Town of Woodford

Hazard Mitigation Plan

November 13, 2012

Town of Woodford
Town Hall
1391 Vermont Route 9
Woodford, VT 05201

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I. Introduction and Purpose

Hazard mitigation is intended to reduce potential losses from future disasters. Hazard mitigation plans identify potential natural hazards that could affect a community and the projects and actions that a jurisdiction can undertake to reduce risks and damage from natural hazards such as flooding, landslides, wildland fire, and similar events (FEMA 2011).

This plan is intended to identify, describe and prioritize potential natural hazards that could affect the Town of Woodford and measures to reduce or avoid those effects. The Federal Emergency Management Agency, within the U.S. Department of Homeland Security and the Department of 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 committee and dates of meetings and public and agency review. Section IV analyzes the following natural hazards:

- Floods and Flash Floods
- Winter Storms
- High Wind Events
- Drought
- Wildfire
- Earthquake
- Landslides and Debris Flows

II. Town Profile

The Town of Woodford is located east of Bennington (Map 1). The Town has 30,332 acres making it the largest of all towns in the Bennington Region. Much of the town is on the upper plateau of the Green Mountain range with typical elevations exceeding 2,000 feet. The town is nearly divided between the Hudson (Walloomsac) and Connecticut (West Branch-Deerfield) River Basins. The plateau supports a rich variety of aquatic environments including ponds and wetlands. Woodford Hollow on the western side of town is rugged with a narrow valley and an extensive watershed including Bolles Brook, Bickfork Hollow Brook, City Stream and Stamford Stream. Much of the rural development is near Route 9, the principal means of access. The balance of the land is largely in the Green Mountain National Forest (Map 2). The settlement areas of the town are divided into five areas: Woodford Hollow, Burgess Road, Woodford City, Red Mill Pond and the balance is in Green Mountain National Forest/public lands.

Woodford Hollow starts at the Bennington town line along Route 9 and continues along Harbour Rd. The area has mixed uses characterized mostly by single family homes on small lots. Along this route several businesses are located. The Town Meeting Hall and the Town clerk's office are centrally located along this major highway along with the Woodford Hollow Elementary School and the Town of Bennington's water filtration plant. Burgess Road is at the foothills of Harmon Hill of the Green Mountain Range. The area is mainly rural residential and includes two Class 3 town roads with access to the Town of Bennington. The area is generally characterized by moderate to steep slopes.

Woodford City is an area on the plateau which encompasses the largest area of private holdings outside the Green Mountain National Forest. The largest concentration of seasonal-vacation homes is located in this area. The Woodford City limits include Prospect ski area and continue east towards the end of Big Pond, also known as Woodford Lake Estates. The interconnecting streams and wetlands are an important natural system in this area which the Town strives to protect through the town plan. The Red Mill Pond area includes the Woodford State Park and extends to the Town of Searsburg's town line. Woodford State Park and the Vermont Fish and Game access at the Red Mill pond, together with access to the Green Mountain National Forest, are the primary recreation uses. Green Mountain National Forest makes up about 88% of the 30,332 acres. Because of this there is not a lot of opportunity for development. Nearly 20% of the town is in the George D. Aiken Wilderness Area located entirely within the Town of Woodford. The Green Mountain National Forest manages how the land is used. Emphasis has been on recreation and natural resource protection (Maps 2 and 3).

The population of the Town, according to the 2010 U.S. Census, is 424. Total family households remain relatively constant through the years. The resident workforce in 2000- including all town residents aged 16 and over who were working or actively seeking employment- numbered 220, representing 53% of the town's population. Woodford is host to a modest number of establishments which has remained relatively steady over the years. Only about 10% of Woodford's workforce actually works in town. Table 1 below shows the distribution of types of structures in the town

Table 1. Number and type of structures in Woodford. Source: Vermont Center for Geographic Information E911 data. April 12, 2011

Type	Number
Single family residential	173
Seasonal single family	134
Mobile home	27
Other residential	7
Commercial	17
Lodging	7
Institutional (school, government, church)	5
Other	8
Total	378

A predominant characteristic of the Woodford environment is the abundance of natural resources, rural and back country recreational opportunities. Because of direct access from Route 9, Woodford serves as a hub in southern Vermont to a vast network of trails both north and south. Types of recreation attractions in Woodford include: Appalachian/Long Trail crossing and parking access, Woodford State Park, George Aiken Wilderness, Little Pond, Red Mill Pond, Adams Reservoir Access, Pine Valley Access, Cross country skiing, extensive VAST snow mobile trails, hunting, fishing , hiking and boating.

Vermont Route 9 is a principal arterial state highway serving east-west traffic in southern Vermont through Woodford. It is also on the national highway system and serves as the "Main Street" for the town. Along Route 9, The Woodford Hollow School is situated. The school is a member of the Southwest Vermont Supervisory Union and provides education for K-6.

The Bennington Water Filtration Plant, also located along Route 9, provides water to Bennington and several Woodford residents west of the plant. Other water supply sources are provided by on-site wells and septic disposal.

The economic impact of and attraction to Vermont is quite profound and can be attributed to the quality of the environment for leisure and active recreation. Woodford plays an important role and contribution to the area's economy. It seems unlikely that any significant changes will be made in respect to economic development trends. Exceptions may be based more on technology and telecommunication advancements which make telecommuting and home based businesses or cottage industries more attractive to rural areas. Given the lack of any significant infrastructure and challenging access, particular road safety, Woodford is likely to continue as a bedroom community compared to the more densely developed Bennington area.

III. Planning Process

A. Planning Committee

The Woodford Select Board requested that the Planning Board Chair form a committee to serve as a Hazard Mitigation Committee to draft a hazard mitigation plan. Table 2 lists committee members. The Bennington County Regional Commission provided support.

Table 2. Planning committee members

Name	Affiliation
Susan Wright	Planning Commission Chair
Anita Capella	Woodford Lake Estates Resident
Betty Charette	Lister
Michael Charette	Select Board member
Charles Suss	Planning Commission

Table 2. Planning committee members	
Name	Affiliation
Ed Shea	Planning Commission
Ryan Thurber	Select Board Chair
Lauri Wright	Planning Commission

The committee held meetings in early 2012. Except for the organization meeting on January 25th, all meetings were properly warned. Other members of the community were consulted to gather information on potential hazards and mitigation measures. The draft Town Plan, existing town ordinances and the regional plan were all reviewed as well as FEMA and VEM guidance documents (see reference section). Data was collected from several sources on natural hazards that have or could potentially affect Woodford.

Table 3. Dates of planning meetings and public and agency review	
Meeting	Date (s)
Select Board requests formation of planning committee	January 18, 2012
Planning committee organization meeting	January 25, 2012
Planning committee meetings	February 8, 2012 February 28, 2012 March 19, 2012 August 20, 2012
Draft made available for public and agency review by the planning committee	March 19, 2012
Select Board approved the plan for release	March 21, 2012
Redraft of plan again made available for public and agency review	September 4, 2012

Comments and information were also solicited from the Town Road Commissioner, long-time residents, volunteer fire personnel and the former and current Zoning Administrator. The plan was also sent to the neighboring towns of Bennington, Pownal, Stamford, Readsboro, Searsburg, Somerset, Glastenbury and Shaftsbury and to Local Emergency Planning Committee #7, which includes Woodford for comment.

The above meetings were warned and comments were solicited from members of the public who attended. The draft plan was put online on the Bennington County Regional Commission website, and notices sent out to members of the public informing them that they could review the plan at that website or in the Town Hall in Woodford, VT. The plan was submitted for review by Vermont Emergency Management and the Federal Emergency Management Agency on March 22, 2012. The second draft was substantially revised based on these comments. This second draft was submitted to FEMA on June 20, 2012. FEMA provided additional comments on the second draft in August 2012. The Planning Committee met following receipt of those comments, and a third draft was prepared and submitted on

September 4, 2012. This third draft was also posted on the BCRC website, made available at the Town Hall and comments solicited. Following review and approval by those agencies, the Select Board of the Town of Woodford adopted the plan on February 27, 2013.

B. Comments Received

Other than comments received from FEMA, no comments were received from other towns or agencies, including Vermont Emergency Management or LEPC 7. Members of the public who attended planning team meetings provided information on the kinds of damage caused by Irene.

IV. Hazard Analysis

A. Hazard Assessment

This section addresses each of the potential natural hazards based on data from the National Climate Data Center, the National Weather Service river gauge web site (www.water.weather/ahps/), the Federal Emergency Management Agency list of disasters (http://www.fema.gov/femaNews/disasterSearch.do), the Vermont Department of Forests, Parks, and Recreation and local knowledge. There are no stream gauges located in or near Woodford. There are two weather stations within the town. A private resident in the eastern part of town reports to Channel 6 news. The second was erected by the State and serves as an observation tower and camera to report road conditions. It is located on Route 9 approximately 1/2 mile west of Prospect. Data for this private site is not readily accessible or searchable (Steve LaPoint, Channel 6 News, personal communication). VT AOT has not returned requests for data. Earthquake data came from a run of HAZUS completed by Jon Kim of the Vermont Geological Survey. Data on landslides was provided by VT AOT and by field surveys by BCRC staff.

1. Floods and Flash Floods

a. Description

Flooding is the most frequent and damaging natural hazard 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 creeks 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.

