identifies hazards from flooding and fluvial erosion. The section encourages avoiding development in flood hazard areas, reconstruction of bridges and culverts that impede flows, undisturbed buffer areas along streams to provide for lateral movement and attenuation of overland flow, participation in the

National Flood Insurance Program, updating of flood bylaws, adoption of up to date road and bridge standards and participation in the community rating system.

3. Vermont Agency of Natural Resources

The Vermont Agency of Natural Resources has worked with Bennington and other communities to adopt updated flood and river corridor regulations. VT ANR has mapped river corridors and can regulate activities within those that are not subject to review by municipalities. VT ANR reviews permit applications for development within the special flood hazard area. VT ANR also reviews permit applications for stream alterations or regulated activities within wetlands as well as permitting for transporting hazardous materials.

4. Act 250 Review

The Vermont Natural Resources Board implements Act 250, which requires permits for several activities, including developments above 2,500 feet in elevation, commercial and industrial uses greater than 10 acres, construction of more than 10 housing units, subdivision of more than 10 lots, among other activities. During Act 250 proceedings, agencies and the public can offer comments on such proposed developments.

5. Other Organizations

A Phase I and II geomorphic assessment has been completed for the Walloomsac River Watershed. Phase I identified physical features of the river and discussed the impacts of human alterations. The Bennington County Conservation District conducted the assessment to target areas that need restoration to reduce river instability. Phase II further identifies physical features of the river and discusses restoration activities. The Vermont Agency of Natural Resources River Management Program, the Bennington County Conservation District, and the Town of Bennington worked together to develop the assessment.

The Vermont Agency of Natural Resources Watershed Management Division developed a Tactical Basin Plan for the Batten Kill, Walloomsac, and Hoosic Rivers (Vermont Agency of Natural Resources 2016). The plan discusses actions to protect, maintain, improve and restore surface waters in the basin.

E. Current Programs Supporting Mitigation

Bennington joined the National Flood Insurance Program in 1986. The community report for Bennington (available via floodready.vermont.gov/) indicates there are 468 buildings in the Special Flood Hazard Area and 170 of them have flood insurance policies. Bennington adopted a revised zoning ordinance in 2013, which included the Flood Hazard Overlay District guidelines. The purpose of the guidelines was to:

- Avoid and minimize the loss of life and property, the disruption of commerce, the impairment of the tax base, and the extraordinary public expenditures and demands on public services that result from flooding related inundation.
- To manage all flood hazard areas.
- To make Bennington, its citizens and businesses, eligible for federal flood insurance, federal disaster recovery funds and hazard mitigation funds.

Specific uses allowed within the Flood Hazard Overlay include agriculture and forestry; unimproved open space, recreational and educational uses; and those uses generally permitted within existing single-family dwellings, which do not require structural alterations. All other uses and structures, including but not limited to new or expanded single-family dwellings, additions and accessory structures, are subject to flood hazard review. The Flood Hazard Overlay District:

- Prohibits development within floodways unless a registered professional engineer certifies that the proposed development will not result in any increase in flood levels. Junkyards and storage facilities for floatable materials, chemicals, explosives, flammable liquids, or other hazardous or toxic materials, are specifically prohibited within the floodway.
- Requires all development to be designed to minimize flood damage to the proposed development and to public facilities and utilities, and to provide adequate drainage to reduce exposure to flood hazards.
- Requires structures to be designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure during the occurrence of the base flood, be constructed with materials resistant to flood damage, be constructed by methods and practices that minimize flood damage, and be constructed with electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
- Requires new and replacement water supply and sanitary sewage systems to be designed to minimize or eliminate the infiltration of flood waters into the systems and discharge from the systems into flood waters.
- Requires new and replacement manufactured homes to be elevated on properly compacted fill such that the top of the fill (the pad) under the entire manufactured home is above the base flood elevation.
- Requires the lowest floor, including basement, of all new buildings, except for accessory buildings, to be at or above the base flood elevation.
- Requires any existing buildings that are to be substantially improved for residential purposes to be modified or elevated.
- Requires all new construction and substantial improvements with fully enclosed areas below the lowest floor that are subject to flooding to be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters.

- With proper permits and/or approval, allows accessory buildings that represent a minimal investment to be built below the base flood elevation provided that the building is not used for human habitation, will be designed to have low flood damage potential, will be constructed and placed on the building site so as to offer minimal resistance to the flow of floodwaters, will be firmly anchored to prevent flotation which may result in damage to other structures, and will have elevated or flood-proofed service facilities such as electrical or heating equipment.

Bennington also has a Fluvial Erosion Hazard Area Overlay District, which was adopted in 2009. The purpose of this district was to prevent increases in fluvial erosion resulting from development in identified fluvial erosion hazard areas, minimize property loss and damage due to fluvial erosion, and prohibit land uses and development in fluvial erosion hazard areas that pose a danger to health and safety. The Fluvial Erosion Hazard Area Overlay District (with proper reviews and/or permits):

- Allows the removal of a structure.
- Allows improvements to residential structures and accessory structures that do not decrease the setback from the stream, and do not expand the footprint of the original structure by more than 500 square feet.
- Allows new residential accessory structures provided that the setback is the same or greater than the existing primary structure setback from the stream.
- Allows construction of driveways and/or access roads.
- Allows buried utilities, including power, telephone, cable, sewer and water.
- Allows excavation, filling and/or grading of land.
- Allows forestry and agriculture activities, which are exempt from permitting.
- Prohibits the storage or facilities for floatable materials, chemicals, explosives, flammable liquids, or other hazardous or toxic materials.
- Prohibits any other development that is not specifically allowed in the district guidelines.

F. Town Capabilities

Bennington has a large staff compared to most other municipalities in Bennington County. In the Town Offices, Bennington has a Town Manager; Assistant Town Manager and Permitting, Planning and Code Enforcement Director; Finance Director; Economic and Community Development Director; Human Resources and Contracts Director; Building Inspector; Facilities Manager; Road Foreman; Chief Assessor; Town Clerk; and Director of Collections and Treasurer. There are also three Forest Fire Wardens and two Health Officers.

Bennington has three fire departments, the village fire department near the downtown and two rural departments (one located north and the other east of downtown), a police department, county sheriff's department, rescue squad, medical center, public works

department for the water and wastewater facilities, parks and recreation department and buildings and grounds department.

There are also several boards and commissions. A seven-person Select Board is empowered by the Vermont statute and charter to determine policy, finances, ordinances and general direction of Town business, appoint the Town Manager and members of the boards and commissions. A seven-person Development Review Board hears and decides upon permit applications regarding development. A five-person Planning Commission updates the Town Plan, makes recommendations to the Select Board regarding amendments to the bylaws, participated in the preservation of historic sites and agricultural lands, and is charged with the overall planning of Bennington. A four-person Historic Preservation Commission oversees the survey and review of historic sites eligible for the National Register. A five-person Housing Authority acts as the Board of Directors for the Housing Authority properties and oversees the staff and sets policies for operations.

The total expenditures for fiscal year 2016 were $7,383,159, with $5,746,309 going to departments such as, police, fire, highway, parks and recreation, and buildings and grounds departments. The total proposed expenditures for fiscal year 2017 are $12,020,560, with $8,519,260 of that going to Town departments.

Table 22 below summarizes Town capabilities and areas needing improvement to enhance those capabilities.

Table 22. Capabilities of the Town of Bennington			
Plans, Policies, Ordinances	Description/Responsible Agent	Effectiveness	Improvements Needed
Town Plan	Planning Commission; Emergency Management Director; Select Board (approval of Town Plan)	Effective; Town Plan has a flood resilience chapter that gives an overview on flood hazards and emergency management	The Town Plan was updated and adopted October 6, 2015. At this time, there are no improvements needed.
LEOP	Emergency Manager Director; Select Board (approval of plan)	Needs some updates	Continue to update the LEOP annually.
Flood Hazard Overlay District (Zoning and Subdivision Regulations)	Planning Commission and Planning Director/Zoning Administrator; Development Review Board; Select Board (approval of bylaws)	High effectiveness; recently adopted new flood hazard regulations (2013)	Continue to monitor FEMA regulations and new local flood hazards.
Fluvial Erosion Hazard Area Overlay District (Zoning and Subdivision Regulations)	Planning Commission and Planning Director/Zoning Administrator; Development Review Board; Select Board (approval of bylaws)	High effectiveness; were adopted in 2009	Continue to monitor for any changes; consider River Corridor protection for all rivers and streams in Bennington.
Land Use and Development Regulations (Zoning and Subdivision Regulations)	Planning Commission and Planning Director/Zoning Administrator; Development Review Board; Select Board (approval of bylaws)	Effective	Review regulations; continued training of volunteer board members to ensure effective permitting.
Steep Slopes, Surface Water Protection, Stormwater Management and Erosion Control, Protection of Natural Resources	Planning Commission and Planning Director/Zoning Administrator; Development Review Board; Select Board (approval of bylaws)	Effective	Review regulations; continued training of volunteer board members to ensure effective permitting.
Water/Sewer Facilities	Water Resources Superintendent; Town Manager; Select Board	Effective	Develop a stormwater system that keeps stormwater from overtaxing the wastewater treatment facility.
Road Maintenance Programs	Highway Superintendent and Foremen; Town Manager; Select Board	Effective; Town adopted most recent State of Vermont (AOT) Road and Bridge Standards	Maintain and update roads and culverts as needed.
School Emergency Response	School administrators; Emergency Management Director; Fire Chief; Police Chief	Effective	Continue to work with local schools to maintain current evacuation and emergency plans.