Most development along streams in Woodford is within the Hoosic River Watershed and includes Walloomsac Brook along Route 9, Bolles Brook that flows to Walloomsac Brook form the north along Harbor Rd., Dunville Hollow Stream that flows from the south, and City Stream that flows from the east to the confluence of Walloomsac and Bolles Brooks. These are considered part of the Roaring Branch watershed and are relatively narrow, high gradient streams with boulder and cobble substrates. These streams can be very flashy, and while some flood losses are the result of inundation, more often flood losses are caused by fluvial erosion. This can range from gradual bank erosion to catastrophic changes in the location of the river channel (Vermont River Management Program 2010). Runoff from snowmelt in the spring, summer thunderstorms, and tropical storms and hurricanes can all result in flooding in Woodford. 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 are the most common type of flood in the steep terrain of Woodford, and can occur after spring melt of mountain snow, following large storms such as Tropical Storm Irene, or after significant thunderstorms. Digital flood zone maps have been prepared and are currently under review (Map 4).

b. 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 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.

Table 4. Total number of flood events by type and year for Bennington County. Source: NCDC 2011			
Year	Flash Flood	Flood	Total
1993		1	1
1994		1	1
1995	1	1	2
1996	3	5	8
1998		3	3
1999		2	2
2000	2	2	4
2002	1	1	2
2004	1	3	4
2005		3	3
2006		1	1
2007	1	1	2
2009	2		2
2011		2	2
Total	11	31	42

Table 4 shows a total of 42 flood events in Bennington County from 1990 to 2011, using NCDC data. These have been primarily minor and affected either specific streams, such as the Batten Kill and the Walloomsac or specific towns.

Table 5 describes ten moderate and extreme events that have occurred since 1990, using the National Weather Service (2010) categories, which likely affected Woodford. These events were described in the National Climate Database records (2011). It should be noted that only the January 1996 event occurred in the winter, with all other events in the spring, summer or fall. Ice jam flooding does occur and one instance of damage is described below.

Table 5. Significant flood events affecting Bennington County. Source: NCDC 2011					
Dates	Type	Description	Area	Category	FEMA
19-20 Jan 1996	Flood	An intense area of low pressure located over the Mid-Atlantic region produced unseasonably warm temperatures, high dew points and strong winds. This resulted in rapid melting of one to three feet of snow. In addition to the rapid snowmelt one to three 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.	Countywide	Moderate	DR-1101 1/19 to 2/2 1996
11-12 May 1996	Flood	A low pressure system tracked across New York State and New England and moved to the east coast and intensified creating a prolonged 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 in Bennington County.	Bennington	Moderate	
8-10 Jan 1998	Flood	Mild temperatures and rain combined to cause small stream flooding throughout Bennington County The Batten Kill rose over 8 feet at the new Arlington gage with substantial flooding reported. The main impact from the flood waters was extensive flooding of fields and roadways. Route 7A north of Arlington was closed due to flooding. The Walloomsac River crested nearly two feet above flood stage at Bennington.	Arlington; Bennington; Countywide	Moderate	

Table 5. Significant flood events affecting Bennington County. Source: NCDC 2011					
Dates	Type	Description	Area	Category	FEMA
16-17 Sept 1999	Flood	The remnants of Hurricane Floyd moved up the eastern bringing both high winds and heavy rainfall (3-6 inches) to Southern Vermont. Many smaller tributaries reached or exceeded bankfull. Winds from the passage of Floyd were estimated to have gusted to over 60 mph, especially over hilltowns. The combination of the wind and very saturated ground, produce widespread downing of trees and power lines across much of Southern Vermont. As many as 2,000 people lost power in Southern Vermont.	Countywide	Moderate	DR-1307 9/16-21 1999
14-17 Jul 2000	Flash Flood	Thunderstorms caused torrential rainfall with flash flooding which washed out sections of roadways in northeast Bennington County and southern Bennington County. Routes 7 and 67 were closed and some roads were washed out.	Northeast Bennington County; Southern Bennington County; Arlington; Bennington; Shaftsbury	Moderate	DR- 1336 7/14-18 2000
17 Dec 2000	Flood	Unseasonably warm and moist air brought a record breaking rainstorm to southern Vermont. Rainfall averaged 2-3 inches. The rain fell very heavily at times, up to an inch per hour. The rain, combined with snowmelt and frozen ground, lead to a significant runoff and flooding.	Peru; Dorset: West Rupert	Moderate	DR-1358 12/16-18 2000 (Severe Winter Storm)
21 July to 18 Aug 2003		Severe storms and flooding affected Vermont including Bennington Account. This event does not appear in the NCDC data			DR-1488 7/21-8/18 2003
16-17 Apr 2007	Flood	An intense coastal storm spread heavy precipitation across southern Vermont, starting as a mixture of wet snow, sleet and rain, with snow and sleet more prevalent across the higher elevations. The precipitation then changed to plain rain. Liquid equivalent precipitation totals from this storm ranged from 3 to 6 inches. This led to minor flooding across portions of southern Vermont from Monday afternoon into early Tuesday.	Arlington	Minor	DR- 1698 4/15-21 2000
28-29 Aug 2011	Flood/Flash Flood	Tropical Storm Irene tracked north northeast across eastern New York and western New England during Sunday, August 28th, producing widespread flooding, and damaging winds across the region. Rainfall amounts generally averaged 4 to 8 inches. Much of the rain which fell occurred within a 12 hour period, beginning early Sunday morning, and ending Sunday evening. This resulted in widespread flash flooding and river flooding across southern Vermont. 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. Route 9, the main route across southern Vermont, was closed. The city of Bennington was inaccessible for a period of time. Record flooding occurred on the Walloomsac River at Bennington. 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 numerous downed trees and power lines across the region. This also resulted in widespread long duration power outages.	Countywide	Extreme	DR-4022 8/27-2 2011

Table 5. Significant flood events affecting Bennington County. Source: NCDC 2011					
Dates	Type	Description	Area	Category	FEMA
7 Sept 2011	Flood	Large amounts of moisture from the remnants of Tropical Storm Lee interacted with a frontal system producing heavy rainfall. Total rainfall amounts across southern Vermont for the period from Monday into Thursday ranged from 3 to 7 inches. This heavy rainfall, combined with saturated soil from the excessive rains which fell in late August associated with the passage of Irene, led to widespread minor to moderate flooding on rivers, as well as small streams and creeks across southern Vermont.	North Bennington; Countywide	Moderate	

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. Woodford has been subjected to two major tropical storms in the past twenty years. The primary damage was from flooding with secondary damage from wind. There have been no NFIP-designated repetitive losses within the jurisdiction.

Tropical Storm Irene caused significant damage to town roads, culverts and bridges as well as to private properties. Aaron Lane, a resident of Harbour Road, recorded 5.30” of rain during the storm. One house on Harbour Road was lost and three damaged. One house on Route 9 was lost and four were damaged, while another three lost land and/or outdoor structures (pool, furnace). The house lost on Route 9 was previously damaged after an ice jam released flood waters in 1987. Erosion along the Walloomsac Brook threatened the Town Hall, and there was extensive debris in the rivers.

Three bridges on Harbour Road were damaged during Irene. Bolles Brook overtopped the banks causing severe erosion that washed away riprap and some undermining of abutments and wing walls. The southern approaches of each bridge were lost for over 100 feet. In addition, approximately 500 feet of road was lost between two of these bridges (Robert Vanluling, FEMA Project Specialist). A bridge was also damaged on Notch Road due to erosion. Post-storm evaluations indicated damage to two culverts on Harbor Rd. and one in Woodford Lake Estates. Along the Walloomsac Brook, which parallels Route 9, debris extended over three feet above the 100-year mapped flood elevation, indicating high water levels had exceeded that elevation. The storm also washed out Route 9 blocking east-west access along that major route. The pipe transferring water from a storage tank on Harbour Road was cut. The water supply to Bennington was also cut off for several days. There had been previous damage to Route 9 in 1997 following a spring thaw. The Harbor and Notch Road bridges suffer annual damage from ice striking the abutments during the spring melt.

There are five dams within the Town (Map 5). One of these at Woodford Lakes Estates has some seepage and no emergency spillway (email from Stephen Bushman, PE, Dam Safety Engineer dated July 5, 2006). The condition was reported as fair. While the downstream hazard of the dam is categorized as low, failure of that dam could damage culverts downstream along City Stream. Mr. Bushman also reported on the Bugbee Pond Dam that day, and the condition

was reported as good. The dam on Adams Reservoir in Woodford State Park is categorized as a significant hazard potential based on a breach analysis prepared by the U.S. Army Corps of Engineers in 1993. The inspection report for that dam, completed in 2008, indicated it was in good condition (Memorandum from Stephen Bushman, PE, Dam Safety Engineer dated August 5, 2008). A report from Mr. Bushman dated August 10, 2005 indicated that the condition of Red Mill Pond Dam as good and that of Red Mill Pond Dike as poor. Little Pond dam is small and located in the backcountry.

c. Extent and Location

Based on historical data, a tropical storm such as Irene would represent the worst case flood, with flooding primarily along Route 9 from the Bennington town line east to Harbor Rd. and also along City Stream, Harbor Rd. and Dunville Hollow Rd. Several culverts and bridges were damaged and portions of roadways washed away. In addition, Route 9 was washed away, cutting transportation between Bennington and Brattleboro. There were no observations of flood water depths along area roads. However, debris was piled above the base flood elevation near the boundary with Bennington along Route 9 indicating that floodwaters had exceeded that elevation along that section of the Walloomsac.

d. Probability, Impact, and Vulnerability

Based on data from 1990 to 2011, ten moderate or major flood events have affected Bennington County, resulting in a 50% chance of such an event occurring. However, these have not all directly affected Woodford, so that probability should range from 10 to 50%. Woodford has a total of 307 single family residences, of which 134 are seasonal, 27 mobile homes, 24 commercial establishments and a small number of government, church and school buildings. The damage from Irene was less than 10% of this total number of structures, though more than 10% of town bridges were damaged. Therefore, the potential proportion damaged within the town from severe flooding would range from 1-10% with injuries of 1-10%. Most services would be recovered in less than seven days, though help for specific property owners may take significantly longer. Map 8 shows Critical Facilities including water supply facilities serving the Town of Bennington, the Woodford Town Hall and Woodford Elementary, which also serves as the town emergency shelter. There are no residential, commercial or institutional buildings within the flood hazard zones in the Town of Woodford.

2. Winter Storms

a. 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. In rare cases, the weight of snow may collapse roofs and cause other structural damage. Wind can also accompany snowstorms increasing 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.

b. Previous Occurrences

Table 6 below summarizes the 152 winter storm events that have occurred in Bennington County since 1993. As can be seen, a high numbers of events occurred in 1997, 2007, 2008, and 2009.

Table 6. Summary of winter storm events in Bennington County. Source: NCDC 2011

Year	Blizzard	Record Snow	Heavy Snow	Snow	Heavy Mix	Ice Storm	Freezing Rain	Snow/ Freezing Rain	Snow/Sleet	Winter Storm	Winter Weather	Total
1993	1	1	4	5			1					12
1994			4	1	1			1	2			9
1995			3	1				5				9
1996			5							2		7
1997			1				2			7		10
1998				1						2		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
2007			4			1				6	3	14
2008			5			2				1	13	21
2009			4							1	12	17
2010			3							1	3	7
2011										4	3	7
Totals	2	1	36	9	1	3	3	5	2	54	35	152

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.” Table 7 describes these events.

Table 7. Significant winter storm events in Bennington County and Woodford. Source: NCDC 2011

Dates	Type	Description	Category	Area
13-14 Jan 1993	Heavy Snow	Snowfall amounts across the state ranged from six to sixteen inches	High	Statewide
16-17 Feb 1993	Heavy Snow	Snowfall amounts ranged from 6 to 18.	High	Statewide
13-14 Mar 1993	Blizzard	The "Blizzard of 93", one of the worst storms this century virtually shut down Vermont on the weekend of March 13-14 forcing the closure of roads and airports. This was one of the most powerful snowstorms on record. Snowfall amounts ranged from 10 to 28 inches across the state.	Extreme	Statewide
2-4 Mar 1993	Heavy Snow	Snowfall amounts across the state ranged from 8 to 22 inches with snowfall rates as high as three to four inches per hour during the storm.	High	Statewide
4-5 Feb 1995	Heavy Snow	A low pressure system tracked up the east coast on February 4th reaching the Gulf of Maine on the morning of February 5th dumping heavy snow across Vermont. Snowfall amounts ranged from 6 to 20 inches.	High	Statewide
27-28 Feb 1995	Snow Freezing Rain	A mixture of snow, sleet, and freezing rain fell across Vermont. Snow accumulations ranged from four to eight inches across much of northern Vermont with localized amounts of 8 to 12 inches in Vermont's Green Mountains. Across southern and central Vermont two to five inches of snow fell along with significant ice.	High	Central; Southern VT
2-3 Jan 1996	Heavy Snow	Heavy snow fell across southern Vermont with the average snowfall ranging from 10 to 12 inches.	High	Southern Vermont
12-13 Jan 1996	Heavy Snow	Heavy snow fell across southern Vermont with snowfall totals ranging from 6 to 10 inches with a few locations reporting up to one foot. Some specific snowfall totals included 7 inches in Pownal in Bennington County.	High	Southern Vermont
23 Jan 2005	Blizzard	Frequent whiteout conditions observed by plow crews. Whiteout conditions were most prevalent across the Green Mountains.	High	Countywide
15-16 Jan 2007	Ice Storm	Significant icing occurred from the freezing rain during Monday, leading to widespread power outages from downed trees and tree limbs, and from power transformers which shorted out. Strengthening winds in the wake of the storm continued to down tree limbs and exacerbate power outages across the region.	High	Southern Vermont
16-17 Mar 2007	Heavy Snow	This storm brought widespread snowfall amounts of 10 to 18 inches across southern Vermont.	High	
30-31 Dec 2007	Heavy Snow	This storm system brought a swath of heavy snow to eastern New York and western New totaling from 6 to 12 inches across southern Vermont. Snowfall amounts ranged from 6 to 11 inches, with 11 inches reported at Woodford, and 6 inches reported at Dorset.	High	Southern Vermont
1-2 Jan 2008	Heavy Snow	Snowfall accumulations of 6 to 12 inches led to treacherous travel conditions and the closings, or delayed openings of numerous schools and businesses.	High	Southern Vermont
4-5 Mar 2008	Ice Storm	This storm system spread freezing rain and sleet across higher elevations of east central New York and portions of southern Vermont, resulting in significant ice accumulations of one half, to locally up to one inch in the higher elevations of western Windham county and one quarter to less than one half of an inch in lower elevations.	High	Southern Vermont
11-18 Dec 2008 FEMA DR-1816	Winter Storm	A series of snowstorms hit eastern New York and western and southern New England during this period resulting in 3-9 inches per storm, but accumulating to over a foot during the period.	High	Southern Vermont

Table 7. Significant winter storm events in Bennington County and Woodford. Source: NCDC 2011

Dates	Type	Description	Category	Area
1-3 Jan 2010	Heavy Snow	This storm brought widespread snowfall to southern Vermont along with blustery conditions, resulting in blowing and drifting of the snow. Snowfall totals across Bennington and western Windham counties ranged from about 10 inches, up to just over two feet.	High	Southern Vermont
23-24 Feb 2010	Heavy Snow	This system blanketed the area in a heavy wet snow that resulted in treacherous travel conditions and widespread power outages across southern Vermont. Generally 1 to 2 feet of snow accumulated with the highest amounts above 1500 feet.	High	Southern Vermont
26-27 Feb 2010	Heavy Snow	A powerful storm brought heavy rainfall and a heavy wet snow resulting in widespread power outages across southern Vermont, downed trees and power lines, treacherous travel and road closures. Strong and gusty winds developed along the east facing slopes of the Green Mountains of southern Vermont with gusts up to 50 mph. By the time the snow came to an end, snowfall totals of 1 to 2 feet were reported across the higher terrain, with lesser amounts of 3 to 6 inches below 1000 feet. The liquid equivalent totals from the storm were 1 to 2 1/2 inches.	High	Southern Vermont

c. 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 12.7 to 17.6 inches (NOAA/National Climate Data Center 2011).

Woodford has areas of high elevation that are subject to snow particularly on the Woodford mountain plateau area to the Searsburg border (Map 5). The skill of road crews in Vermont means that only the heaviest snowstorms (>12 inches) or ice storms affect the populations. However, there are areas along Route 9 that have a high potential for rock slides and where the road is not properly banked. These areas may become more dangerous during winter storm events.

d. Probability, Impact and Vulnerability

There is a greater than 50% probability of a moderate or greater snowstorm affecting Bennington County, including Woodford. These are large-scale events, though local impacts may vary greatly. Roads and power lines are most vulnerable, with traffic accidents the most likely to create injuries (1-10%). Power outages could be short term or last seven or more days. Some roads may remain impassable for long periods as well.

3. High Wind Events

a. 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 52 thunderstorms with damaging winds in Bennington County since 1990. Damage was reported in Woodford from a storm that occurred on September 7, 1998. Events categorized as "strong wind" tended to occur during the winter months.

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. According to the report, a storm on June 5, 2002 "… spawned two tornados, one in Woodford Hollow, Bennington County and the other one near Wilmington, Windham County. The first touchdown, one mile north from Route 9, produced a swath 150 yards wide and a path length of one half mile. Many trees, as large as a foot in diameter, were either knocked over or ripped apart. Trees also fell on three automobiles. This tornado was estimated to be F1 in intensity, with winds estimated between 80 and 100 mph." The Planning Committee also identified a tornado in 2011.

b. Previous Occurrences

Table 8 below summarizes the total number of significant wind events including thunderstorms, strong winds, and tornadoes from 1990 to 2011.