Table 22. Capabilities of the Town of Bennington			
Plans, Policies, Ordinances	Description/Responsible Agent	Effectiveness	Improvements Needed
Vulnerable Populations	Emergency Management Director; Health Officer	Needs some improvements and updates	Map and catalog vulnerable populations; review Emergency Management plans for schools, medical facilities, senior housing facilities; train emergency personnel on response to vulnerable populations; continuing training of Town Health Officer.
Mobile Homes	Emergency Management Director; Health Officer	State of Vermont regulates mobile homes and mobile home parks	Outreach to owners of mobile home parks and mobile home residents about emergency preparedness.

G. Mitigation Actions

Table 24 below lists mitigation actions for each of the hazards. Some will be implemented by the Town of Bennington and others by agencies such as the Vermont Agency of Transportation. Mitigation actions are listed by the type of hazard. Table 23 lists the criteria used in establishing project priorities, with ranking based on the best available information and best judgment as these proposed projects would need further study and design work. Prior to the implementation of any action, a benefit-cost analysis would be completed to assure the action would be feasible and cost-effective.

Table 23. Ranking of mitigation actions

Criteria	Ranking (score in parentheses)
Potential vulnerability from hazard	High (3): risk assessment score Medium (2): risk assessment score Low (1): risk assessment score
Potential protection of life and degree of reduction in damage by action	High (3): greater than 50% reduction in estimated damage, loss of life or injury Medium (2): 25-50% reduction in estimated damage, loss of life, or injury Low (1): less than 25% reduction in estimated damage, loss of life or injury
Consistency of the action with Town goals and plans	High (3): goals are consistent with existing plans Low (1): goals are inconsistent with existing Town plans
Degree of technical feasibility of the proposed action	High (3): project is technically feasible Low (1): feasibility is low
Implementation costs	High (3): project could be implemented for less than $25,000 Medium (2): project would cost between $25,000 and $100,000 Low (1): project costs would exceed $100,000
Ability of the Town to implement the proposed action in terms of administrative capability and legal authority	High (3): Town has current capability to implement the action Medium (2): Town would need to expand capability while implementing action through contractors or additional staffing Low (1): Town would need extensive assistance to implement action
Degree of local support for the action	High (3): the community supports the proposed action Low (1): the project is opposed in the community
Potential costs to natural systems of implementing the action	High (3): natural systems would not be affected, would be enhanced by the action or be affected to a minimal degree Medium (2): natural systems would be affected by impacts could be mitigated or reduced Low (1): natural systems would be negatively impacted and those impacts could not be mitigated or reduced
Potential costs to cultural resources of implementing the action	High (3): cultural resources would not be affected Medium (2): cultural resources would be affected by impacts could be mitigated or reduced Low (1): cultural resources systems would be negatively impacted and those impacts could not be mitigated or reduced
Potential costs to social and economic resources of implementing the action	High (3): social and economic resources would either be unaffected or enhanced by the project Medium (2): economic and social resources would be affected by impacts could be mitigated or reduced Low (1): economic and social resources would be negatively impacted and those impacts could not be mitigated or reduced

Table 24. Mitigation Actions. Type is based on categories in Federal Emergency Management Agency 2013b						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
All Hazards	Education and Outreach	Provide a "be prepared" section of the Town website with links to information for residents	Town Manager	2018 to 2019	Town general fund	High
All Hazards	Local Planning and Regulations	Maintain a current Local Emergency Operations Plan	Public Safety Director	2018 to 2023 (ongoing)	Town General Fund	High
All Hazards	Local Planning and Regulations	Encourage proper construction techniques and use of appropriate materials to address hazards, particularly flooding, winter storms, wind events, earthquakes, landslides and wildfire	Building Inspector	2018 to 2019	Town general fund	High
All Hazards	Local Planning and Regulations	Integrate this hazard mitigation plan into the Town Plan, the Local Emergency Operations Plan and budgeting and capital improvements plan	Town Select Board; Town Planning Commission; Zoning Administrator; Town Manager	2018 to 2023 (ongoing)	Town general fund	Medium to High
All Hazards	Education and Awareness	Encourage businesses and institutions to develop continuity of operations plans	Public Safety Director	2018 to 2020	Town general fund	Medium
All Hazards	Local Planning and Regulations	Continue to assess the need for driveway standards to assure adequate emergency access particularly to assure adequate access in winter storms, floods and for wildfire protection	Town Planning Commission	2018 to 2023 (ongoing)	Town general fund	High
Floods and Flash Floods	Education and Awareness	Educate owners on importance of securing propane tanks and other items that could float or blow away in storms	Town Zoning Administrator	2018 to 2019	Town general fund	Medium
Floods and Flash Floods	Local Planning and Regulation	Develop a watershed planning team with other municipalities within the watershed to coordinate planning and other actions to protect rivers and promote flood resilience	Town Planning Commission; BCRC	2019 to 2023	Town general fund; Watershed Grant from VT ANR	Medium

Table 24. Mitigation Actions. Type is based on categories in Federal Emergency Management Agency 2013b						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
Floods and Flash Floods	Local Planning and Regulations	Maintain and enforce updated flood hazard and river corridor protection zone bylaws	Development Review Board; Zoning Administrator	2018 to 2023 (ongoing)	Town general fund	Medium
Floods and Flash Floods	Local Planning and Regulations	Maintain participation in the Community Rating System to help reduce flood insurance premiums for residents and businesses	Town Select Board	2018 to 2023 (ongoing)	Town general fund	High
Floods and Flash Floods	Local Planning and Regulations	Encourage appropriate stormwater and erosion control measures in new developments	Development Review Board; Department of Public Works	2018 to 2023 (ongoing)	Town general fund	High
Floods and flash floods	Local Planning and Regulations	Adopt the latest Vermont Town Road and Bridge Standards and revisions as necessary	Town Select Board	2018 to 2023 (as standards are updated)	Town general fund	High
Floods and Flash Floods	Local Planning and Regulations	Inventory roads for stormwater mapping as part of the Vermont Stormwater program	Department of Public Works; BCRC	2019 to 2022	VT Better Roads; Town general fund	High
Floods and Flash Floods	Local Planning and Regulations	Complete Town-wide stormwater management plan in accordance with the Vermont Stormwater Manual	Department of Public Works	2019 to 2022	VT Better Roads; Town general fund	High
Floods and Flash Floods	Local Planning and Regulations	Maintain an accurate map of the stormwater system	Vermont DEC	2018 to 2023 (ongoing)	State funding	Medium
Floods and Flash Floods	Local Planning and Regulations	Maintain an updated culvert inventory	Highway Department; BCRC	2018 to 2023 (ongoing)	Town general fund; VT Better Roads funding	Medium
Floods and flash floods	Natural Systems Protection	Identify possible acquisition of wetlands and special flood hazard areas to assure natural systems protection	BCRC	2020 to 2023	Town general fund; Municipal Planning Grant	Medium