Table 8. Summary of wind events in Bennington County.
Source: NCDC 2011

Year	Funnel Cloud	Strong Wind	Thunderstorm Winds	Tornado
1990			2	
1991			4	
1993		2	3	
1994		1	1	
1995		1	2	
1996		5		
1997		4	4	
1998		1	4	1
1999		2	3	
2000		1	1	
2001			2	

Table 8. Summary of wind events in Bennington County. Source: NCDC 2011

Year	Funnel Cloud	Strong Wind	Thunderstorm Winds	Tornado
2002		1	3	1
2003		1		1
2005		1	3	
2006		5	4	
2007		3	4	
2008		3	3	
2009		1	1	
2010	1	5	3	
2011		1	5	
Totals	1	38	52	6

Wind speed data is not available for wind events due to the lack of weather stations. NCDC data (2011) did not always include estimates of wind speed. Generally, wind speeds of greater than 55 miles per hour are considered damaging (NOAA Undated). Therefore, events were categorized based on damage assessments in the NCDC database. Damage greater than $10,000 and tornados were categorized as moderate. Most events resulted in minor damage. Significant events are described in Table 9.

Table 9. Significant wind events in Bennington County. Source: NCDC 2011

Dates	Type	Description	Area	Category
14-Sep-95	Thunderstorm	Severe thunderstorms produced damaging winds which downed trees and wires in a couple of locations in Bennington County.	Countywide	Minor
6-Mar-97	Wind	During the morning of March 6, deep low pressure off the coast of New England produced damaging winds across parts of Bennington County. The damaging winds brought trees and power lines down, which resulted in power outages.	Countywide	Minor
7-Sep-98	Thunderstorm	A derecho ahead of a strong cold front, which had moved east from southern Ontario across New York, weakened considerably as it moved into southern Vermont. The derecho still had wind strong enough to down trees in the town of Woodford in Bennington County as well as the town of Londonderry in Windham county.	Countywide; Woodford	Minor
5 Jun 2002	Tornado	Thunderstorms that initially developed in New York produced a macroburst in extreme eastern New York and moved into southern Vermont. The storms spawned two tornados, one in Woodford Hollow, Bennington County and the other one near Wilmington, Windham County. The first touchdown, one mile north from Route 9, produced a swath 150 yards wide and a path length of one half mile. Many trees, as large as a foot in diameter, were either knocked over or ripped apart. Trees also fell on three automobiles. This tornado was assessed to be a F1 intensity, with winds estimated between 80 and 100 mph. The second tornado, 4 miles northeast of Wilmington, was even stronger despite a narrower swath of 50 yards. The path length was also about a half mile. The winds with this tornado 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.	North Bennington; Woodford	Moderate

Table 9. Significant wind events in Bennington County. Source: NCDC 2011				
Dates	Type	Description	Area	Category
24-25 Dec 2008	Wind	A low pressure system tracked from the Great Lakes to off the northern New England coast. Strong winds developed immediately ahead of, and with a cold frontal passage Wednesday night, and persisted into Thursday morning. Wind gusts reached 40 to 55 mph, with the strongest winds occurring across the higher elevations of eastern Bennington County, and western Windham County.	Eastern Bennington County	Minor
9 Dec 2009	Wind	A strong low pressure system tracked northeast, into the eastern Great Lakes region creating strong east to southeast winds developed across southern Vermont during Wednesday morning, before gradually diminishing by Wednesday evening.	Countywide; Bennington, Pownal, Shaftsbury, Sunderland, Sandgate, Manchester, Dorset	Moderate
22 Aug 2010	Wind	Trees and wires were reported down due to high winds in Arlington, Sunderland, Shaftsbury and Bennington. Power outages occurred across Bennington County. The hardiest hit towns were Arlington and Shaftsbury. In Arlington, trees came down on transmission lines on both sides of town, blocking out two substations throughout Sunday night. An uprooted tree fell onto a house on Sunderland Hill Road. In Shaftsbury, the tree and powerline damage was concentrated on the east side of town, particularly East Road. Strong and gusty east to southeast winds occurred across southern Vermont, with the higher terrain of the southern Green Mountains being impacted the hardest.	Arlington, Sunderland, Shaftsbury, Bennington; Countywide	Moderate
26-May-11	Thunderstorm	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. Hundreds of branches were reported down on roads throughout the Bennington area due to strong thunderstorm winds.	Pownal; Countywide	Minor
9-Jun-11	Thunderstorm	A series of discrete storms developing into a broken line, which eventually evolved into an organized line of severe storms that created damaging winds.	Landgrove; Countywide	Minor

c. Extent and Location

Damaging winds, including the previous occurrences described above, are those exceeding 55 miles per hour (NOAA 2006, NOAA undated). During 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 could strike anywhere, but the majority of development is close to Route 9. Where storms are funneled up this valley, damage could be significant, but most likely less than 10% of structures would be affected. Again, power outages could last up to seven or more days.

d. Probability, Impact and Vulnerability

Wind events causing moderate or greater damage occur almost every other year (40-50%) in Bennington County, so the potential expected probability would be 10-50% in Woodford. Harbor Road and Woodford City are most likely to be impacted by wind events.

4. Drought

a. Description

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

b. Past Occurrences

Data on the Palmer Hydrologic Data Index for western Vermont indicates forty months since 1980 when that index was below -2.00 (Table 10). Levels less than -2.00 indicate that reservoirs and groundwater supplies are likely to be low. NCDC data shows ten recorded periods of drought and extreme heat, so this may occur more frequently.

Table 10. Palmer drought indices from 1980 to 2011 for western Vermont (including Bennington County). Months shown were when Palmer Hydrologic Drought Index (a measure of groundwater and reservoir levels) is <=-2.00. Source: http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp

Year	Month	Precipitation Index	Temperature Index	Palmer Drought Severity Index	Palmer Hydrologic Drought Index
1980	Jan	0.91	20.8	-2.87	-2.87
1980	Feb	0.67	16.7	-3.42	-3.42
1980	Mar	3.05	30.1	-2.73	-2.73
1980	Apr	2.34	44.3	-2.9	-2.90
1980	May	1.54	56.5	-3.5	-3.50
1980	June	2.62	61.9	-3.6	-3.60
1980	July	4.40	69.7	-3.12	-3.12
1980	Aug	4.58	69.0	-2.68	-2.68
1980	Sept	4.09	57.5	-2.16	-2.16
1980	Oct	2.54	44.8	-2.01	-2.01
1981	Jan	0.59	8.5	-2.59	-2.59
1987	Apr	1.99	48.0	-2.33	-2.33
1987	May	2.01	55.3	-2.72	-2.72
1987	Aug	2.73	65.1	-2.23	-2.23
1988	June	2.28	62.5	-2.16	-2.16
1988	July	3.61	71.6	-2.34	-2.34
1988	Sept	1.83	56.6	-2.44	-2.44

Table 10. Palmer drought indices from 1980 to 2011 for western Vermont (including Bennington County). Months shown were when Palmer Hydrologic Drought Index (a measure of groundwater and reservoir levels) is <=-2.00. Source: http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp

Year	Month	Precipitation Index	Temperature Index	Palmer Drought Severity Index	Palmer Hydrologic Drought Index
1988	Oct	2.01	43.3	-2.75	-2.75
1988	Nov	5.15	38.3	-2.02	-2.02
1988	Dec	1.11	21.7	-2.57	-2.57
1989	Jan	0.82	22.7	-3.1	-3.10
1989	Feb	1.28	18.4	-3.24	-3.24
1989	Mar	2.66	27.3	-2.79	-2.79
1989	Apr	2.20	40.5	-2.79	-2.79
1989	May	4.17	58.2	0.17	-2.33
1995	June	1.32	66.0	-2.89	-2.89
1995	July	4.04	71.6	-2.87	-2.87
1995	Aug	4.42	67.2	0.02	-2.56
1995	Sept	3.67	55.2	0.05	-2.26
1999	June	2.15	67.5	-2.24	-2.24
1999	July	3.46	71.1	-2.49	-2.49
1999	Aug	2.50	66.0	-3.05	-3.05
2001	Aug	2.61	69.9	-2.41	-2.41
2001	Sept	3.20	59.2	-2.54	-2.54
2001	Oct	1.52	49.2	-3.32	-3.32
2001	Nov	2.28	40.3	-4.22	-4.22
2001	Dec	2.07	31.9	-4.64	-4.64
2002	Jan	1.85	27.0	-4.40	-4.40
2002	Feb	3.23	25.7	0.78	-3.17
2002	Mar	2.74	31.4	0.86	-2.68

c. Extent and Location

Moderate droughts (PHDI -3.0 to -4.0) occurred in 1999 and 2001 and severe droughts (<-4.0). Droughts would most likely affect those properties with shallow wells. These have not been mapped.

d. Probability, Impact and Vulnerability

Based on the Palmer Drought Severity data, there is a 3% chance of a drought occurring in any one year. Groundwater resource mapping has not been completed, and areas that could be affected by drought are unknown, but any houses with shallow wells are most likely to be affected. Drought may affect the potential for wildfire, which is discussed below.

5. Wildfire

a. 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 11 shows how wildfires can be categorized based on size.

Table 11. Wildland fire size classes. Source: NWCG 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 the northeastern United States, 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). Map 6 shows fuel types mapped as part of the Landfire program (http://www.landfire.gov/), a national program to provide spatial and other data on fuels, topography and potential fire behavior. Most of the land area is covered by broadleaf litter fuels that exhibit fires of low intensity and slow rates of spread.

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% (Michael S. Batcher, personal observation). These conditions are most prevalent in the spring, following snow melt, 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).

b. Past Occurrences

According to records from the Vermont Department of Forests, Parks and Recreation, from 1990 to 2010, 156 wildfires were reported in Bennington County. Of these, two occurred in Woodford. One in 1994 (1.5 acres) was due to downed wires and the second (12 acres) was attributed to arson.

c. Extent and Location

The two fires were Class B and C. Low intensity fires with slow rates of spread could occur in forested areas, nearly all of which is in the National Forest, throughout the town, though there may be pockets of heavier fuel loads, such as brush, or more flammable fuels, such as cured herbaceous vegetation and shrubs.

d. Probability, Impact and Vulnerability

Natural fire return intervals in most forests in Vermont are greater than 50 years (Malamud et al. 2005), and more likely greater than 200 years, as reported in Landfire data for this area. 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. However, large roadless areas and steep topography can make suppressing wildland fires that do occur very difficult. Settled areas have a low vulnerability to fire.

6. Landslide and Debris Flow

a. 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 12 shows how landslides can be categorized.

Table 12. Landslide and debris flow types. Source: USGS 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.

b. Past Occurrences

All past events would be characterized as "local" in magnitude using Table 12. Rockfall hazards have been identified on Vermont Route 9 in Woodford (Eliason and Springston 2007). The categories in that report are:

A (High) = Rockfall is expected to occur and reach roadway,
B+ (Significant) = Rockfall is likely to occur and reach roadway,
B (Elevated) = Rockfall is possible at this location and may reach roadway,
B- (Moderate) = Rockfall is unlikely to occur, however there is a slight chance if rockfalls do occur rock may reach roadway,
C (Low) = Rockfall potential is not likely to occur.

Two cuts were categorized as "A" and a third as B+. These could present hazards to traffic, and significant rock falls might block traffic on Route 9. In some cases, where the road turns, steep areas also limit visibility (Map 7). BCRC staff mapped twelve post-Irene landslides, all less than one acre in area. These are generally located along streams and are contributing debris to those streams (Map 7).

Areas of steep topography that might be subject to landslide or debris flow are in the high elevation areas, away from roads and development. There are no reports of damage from these kinds of events.

c. Extent and Location

All of the mapped landslides would be categorized as localized. Map 8 shows the locations of mapped rockfall hazards and landslides.

d. Probability, Impact and Vulnerability

Occurrences of rockfalls and landslides are difficult to predict. The locations indicate the steep, rocky outcrops along Route 9 and sections along streams as the most likely areas of future occurrences. Impacts could range from closing of Route 9 to increase debris in streams, altering flows and fluvial erosion hazard downstream.

7. Earthquake

a. Description

Vermont has no active faults, but has experienced minor earthquakes. Table 13 below shows the most recent occurring within the state, though there have been others, located outside, 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).

b. Past Occurrences

Table 13. Earthquakes in Vermont. Source: Vermont Geological Survey: 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

c. Extent and Location

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 to Woodford (Kim 2003).

d. Probability, Impact and Vulnerability

Based on the 2003 HAZUS analyses, both the probability and impact of an earthquake of a magnitude that could potentially occur in Vermont are low. However, earthquake prediction science is very limited.

B. Vulnerability Assessment

The vulnerability assessment combines the results of data from the National Climate Data Center, the Vermont Department of Forests and Parks and local knowledge. Tables 14 and 15 show frequency and severity definitions from Vermont Emergency Management.

Table 14 Hazard frequency. Source VEM 2010.

Frequency	Occurrence in Vermont	Annual Probability
Rare	May never have occurred	1% or less
Very low	Has occurred	1% to 4%
Low	Has occurred	4% to 10%
Occasional	Occurs occasionally	10% to 50%
Frequent	Occurs often, but degree varies	50% or more

Table 15. Severity definitions. Source: VEM 2010

Proportion of Properties Damaged	Loss of facilities/services	Injuries	Response
< 10%	Minimal	Minimal	Local
10% to < 25%	Up to 7 days	<=1%	State resources needed
25% to 50%	7-14 days	1-10% and few deaths	Federal resources possibly needed
>50%	>14 days	>10% and multiple deaths	Federal resources required

The Planning Team assessed each of the natural hazards described in Section B above, including potential damage, loss of services and vulnerability. The results are shown in Table 16.

Table 16. Vulnerability assessment for the Town of Woodford.

Hazard	Date/Event (# events)	Recurrence Interval	Proportion of town damaged	Injuries/ deaths	Loss of facilities/services	Vulnerability Facilities/Populations
Flood/Flash Flood	1927 1987 1996 (2) 1998 1999 2000 (3) 2003 2007 2011 (2)	Occasional; spring floods occur after ice melts	<10%	1-10%	Minimal to seven days. Roads may become impassable and power outages in some areas	Primarily adjacent to the Walloomsac Brook (Route 9) downstream of Bolles Brook, along Bolles Brook (Harbour Rd). and Dunville Hollow. Some areas may be isolated. Damage to area roads was significant during Irene. Water to Bennington and travel east on Route 9 are vulnerable
Winter storm (snow and ice)	1987 (Oct) 1993 (4) 1995 (2) 1996 2005 2007 (3) 2008 (3) 2010 (3) 2011 (Oct)	Frequent (annual) in winter months	<10%	1-10% primarily traffic accidents	Minimal to seven days with some areas impassable and power outages in some areas	Entire town, though higher elevations may be affected more frequently. East-west transportation on Route 9 may be limited or even impossible
Wind Event	1995 1997 1998 2002 2008 2009 2010 2011 (2)	Occasional to Frequent	<10%	<=1%	Minimal for the entire town, but may be significant in localized areas. Power outages may occur.	Harbour Rd. area impacted. Power outages can occur in Woodford City. Lightening may also cause power outages
Drought	1980 1981 1987 1988 1989 1995 1999 2001 2002	Low to occasional	<10%	<=1%	Minimal but water could be unavailable for significant lengths of time.	Homes with shallow wells lose water
Wildfire	1994 1998	Rare	<10%	<=1%	Minimal	Likely confined to the National Forest
Earthquake	2011	Rare	<10%	<=1%, but larger in a significant earthquake	Minimal	No specific areas
Landslide/Debris Flow	Small scale events along Route 9 Several small post-Irene slides	Very low	<10%	<=1%, but traffic accidents possible	Minimal depending on scale and ability to remove material	Areas along Route 9 could result in accidents or the blocking of Route 9.

V. Mitigation Programs

Goals were developed based on existing plans as well as the above review of potential natural hazards.

A. Review of Existing Plans that Support Hazard Mitigation

1. Town of Draft Woodford Plan

The Planning Commission has been working for over a year on a draft of the town plan that is a complete review and revision of the current plan. This plan is in the public review stage. Policies in the draft Town Plan that support hazard mitigation include:

a. Maintaining low density in areas above 2,000 feet in elevation (page 35).
b. Development or filling in the floodplain should comply with accepted standards and should not be allowed in the floodway (page 35).
c. Protect the natural state of streams by maintaining vegetation and other measures to avoid streamside erosion (page 36).
d. Development should maintain a level of density compatible with land suitability (page 45).
e. Emphasis should be on the maintenance of the existing town roads and bridges rather than adding new road mileage. In lieu of established minimum Woodford town road and bridge standards, private roads or bridges should meet the most commonly used town standards to ensure safe passage of emergency vehicles. Forest Service roads should be properly managed and maintained for their intended purpose including provision for fire access and control (page 54).
f. Safety is a primary concern for the management and maintenance of Route 9. In addition to surface management (paving & shoulders), consideration should be given to improvements along the several sections having poor sufficiency ratings. Advance warning, patrolling and surface maintenance along Route 9 is especially important during inclement weather conditions (page 54).
g. Encourage the provision of safe, decent and affordable housing for Woodford's residents (page 61).

2. Bennington Regional Plan Policies and Actions (adopted May 17, 2007)

The Bennington Regional Plan lists the following policies and actions supporting hazard mitigation:

a. Intensive development should be directed to areas where physical conditions such as elevation, slope, and soils are most capable of supporting such development. (p. 13).
b. Growth should be restricted in areas of high elevation, steep slopes, or poor soils where environmental damage is likely to occur as a result of development. Special attention must be given to the need to prevent soil erosion, contamination of surface and ground water, and degradation of natural ecological communities in these areas (p. 13).
c. Development in floodplains must be carefully controlled in accordance with flood hazard are regulations. Development is strongly discouraged in flood hazard areas (p. 48).
d. Aquifers and ground water recharge areas (including all designated source protection areas) must be protected from activities or development that would adversely affect the quantity or quality of available ground water. Municipal subdivision and health ordinances and the regulations of the Vermont Agency of Natural Resources must be strictly enforced to protect individual water supplies (p. 48).
e. The surface waters of the Bennington region are extraordinarily valuable natural resources that must be protected from incompatible development and land uses. The natural characteristics and values of these resources should be preserved. An undisturbed buffer of at least 50 feet in width should be maintained, wherever possible, between any developed area and a river, stream, lake, pond, or wetland to ensure that water quality and natural ecosystems are protected. Greater buffer distances often will be required depending on the nature of the land and affected waterway (p. 47).
f. New roads, driveways, and drainage systems should be designed, constructed, and maintained in accordance with the municipal subdivision regulations, street standards, and other local and state requirements (p. 75).