Table 24. Mitigation Actions. Type is based on categories in Federal Emergency Management Agency 2013b						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
Floods and flash floods	Natural Systems Protection	Complete inventory of road network to assess whether road segments connected to surface waters through ditches, culverts or other drainage structures meet the new stormwater standards currently under development by the DEC Municipal Roads Program	Department of Public Works	2019 to 2020	Town general fund; VT Better Roads	High
Floods and flash floods	Natural Systems Protection	Develop a long-term plan to bring all sections of connected roads to revised standards as part of the municipal general permit.	Town Highway Department	2019 to 2021	Town general fund; VT Better Roads	High
Floods and Flash Floods	Natural Systems Protection	Implement stormwater control projects and green infrastructure practices to reduce flows and sediment	Department of Public Works; Bennington County Conservation District	2020 to 2023 and beyond	Town general fund; State funding; FEMA HMGP, PDM, FMA	High
Floods and flash floods	Structure and Infrastructure projects	Road crew should regularly survey culverts for blockages including photographs and records of damages and costs	Town Highway Department	2018 to 2022 (ongoing)	Town highway fund	High
Floods and flash floods	Structure and infrastructure projects	Identify and replace culverts and bridges that do not meet current Vermont Town Road and Bridge Standards	Town Highway Department	2018 to 2023 (ongoing)	Town highway fund; State of Vermont; AOT; FEMA HMGP, PDM, FMA	High
Floods and flash floods	Structure and infrastructure protection	Encourage property owners in flood or fluvial erosion hazard zones to consider selling their properties (buy out) or implementing flood proofing including elevating structures	Town Select Board	2018 to 2023 (ongoing)	FEMA HMGP, PDM, FMA	High

Table 24. Mitigation Actions. Type is based on categories in Federal Emergency Management Agency 2013b						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
Winter storms	Education and Outreach	Provide educational materials on sheltering in place and preparation for winter storms, including long-term power outages	Public Safety Director	2018 to 2020	Town general fund	High
Winter storms	Education and Awareness	Provide materials for residents on methods to protect property from wind events	Public Safety Director; Zoning Administrator	2018 to 2020	Town general fund; FEMA HMGP, PDM, FMA	High
Winter storms	Local Planning and Regulations	Maintain agreements with adjacent towns for sharing of highway equipment	Town Select Board; Highway Department	2018 to 2023 (ongoing)	Town general fund	High
Winter storms	Structure and Infrastructure Projects	Place utilities underground for critical facilities	Town Manager; Select Board	2018 to 2023	FEMA HMGP, PDM, FMA	Medium
High wind events	Education and Outreach	Provide educational materials on sheltering in place and preparation for winter storms, including long-term power outages	Public Safety Director	2018 to 2020	Town general fund	High
High wind events	Local Planning and Regulation	Require boats, propane tanks and other items stored outdoors to be secured	Zoning Administrator	2018 to 2019	Town general fund	High
High wind events	Structure and Infrastructure Projects	Retrofit existing buildings to withstand high winds including protection of power lines and other utilities	Town Select Board; Private Owners	2018 to 2023 (ongoing)	FEMA HMGP, PDM	Medium
High wind events	Structure and Infrastructure Projects	Place utilities underground for critical facilities	Town Manager; Select Board; Private Owners	2018 to 2023	FEMA HMGP, PDM	High
High wind events	Structure and Infrastructure Projects	Retrofit existing buildings to withstand high winds including protection of power lines and other utilities	Town Select Board; Private Owners	2018 to 2023 (ongoing)	FEMA HMGP, PDM	Medium
Drought	Local Planning and Regulation	Monitor drought conditions	Public Safety Director	2018 to 2022 (ongoing)	Town general fund	Medium
Drought	Education and Awareness	Provide educational materials on dealing with drought	Public Safety Director	2018 to 2020	Town general fund; FEMA HMGP, PDM	Medium

Table 24. Mitigation Actions. Type is based on categories in Federal Emergency Management Agency 2013b						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
Drought	Natural System Protection	Develop improved assessment of groundwater sources and amend bylaws to assure their protection	Vermont Geological Survey; Town Planning Commission	2019 to 2021	FEMA HMGP, PDM State of VT	Medium
Drought	Local Planning and Regulation	Incorporate planning for droughts in the local emergency operations plan	Public Safety Director	2019 to 2020	Town general fund	Medium
Hazardous materials spill	Structure and Infrastructure Projects	Work with VT AOT to identify and mitigate high accident intersections and road segments	VT AOT	2018 to 2021	State AOT funds	Medium to High
Hazardous materials spill	Natural Systems Protection	Identify groundwater source areas and maintain ordinances to protect those areas	Town Planning Commission	2018 to 2023 (ongoing)	Town General Fund	Medium
Infectious disease outbreak	Local Planning and Regulations	Monitor disease occurrences and potential outbreaks, partnering with the VT Dept. of Health	Town Health Officer	2018 to 2023 (ongoing)	State of VT Dept. of Health	High
Infectious disease outbreak	Education and Outreach	Provide educational materials in printed form and on the Town web site on potential infectious diseases	Town Health Officer	2018 to 2021	Town general fund; State of Vermont Health Department	High
Invasive species	Local Planning and Regulations	Monitor extent of invasive species, particularly forest invasive species such as Emerald Ash Borer	Town Planning Commission	2018 to 2022 (ongoing)	Town general fund	Medium
Invasive species	Local Planning and Regulations	Complete surveys for ash trees vulnerable to Emerald Ash Borer	BCRC; Bennington County Conservation District	2018 to 2020	FEMA HMGP, PDM; VT Department of Forests, Parks and Recreation	Medium

Table 24. Mitigation Actions. Type is based on categories in Federal Emergency Management Agency 2013b						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
Invasive species	Local Planning and Regulations	Survey for invasive species (e.g., Japanese knotweed) along streams to identify potential erosion areas	Town Planning Commission	2018 to 2020	State of Vermont Department of Parks, Forestry and Recreation	Medium
Invasive species	Local Planning and Regulations	Encourage use of native species in plantings for commercial and residential development	Zoning Administrator; Development Review Board	2018 to 2023 (ongoing)	Town general fund	Medium
Invasive species	Education and Awareness	Provide outreach materials for landowners on using native plants and controlling invasive species	Bennington County Conservation District	2018 to 2019	Town general fund; State of Vermont Department of Parks, Forestry and Recreation	High

VII. Plan Maintenance

A. Annual Monitoring and Continued Public Involvement

Copies of this plan will be kept at the Town Office and made available via the Town and BCRC website. The Select Board and Planning Commission intend to involve the public in the implantation, review and update of this plan. Tracking of actions will take place during the annual budgeting process, when funds are allocated for various programs to operate the Town, including capital improvements. The Select Board is responsible for developing a Town budget, which is approved during Town Meeting Day in March. The Town Manager oversees operations in the Town.

This plan will be integrated into existing planning efforts including updates to the Town plan as well as the annual Local Emergency Operations Plan. New data from a variety of studies completed by the Bennington County Regional Commission, the State of Vermont and others will be used in updating the Town plan, as they were used to develop this hazard mitigation plan. The process of updating the Town plan will incorporate public involvement, agency review and adjacent Town review requirements of Vermont statutes.

B. Plan Evaluation and Update

The Bennington Planning Commission and Select Board will be responsible for serving as or creating a planning team for evaluating and updating the plan.

1. Plan Evaluation

The effectiveness of the plan will be determined by whether or not actions listed in Table 24 are implemented. In addition, the Town Select Board will annually evaluate the plan to assess if the goals are being achieved.

a) Prior to town meeting in March, the planning team lead and Emergency Management Director will review each of the actions in Table 24 to determine their status. Status categories will include completed, in progress, scheduled, no progress.
b) The evaluation will be presented to the Select Board and to other Town officials at a public meeting to allow for a discussion on progress in implementing the plan and the need for applying for funding or to address program and budgeting priorities.
c) The evaluation will be used to update the Local Emergency Operations Plan, which is required annually, and to identify potential changes to other Town Plans, programs and policies.

If requested, the Bennington County Regional Commission will provide advice and assistance on the plan evaluation.

2. Plan Update

At least one year before the five-year period covered by this plan, the planning team will initiate a review of the plan by:

a. Updating the descriptions and analyses of events using new information since completion of the 2017 draft.
b. Identification of any new buildings or infrastructure or changes in critical facilities.
c. Estimation of potential probability and extent of hazards based on any new information since completion of the 2017 plan and the Town Plan.
d. Review of completed hazard mitigation projects.
e. Identification of new projects given the revised hazard evaluation.
f. Review of any changes in priorities since adoption of the 2017 plan.
g. Revision of the assessment of risks and vulnerability from identified hazards.
h. Development and use of criteria to assess the potential benefits and costs of identified actions for use in prioritizing those actions.
i. Integration of the updated plan into the Bennington Town Plan and other plans and programs.

The planning team will hold open meetings to solicit opinions and to identify issues and concerns from members of the public and stakeholders. The planning team and the Town of Bennington Select Board and Planning Commission will work with the Bennington County Regional Commission (BCRC) and the State Hazard Mitigation Officer (SHMO) to review and update their programs, initiatives and projects based on changing local needs and priorities. The BCRC will assist in any necessary coordination and communication with neighboring towns to assure that mitigation actions address regional issues of concern. The revised plan will be submitted for review by the State Hazard Mitigation Officer and FEMA and revised based on their comments. Following approval by FEMA, the Select Board will adopt the completed plan.