3. State of Vermont Hazard Mitigation Plan (2007)

The State Hazard Mitigation Plan describes fifteen planning assumptions (p. 12) that include the following:

a. Although the majority of disasters in Vermont are managed locally, a disaster will occur with little or no warning, and will escalate to exceed the response capability of any single local authority or responding organization.
b. Achieving and maintaining effective individual and community preparedness is the first line of defense against disasters and can reduce the immediate stress on response organizations. This level of preparedness requires continual public awareness and education to ensure residents and businesses take precautions to reduce their emergency vulnerability, especially during and immediately after disaster impact.
c. Local officials involved in emergency management initiate actions that save lives and protect property and the environment while maintaining direction and control of resources within their areas based on procedures outlined in a local Emergency Operations Plan (EOP).

B. Mitigation Goals

The Town identified the following mitigation goals:

1. Significantly reduce injury and loss of life resulting from natural disasters.
2. Significantly reduce damage to public infrastructure, minimize disruption to the road network and maintain both normal and emergency access.
3. 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. Significantly reduce the economic impacts incurred by municipal, residential, industrial, agricultural and commercial establishments due to disasters.
6. Encourage hazard mitigation planning to be incorporated into other community planning projects, such as Town Plan, Capital Improvement Plan, and Town Basic Emergency Operation Plan
7. Ensure that members of the general public continue to be part of the hazard mitigation planning process.

C. Current Programs

Vermont, municipalities have the authority to regulate development in flood hazard areas under 24 Vermont Statues Annotated (VSA), Chapter 91. Under 10 VSA, Chapter 32, the Secretary of the Agency of Environmental Conservation has the authority to designate flood hazard areas and to assist the towns with flood hazard regulations. Woodford participates in the National Flood Insurance Program (NFIP) and has bylaws in place to implement that program. This program is overseen by the Town Zoning Administrator. There are currently five policies in the Town for a total coverage of $1.151 million.

The Town bylaws will be reviewed and amended to reflect changes in the flood insurance maps prepared by FEMA. The current FIRM is dated September 18, 1985. More recently, DFIRM maps have been developed using LIDAR, a technology that can be used to develop highly accurate elevations and, thereby, predict potential flood elevations from different storm events (FEMA 2010).

The draft town plan also recommends incorporating a fluvial erosion hazard zone. This zone was delineated in 2008. Currently, the town is working with the Bennington County Conservation District to complete a river corridor plan (BCCD 2012) that will be developed in 2012 and 2013. This plan will also assess damage from Tropical Storm Irene and identify needed river restoration priorities.

Critical facilities such as the Town Hall, Woodford Hollow Elementary and others are outside of flood or fluvial erosion hazard zones (Map 8). Other facilities, such as cell towers and electric transmission lines are located, at least in part, in remote areas where repairs following a storm, may take some time to complete. Maintenance of dams is the responsibility of the owners of those dams. The Town will work with the owners and with safety inspectors to assure that dams are adequately maintained.

The Select Board has the authority to levy taxes and pass local laws and ordinances for the protection of public health, safety and welfare. A member of the Town Select Board serves as the Road Foreman, and the Town uses contractors to perform necessary road work. The Town has adopted the state road standards. This provides for hydraulic studies by the Agency of Transportation to specify the necessary sizes of culverts to handle storm flows. The Town has an active program to maintain roads and bridges and has completed over $400,000 in repairs that resulted from Tropical Storm Irene. An assessment of culverts to be completed by the Bennington County Regional Commission will provide data on any additional repairs or mitigation measures.

The Town can use the Woodford Hollow School as a shelter, though some improvements are necessary. The Town is interested in working with Prospect Mountain and adjacent Greenwood Lodge and Campsites to use their facilities as emergency shelters. Since Green Mountain National Forest encompasses most of the town, cooperative work with the U.S. Forest Service will be needed during certain disasters. Route 9 is a significant

transportation corridor, and the Town plans to work with the Vermont Agency of Transportation to prioritize needed work along that road to address safety concerns.

D. Mitigation Projects

Table 17 below lists mitigation actions for each of those hazards. Some will be implemented by the Town of Woodford and others by agencies such as the Vermont Agency of Transportation. Mitigation actions are listed by the type of hazard. The following criteria were 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:

1. The overall assessment of the potential damage from a given hazard.
2. Whether the proposed action reduce potential damage from the hazard.
3. Consistency of the proposed action consistent with the goals of the town.
4. Whether the action could be implemented within the specified time frame.
5. Whether the proposed action was technically feasible.
6. Whether the action could be implemented to reduce potential damage at a reasonable economic cost while avoiding or mitigating potential impacts to natural, cultural, social and economic resources?

The following projects were given high priority as they met all of the above criteria:

- Acquisition of properties potentially threatened by flooding along Route 9 (Woodford Hollow) and along Harbor Road to reduce risk from future events
- An assessment of culverts and upgrading of specific culverts following hydraulic studies
- Armoring and resizing bridges along Harbor and Notch Roads
- Completion of a river corridor plan to map fluvial hazard zones
- Investigate using Prospect Ski Resort and Greenwood Lodge as potential emergency shelters
- Upgrade Woodford Hollow School to serve as a shelter

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 17. Mitigation actions						
Hazard	*Preparedness or Mitigation*	*Action*	*Responsible Party*	*Time Frame*	*Funding Source(s)*	*Priority*
All Hazards	*Preparedness*	*Reopen Dunville Hollow Road to provide access to private lands, Green Mountain National Forest and emergency access*	*Town of Woodford*	*1 year*	*Town of Woodford FEMA*	*High*
All Hazards	*Mitigation*	*Provide educational materials for landowners on NFIP, proper construction techniques, and utility maintenance to reduce damage from storms*	*Town of Woodford*	*1 year*	*Town of Woodford*	*High*
All Hazards	*Preparedness*	*Distribute materials from VEM and other sources to residents on preparing for emergencies.*	*Town of Woodford*	*1 year*	*Town of Woodford*	*High*
Flood/Flash Flood Wind Event	*Mitigation*	*Educate landowners of the necessity of securing propane tanks, boats, outbuildings, mobile homes and other similar items and structures from wind and flood*	*Town of Woodford*	*1 year*	*Town of Woodford*	*Medium*
Flood/Flash Flood	*Mitigation*	*Armor or resize bridges along Harbour Rd.*	*Town of Woodford*	*1 year*	*Town of Woodford FEMA*	*High*

Table 17. Mitigation actions						
Hazard	*Preparedness or Mitigation*	*Action*	*Responsible Party*	*Time Frame*	*Funding Source(s)*	*Priority*
Flood/Flash Flood	*Mitigation*	*Armor or resize bridge on Notch Rd.*	*Town of Woodford*	*1 year*	*Town of Woodford FEMA*	*High*
Flood/Flash Flood	*Mitigation*	*Complete an assessment of culverts and their condition*	*Town of Woodford Bennington County Regional Commission*	*1 year*	*BCRC*	*High*
Flood/Flash Flood	*Mitigation*	*Complete Woodford River Corridor Plan to map fluvial hazard zones (including flood chutes) and to identify potential future impacts and mitigation measures*	*Bennington County Conservation District VT DEC*	*1 year*	*BCCD; VT DEC*	*High*
Flood/Flash Flood	*Mitigation*	*Following the assessment identify other lands that need to be acquired to avoid future flood damage*	*Town of Woodford*	*2-3 years*	*FEMA*	*High*
Flood/Flash Flood	*Mitigation*	*Identify and replace culverts, based on necessary hydraulic studies, along town roads.*	*Town of Woodford*	*1 -3 years*	*Town of Woodford FEMA*	*Medium to high*
Landslide/Debris Flow	*Mitigation*	*Reduce potential for rock falls at sites identified by AOT by cutting back slope and reducing loose rock*	*AOT*	*2-5 years*	*AOT*	*Medium*

Table 17. Mitigation actions						
Hazard	*Preparedness or Mitigation*	*Action*	*Responsible Party*	*Time Frame*	*Funding Source(s)*	*Priority*
Landslide/Debris Flow	*Mitigation*	*Assess slides mapped by BCRC and develop necessary mitigation measures*	*VT DEC Rivers Program*	*1 year*	*VT DEC Rivers Program Natural Resources Conservation Service*	*High*
Winter Storm/All Hazards	*Mitigation*	*Improve runaway truck ramp to improve safety following investigation of design alternatives*	*AOT*	*2-5 years*	*AOT*	*Medium*
Winter Storm/Wind Storm	*Mitigation*	*Put power lines underground from main lines to buildings for the town hall and Woodford Elementary*	*Town of Woodford*	*2-5 years*	*Town of Woodford FEMA*	*Medium*
Winter Storm/All Hazards	*Preparedness*	*Work with private landowners, including Greenwood Lodge and Prospect Ski Resort to establish emergency shelters*	*Town of Woodford*	*1-3 years*	*Town of Woodford*	*High*
Winter Storm/All Hazards	*Preparedness*	*Improve Woodford Hollow School to serve as an emergency shelter*	*Town of Woodford*	*1 year*	*Town of Woodford Red Cross*	*High*
Wind Event	*Preparedness*	*Work with utility companies to prioritize vegetation clearing on vulnerable lines*	*CVPS*	*1 year*	*Utility companies*	*Medium*

Table 17. Mitigation actions

Hazard	*Preparedness or Mitigation*	*Action*	*Responsible Party*	*Time Frame*	*Funding Source(s)*	*Priority*
Drought	*Preparedness*	*Identify properties with shallow wells*	*Town of Woodford*	*1 year*	*Town of Woodford*	*Medium*
Wildfire/Drought	*Preparedness*	*Work with US Forest Service to identify areas of significant fuel loads near structures*	*Town of Woodford* *US Forest Service*	*1-2 ears*	*US Forest Service* *VT Department of Forests, Parks and Recreation*	*Low*
Wildfire/Drought	*Mitigation*	*Educate property owners to reduce hazardous fuel loads near structures and to establish maintained defensible space zones where necessary*	*Property Owners* *Town of Woodford* *US Forest Service*	*1-3 years*	*FEMA* *Property Owners* *US Forest Service* *Town of Woodford*	*Low*
Earthquake	*Mitigation*	*Educate property owners on proper construction techniques to reduce potential damage from earthquakes*	*Town of Woodford*	*2-4 years*	*Town of Woodford*	*Low*

E. Monitoring and Revising This Plan

1. Annual Review

This plan will be integrated into existing planning efforts when appropriate. During the annual budget process, the status of proposed projects as well as any newly identified projects will be reviewed by the Select Board. If necessary, the plan will be amended to include these new projects. During Town Meeting Day, members of the public will be afforded the opportunity to comment on the status of any projects and on any needed changes to the hazard mitigation plan.

Toward the end of the five year period covered by this plan, the Select Board will initiate a review of the plan, by:

1. Updating the analyses of events using new information since completion of the 2012 draft
2. Identification of any new structures
3. Evaluation of potential probability and extent of hazards based on any new information since completion of the 2012 plan.
4. Review of completed hazard mitigation projects
5. Identification of new projects given the revised hazard evaluation

The Select Board will hold open meetings to solicit opinions and to identify issues and concerns from members of the public and stakeholders. The Town of Woodford Select Board will work with the Bennington County Regional Commission and the State Hazard Mitigation Officer (SHMO) to review and update their programs, initiatives and projects based on changing local needs and priorities. BCRC will assist in any necessary coordination and communication with neighboring towns to assure that mitigation actions address regional issues of concern. For example, the upcoming Woodford River Corridor Study could provide information of benefit to the Town of Bennington in mitigation planning. 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.

Should a declared disaster occur, Woodford 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 findings of the river corridor plan, culvert study and other studies.

Woodford will work with the Vermont Agency of Transportation to help prioritize projects along Route 9 to mitigate potential damage from flooding, winter storms and landslides. Woodford will also work with Green Mountain National Forest on any road, bridge and culvert projects of mutual concern and benefit.

2. Emergency Operations Plan

Emergency Operation Plans provide contact information and list the steps to setting up an incident command structure, assessing risks and vulnerabilities, and providing for resources and support. These plans also allow for documenting the steps used to address an incident. Woodford needs to develop a plan in 2012 and update that plan annually.

VI. References and Sources of Information

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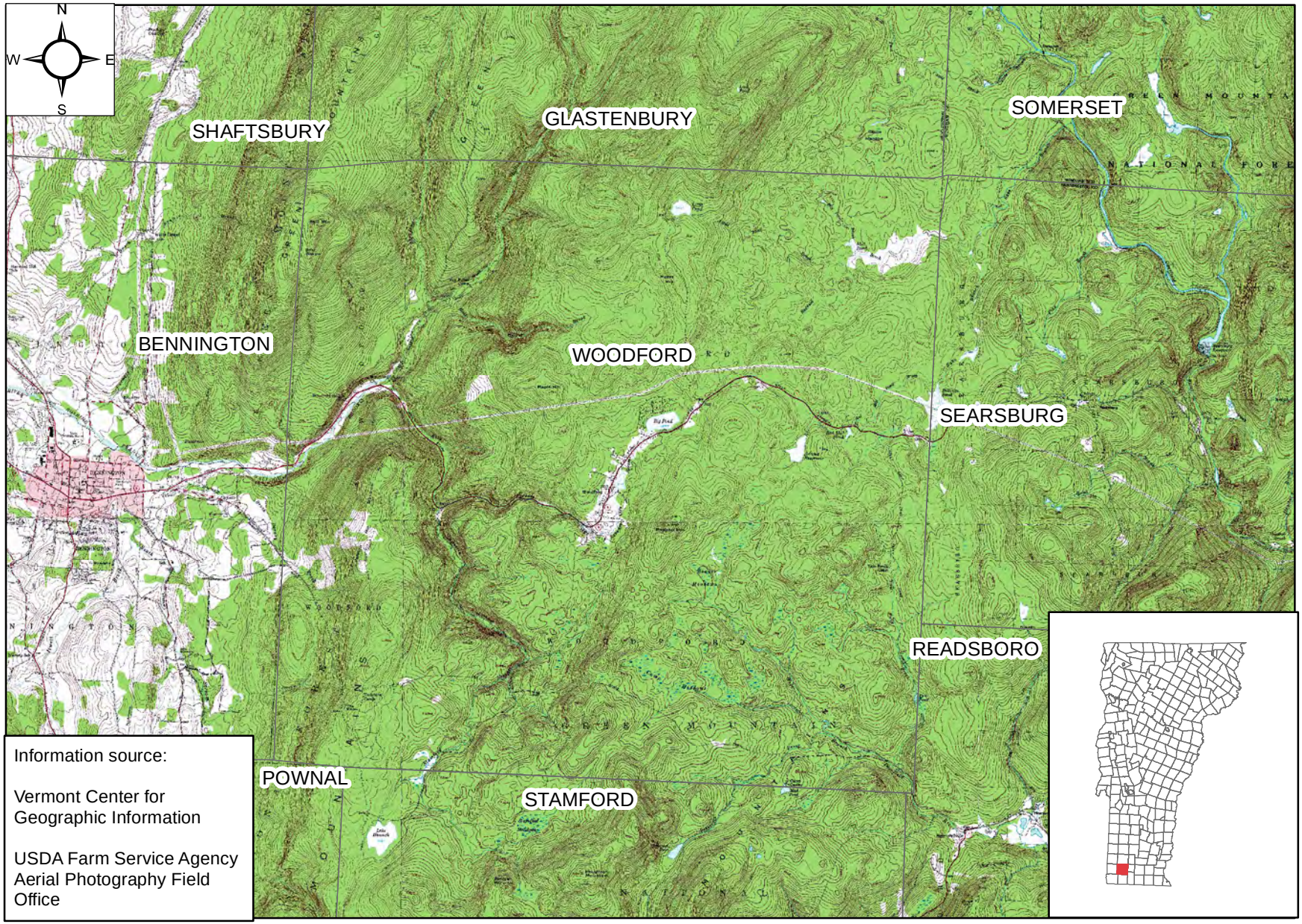
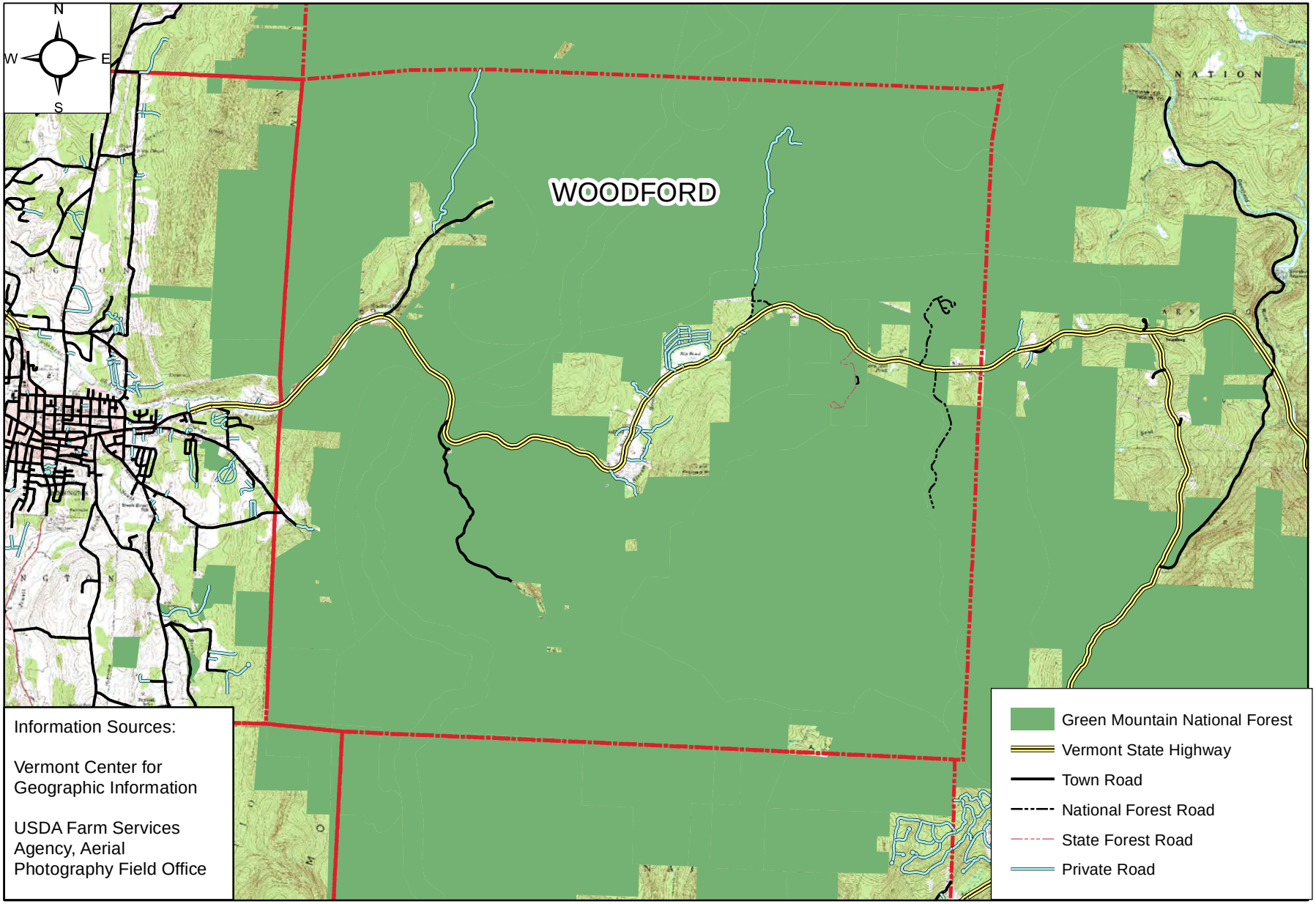
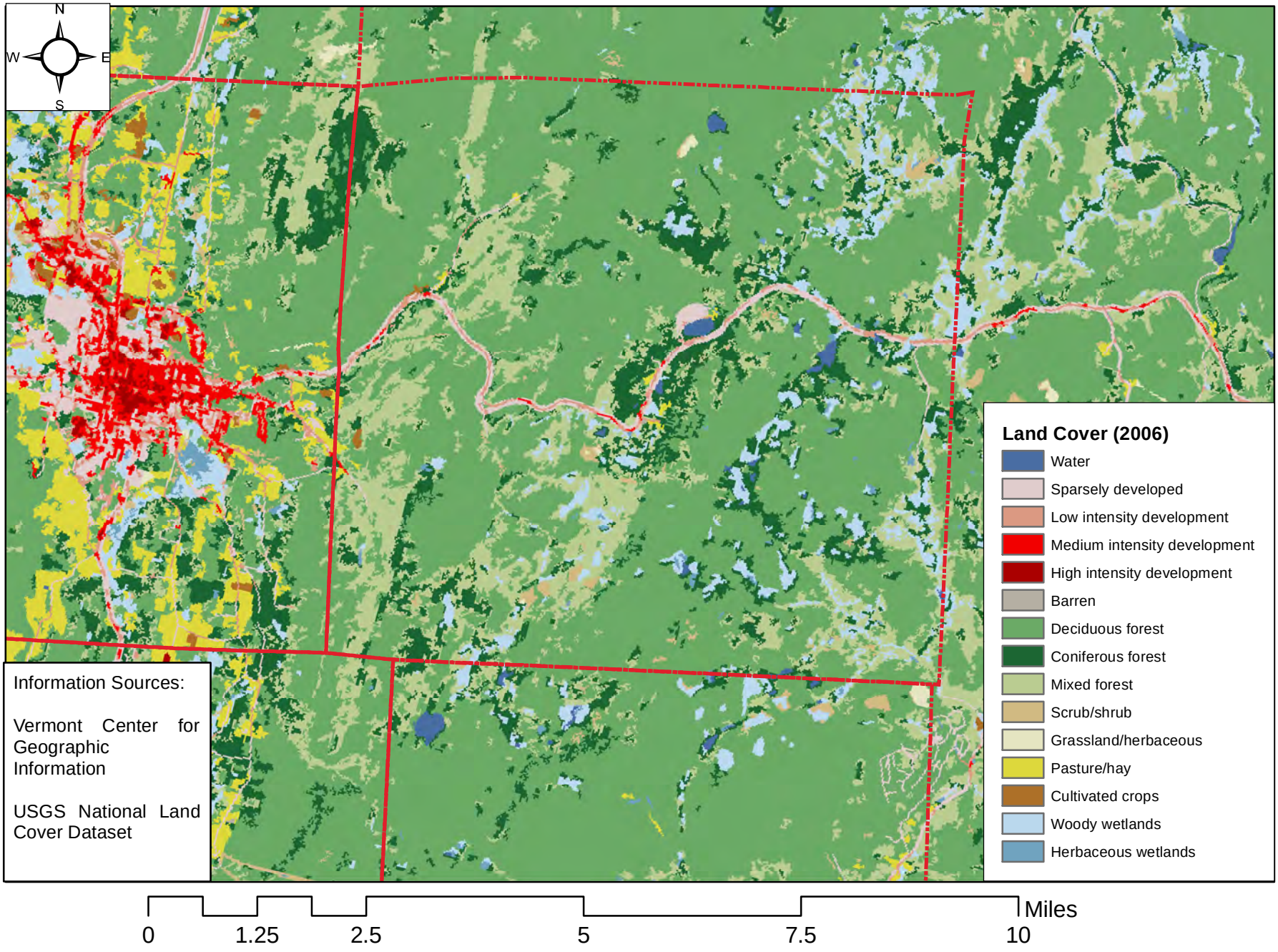
Map 1. Town of Woodford