C. Post Disaster Review and Revision

Should a declared disaster occur, Bennington may undertake special review of this plan and the appropriate updates made. After Action Reports, reviews and debriefings should be integrated into the update process. The plan should also be updated to reflect the findings of any other studies.

VIII. References

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B. Map Data Sources

The Vermont Center of Geographic Information provides data on transportation systems, the location of structures (E911), critical facilities, jurisdictional boundaries, and other information. ESRI data was used for the basemap for most maps. That data was used in all maps. Data from other sources were used in specific maps as noted below.

Map 1. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/

Map 2. Vermont Center for Geographic Information, http://geodata.vermont.gov
National Land Cover Data originally from USGS.

Map 3. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
Data from the Bennington County Regional Commission
Bennington Town Plan 2015

Map 4. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
of Bennington Planning TeamTown

Map 5. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
Vermont Agency of Natural Resources Natural Resources Atlas, http://anrmaps.vermont.gov/websites/anra/
FEMA Flood Map Service Center: https://msc.fema.gov/portal/

Map 6. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/

Map 7. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
LANDFIRE Program, www.landfire.gov
Vermont Forest Resources Plan, http://anrmaps.vermont.gov/websites/sars_data/

Map 8. Dale, J. 2015. Landslide potential in Bennington County, Vermont. Report prepared for Majorie Gale, Vermont Geological Survey from Green Mountain College, Poultney, VT; Eliason and Springston 2007.

Map 9. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
Bennington Hazard Mitigation Planning Team
BCRC Data

C. Personal Communication Sources

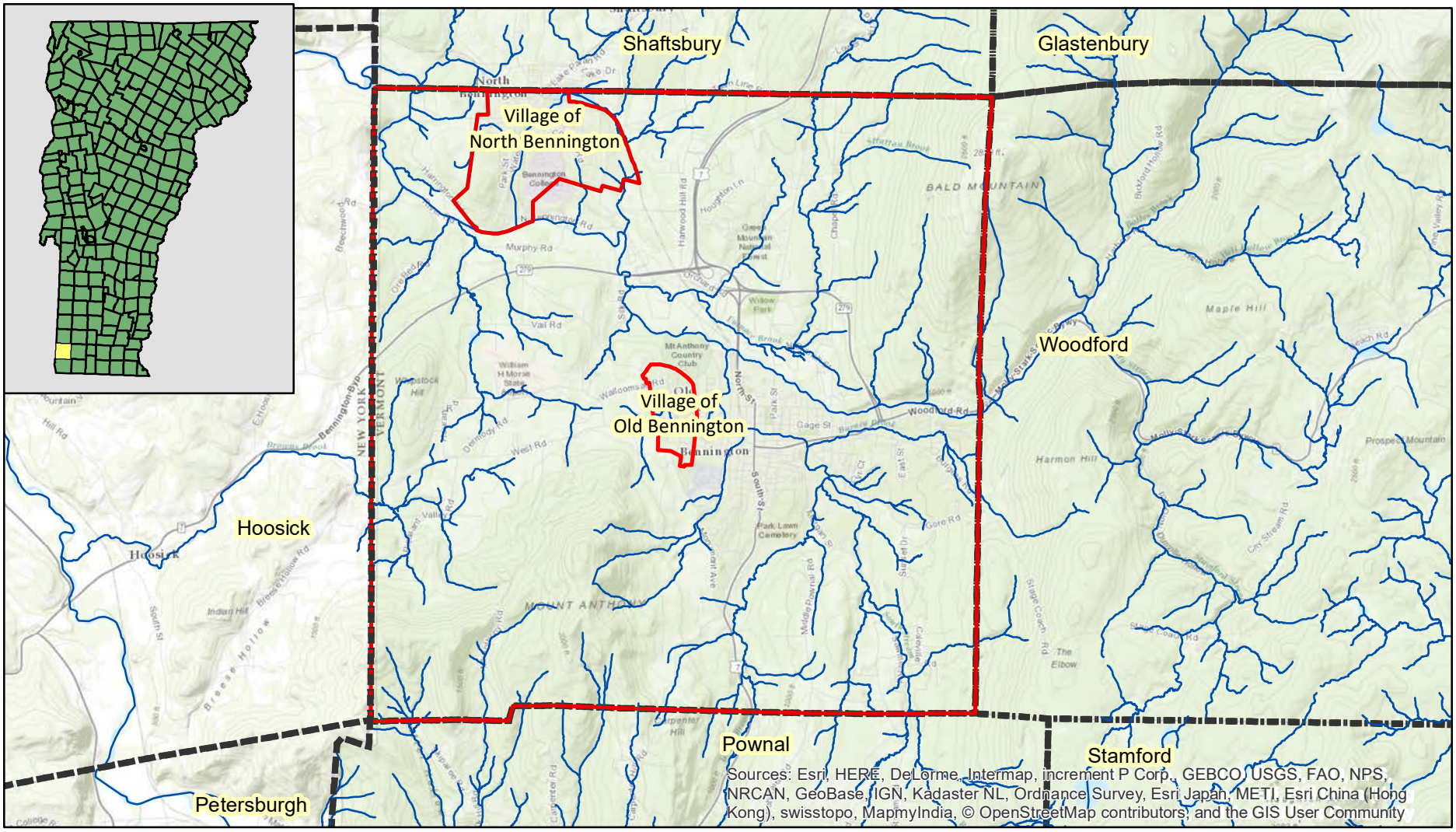
Chelsea Dubie, M.Ed., Infectious Disease Epidemiologist, Vermont Department of Health, Chelsea.dubie@vermont.gov

Richard Heims, NOAA regarding drought indices, richard.heim@noaa.gov

Stuart Hinson, NOAA regarding NCDC data, stuart.hinson@noaa.gov

George Springston, Norwich University, Northfield, VT gsprings@norwich.edu

Map 1. Town of Bennington

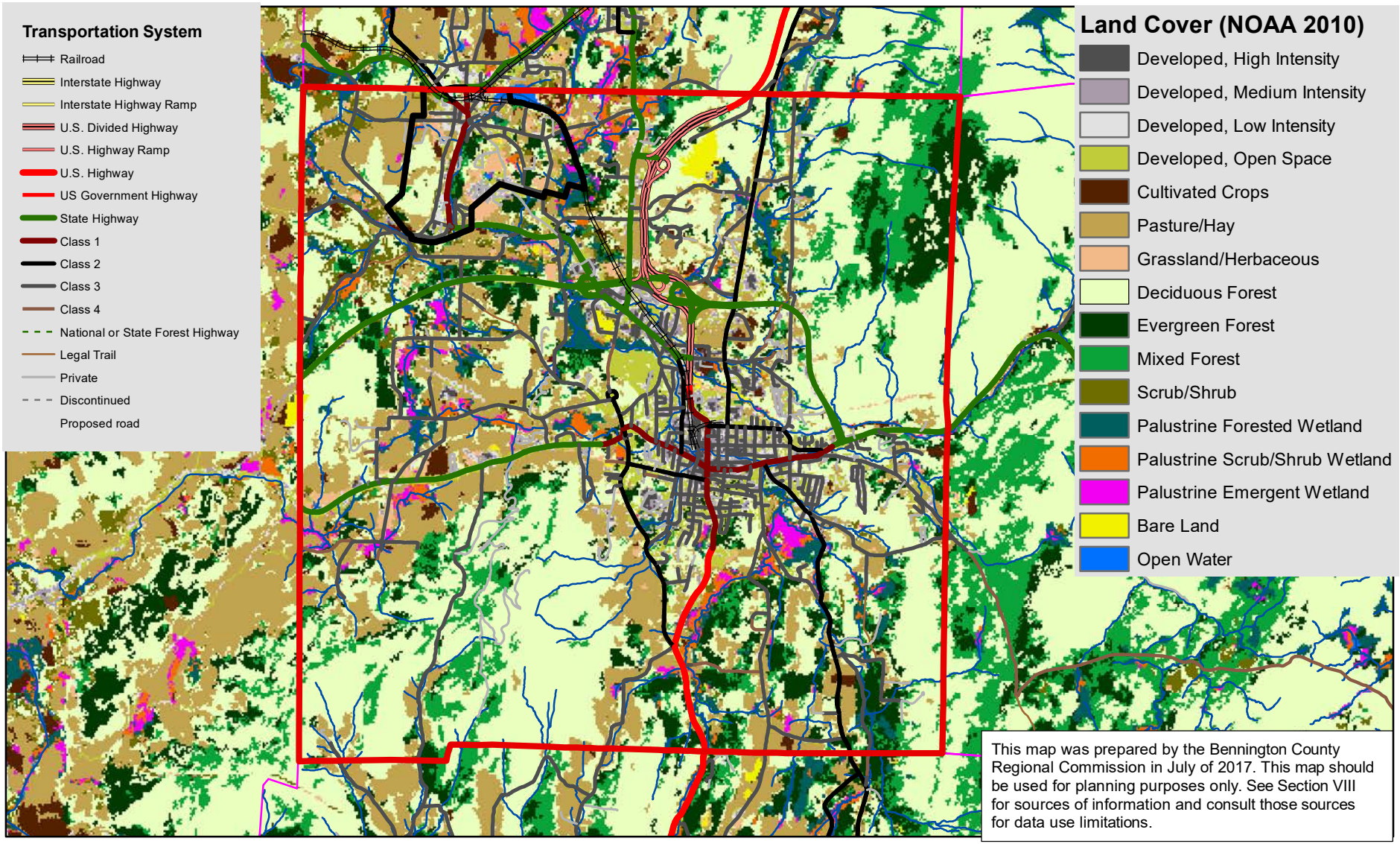


N

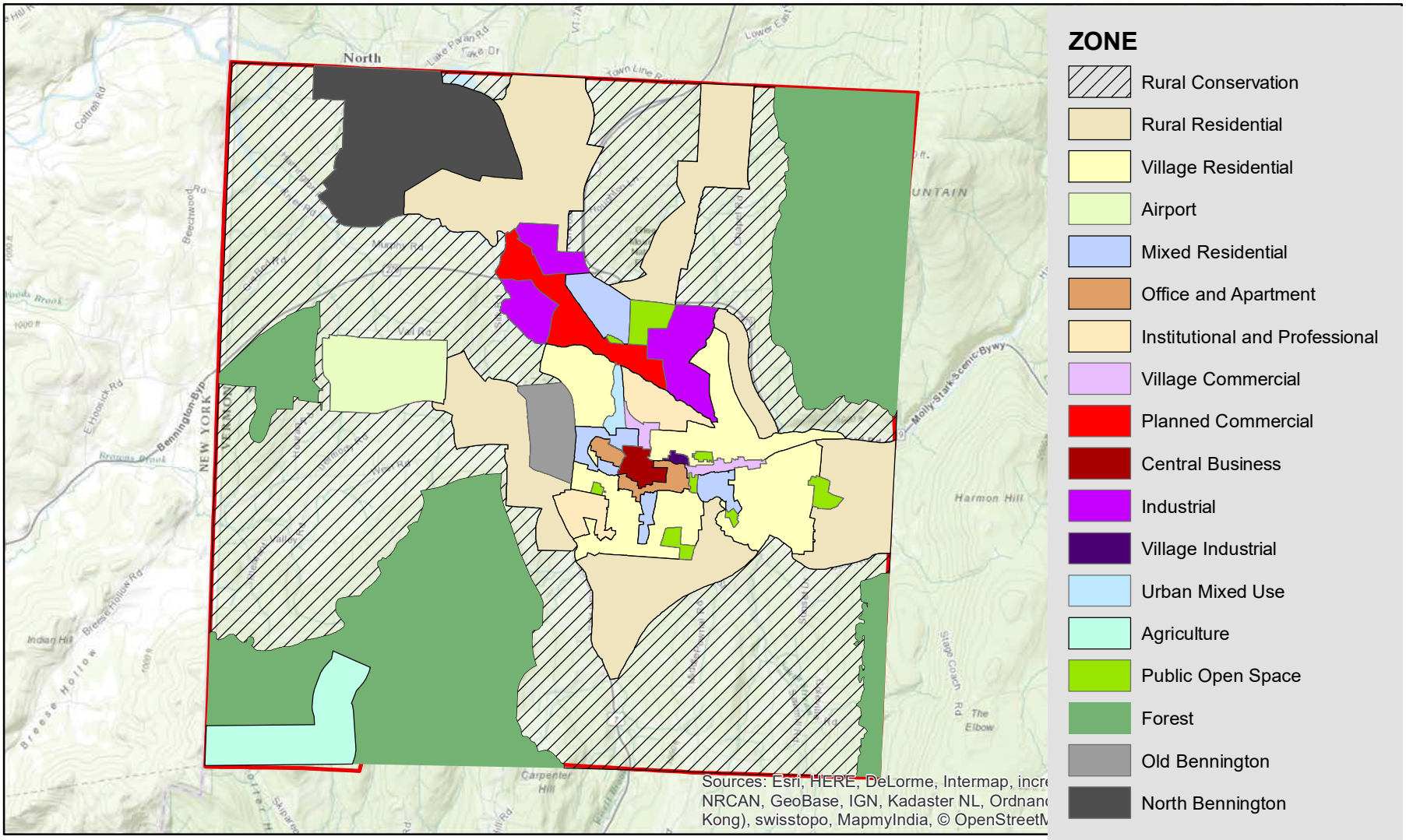
0 1.25 2.5 5 Miles

This map was prepared by the Bennington County Regional Commission in July of 2017. This map should be used for planning purposes only. See Section VIII for sources of information and consult those sources for data use limitations.

Map 2. Town of Bennington Land Cover



Map 3. Town of Bennington Land Use Districts



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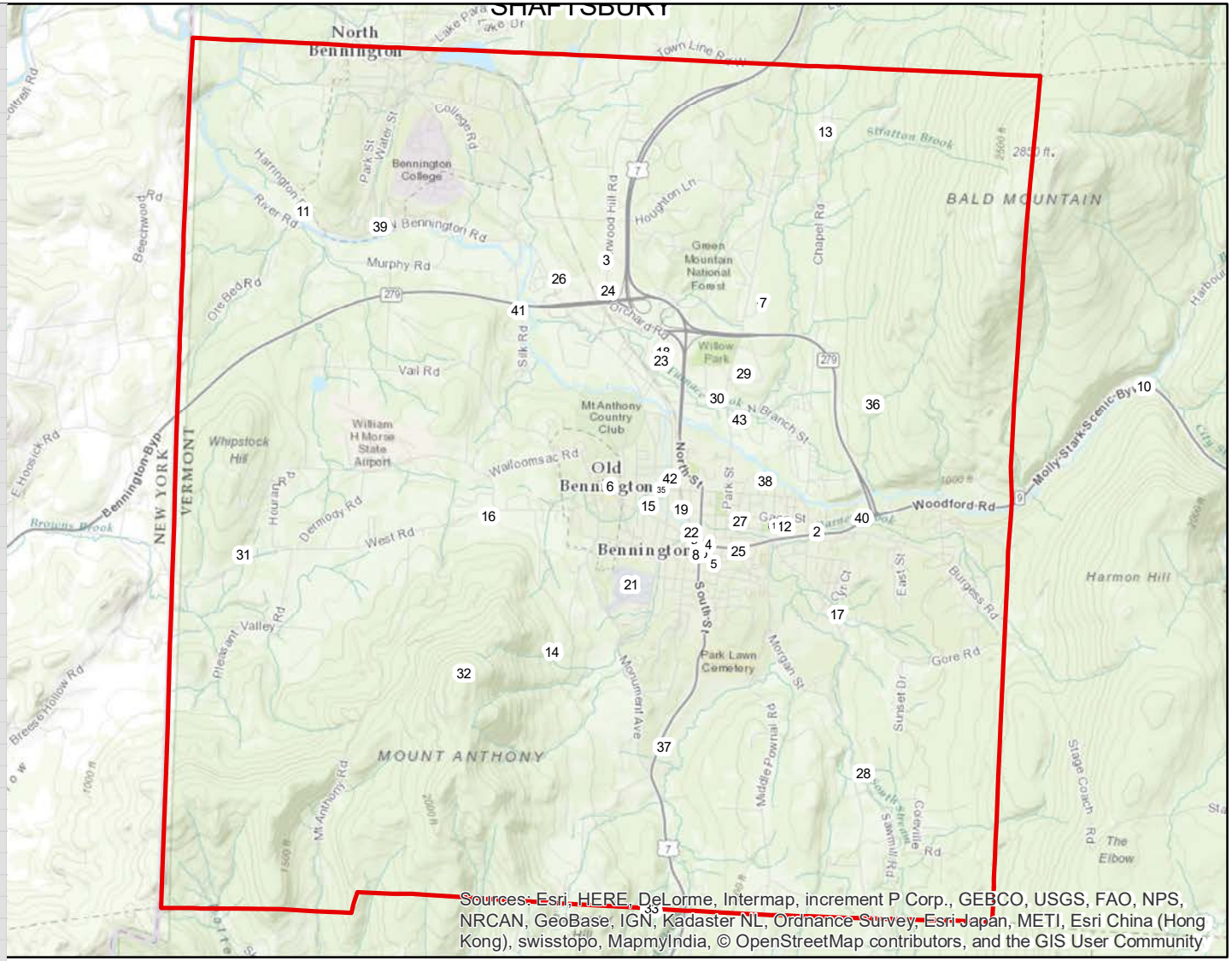
0 1.5 3 6 Miles

This map was created by the Bennington County Regional Commission in July of 2017. Map sources may be found in Section VIII. This map may be used only for planning purposes.

Map 4. Town of Bennington Critical Facilities

Label	Name
1	Bennington Recreation Ctr.
2	Bennington Moose Lodge
3	Bennington Project Independence
4	Green Mt. Christian Ctr.
5	Second Congregational Church
6	Monument Elementary
7	Mt. Anthony Middle School
8	Bennington Town Hall
9	VT Dept. of Health
10	Bennington Water Filtration Facility
11	Bennington Water Treatment Facility
12	Morgan Spring Well
13	Chapel Rd. Reservoir
14	West End Reservoir
15	Bennington Rescue Squad
16	Bennington Rural FD (West Rd.)
17	Bennington Rural FD (Gore Rd.)
18	Bennington Rural FD (Orchard St.)
19	Bennington Town FD (River Rd.)
20	Bennington Police
21	SW VT Medical Ctr.
22	Bennington Town Garage - Depot St.
23	Bennington Town Garage - Orchard St.
24	WBTN Radio Station
25	CAT-TV
26	Home Depot (CPOD)
27	Energizer Battery
28	Bennington Fish Culture Station
29	NSK
30	Kaman
31	Vishay Transitor
32	Mt. Anthony Tower
33	Verizon Wireless Pownal North
34	RCC Carpenter
35	RCC Bennington College
36	Velco Bennington
37	GMP South Bennington Substation
38	GMP Substation - Lyons Rd.
39	GMP North Bennington Substation
40	GMP Woodford Rd. Substation
41	GMP Substation - Silk Rd.
42	GMP Mill St. Substation
43	Bennington Highway Garage

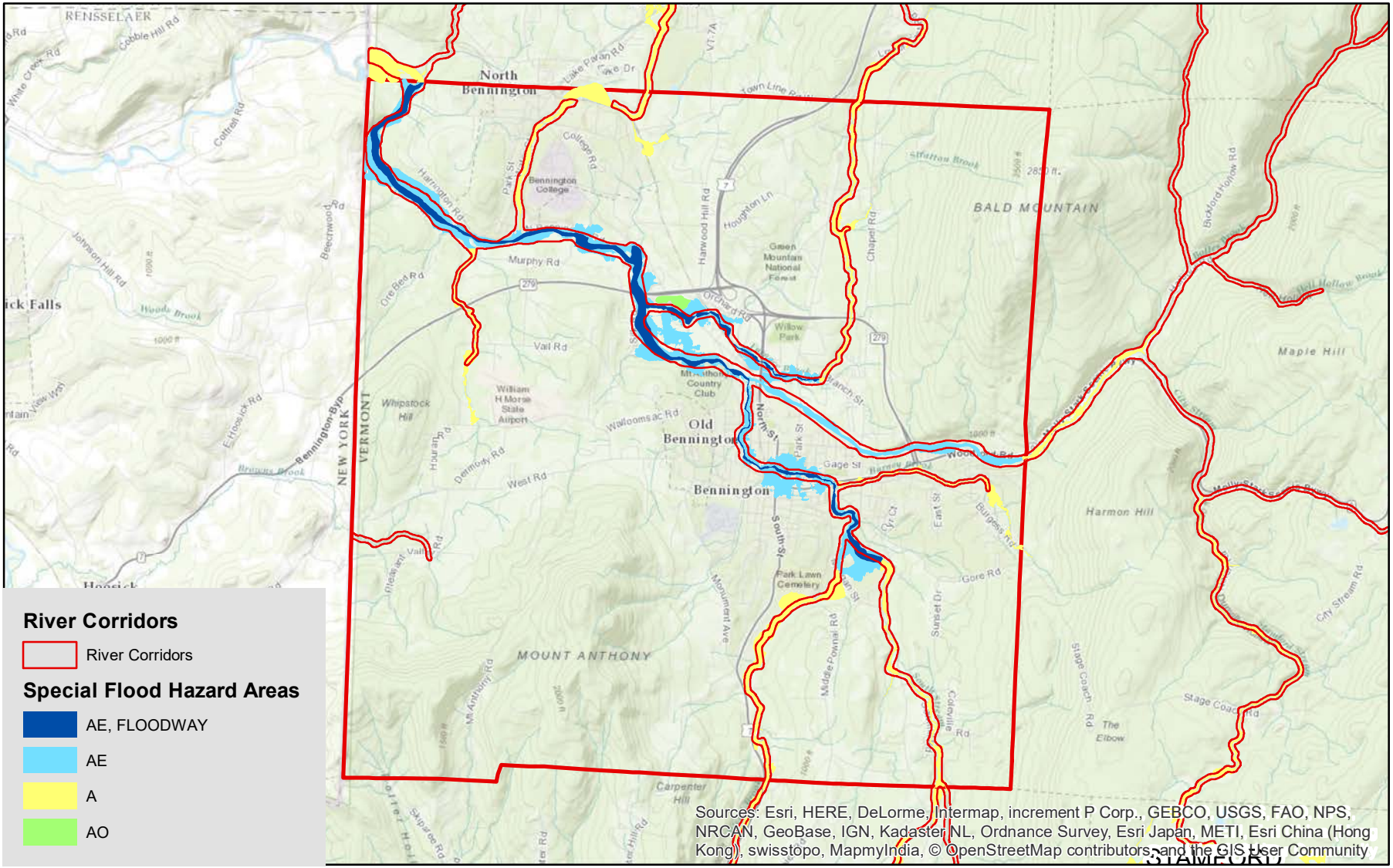


N

0 1.25 2.5 5 Miles

This map was created by the Bennington County Regional Commission in July of 2017. Map sources may be found in Section VIII. This map may be used only for planning purposes.

Map 5. Town of Bennington Flood Hazard Areas



River Corridors

River Corridors

Special Flood Hazard Areas

- AE, FLOODWAY
- AE
- A
- AO

N

0 1.25 2.5 5 Miles

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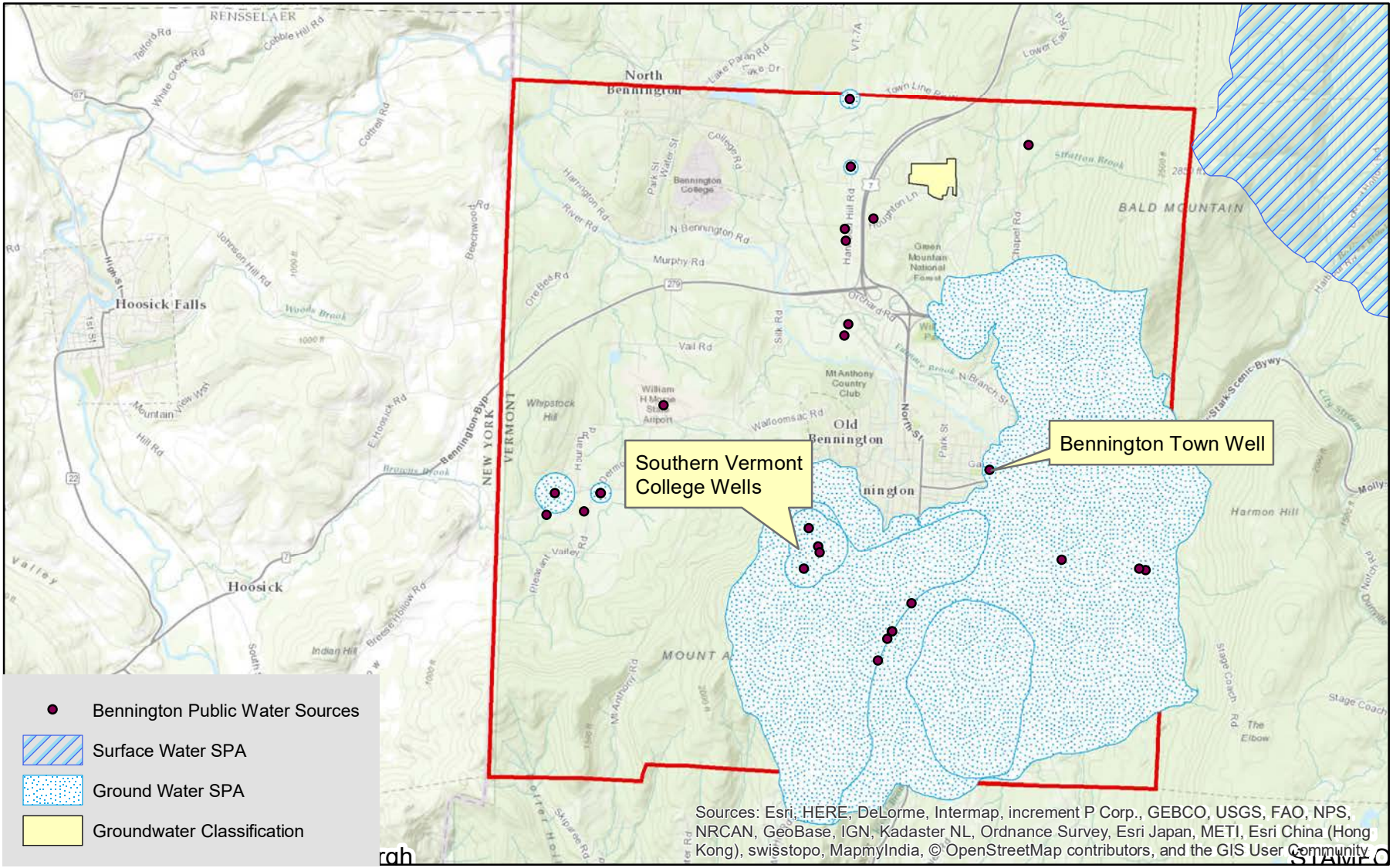
Map 6. Bennington Water Resources



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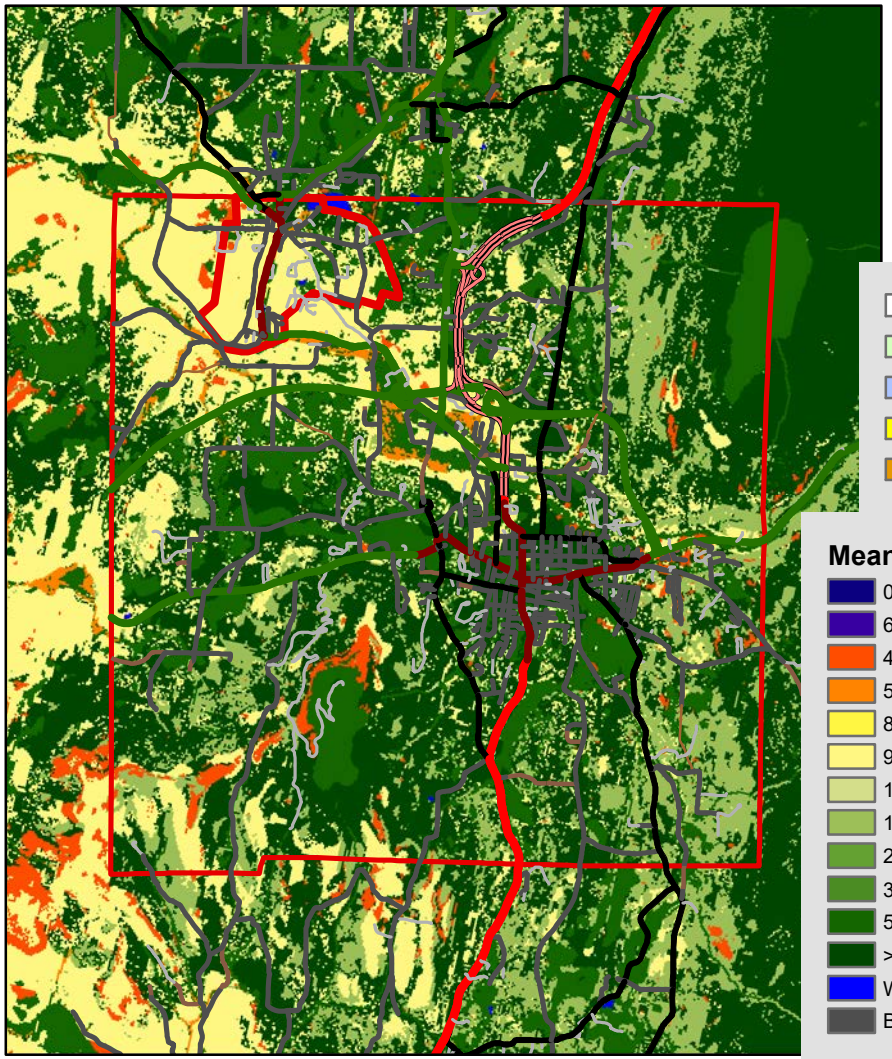
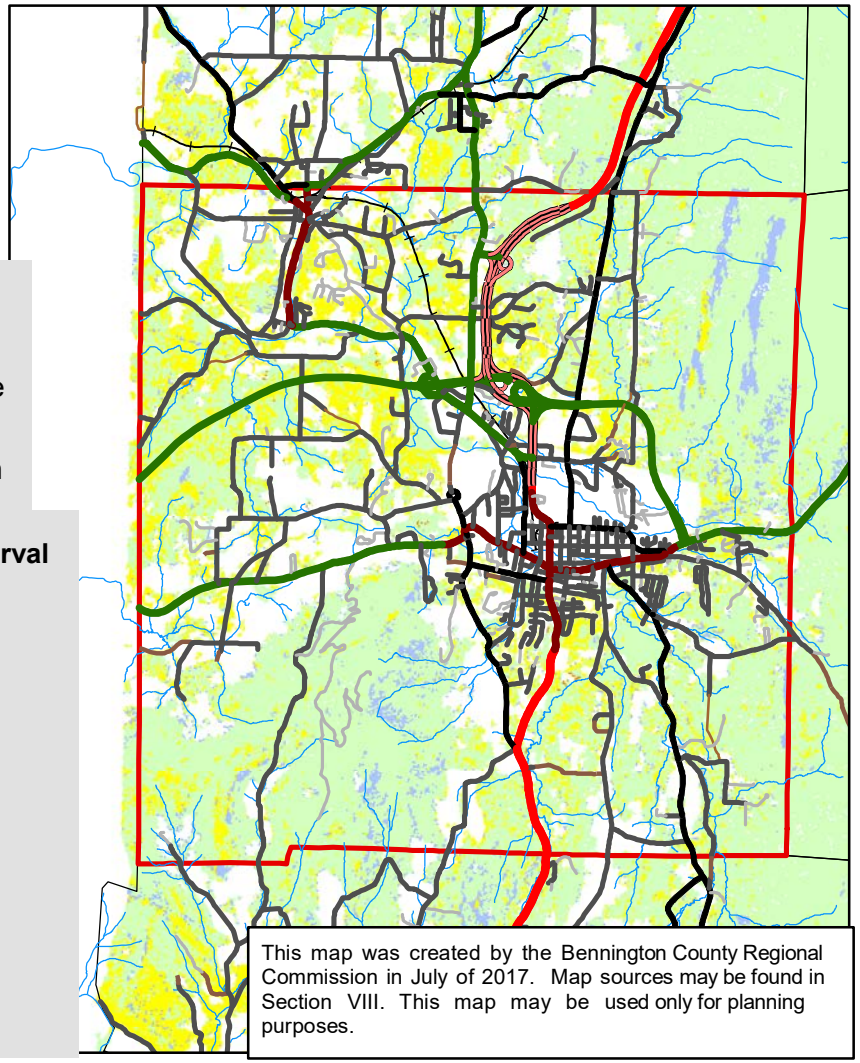
Map 7. Town of Bennington Wildfire Potential

Mean Fire Return Interval



Wildfire Risk



- No risk
- Low
- Moderate
- High
- Very high

Mean Return Interval

- 0-5 Years
- 6-10 Years
- 46-50 Years
- 51-60 Years
- 81-90 Years
- 91-100 Years
- 126-150 Years
- 151-200 Years
- 201-300 Years
- 301-500 Years
- 501-1000 Years
- >1000 Years
- Water
- Barren

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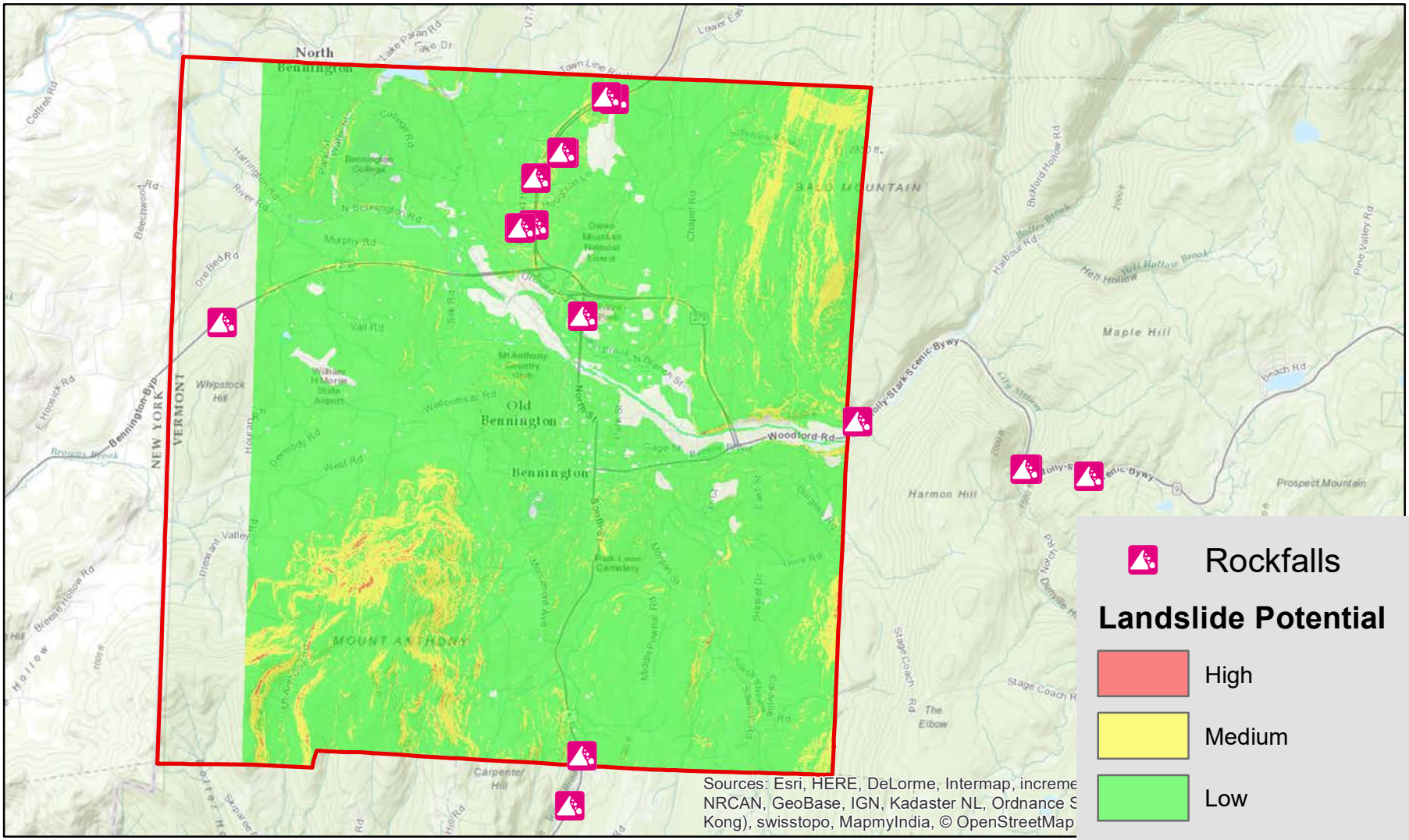
N

0 2.5 5 10 Miles

Map 8. Town of Bennington Landslide Potential and Rockslide Locations



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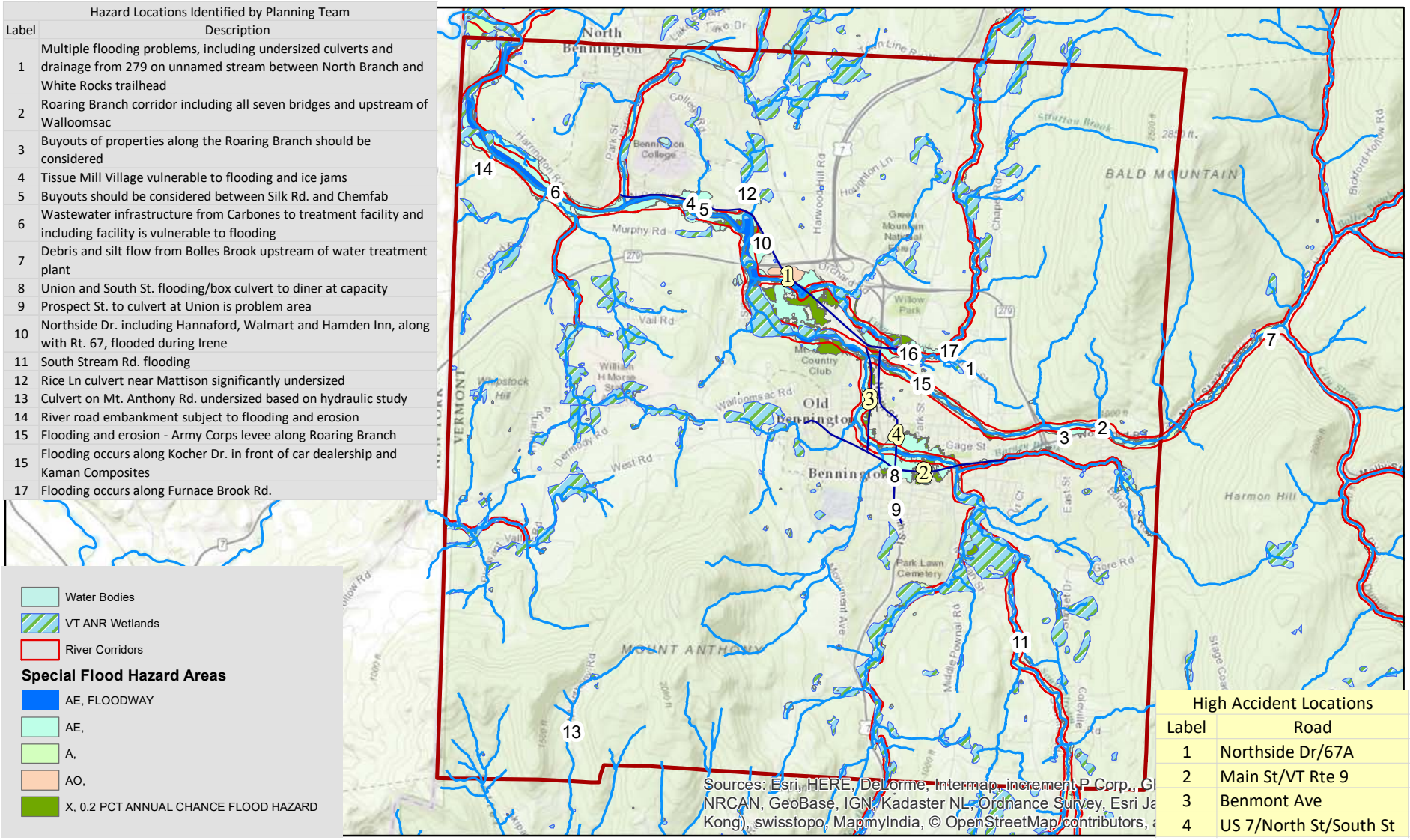
Map 9. Town of Bennington Hazard Assessment

Hazard Locations Identified by Planning Team	
Label	Description
1	Multiple flooding problems, including undersized culverts and drainage from 279 on unnamed stream between North Branch and White Rocks trailhead
2	Roaring Branch corridor including all seven bridges and upstream of Walloomsac
3	Buyouts of properties along the Roaring Branch should be considered
4	Tissue Mill Village vulnerable to flooding and ice jams
5	Buyouts should be considered between Silk Rd. and Chemfab
6	Wastewater infrastructure from Carbones to treatment facility and including facility is vulnerable to flooding
7	Debris and silt flow from Bolles Brook upstream of water treatment plant
8	Union and South St. flooding/box culvert to diner at capacity
9	Prospect St. to culvert at Union is problem area
10	Northside Dr. including Hannaford, Walmart and Hamden Inn, along with Rt. 67, flooded during Irene
11	South Stream Rd. flooding
12	Rice Ln culvert near Mattison significantly undersized
13	Culvert on Mt. Anthony Rd. undersized based on hydraulic study
14	River road embankment subject to flooding and erosion
15	Flooding and erosion - Army Corps levee along Roaring Branch
15	Flooding occurs along Kocher Dr. in front of car dealership and Kaman Composites
17	Flooding occurs along Furnace Brook Rd.



High Accident Locations	
Label	Road
1	Northside Dr/67A
2	Main St/VT Rte 9
3	Benmont Ave
4	US 7/North St/South St

N

0 1.25 2.5 5 Miles

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