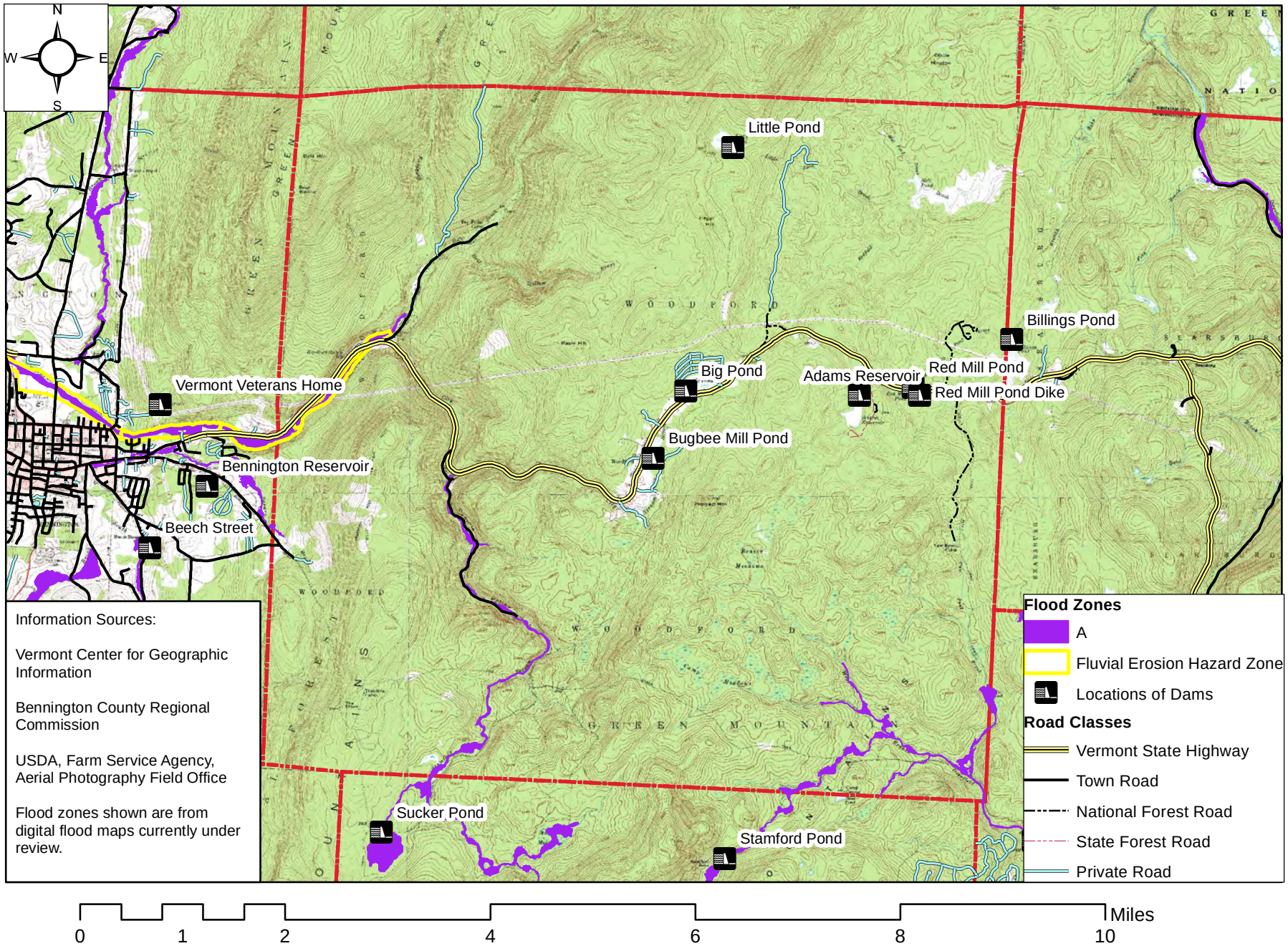
Map 2. Green Mountain National Forest



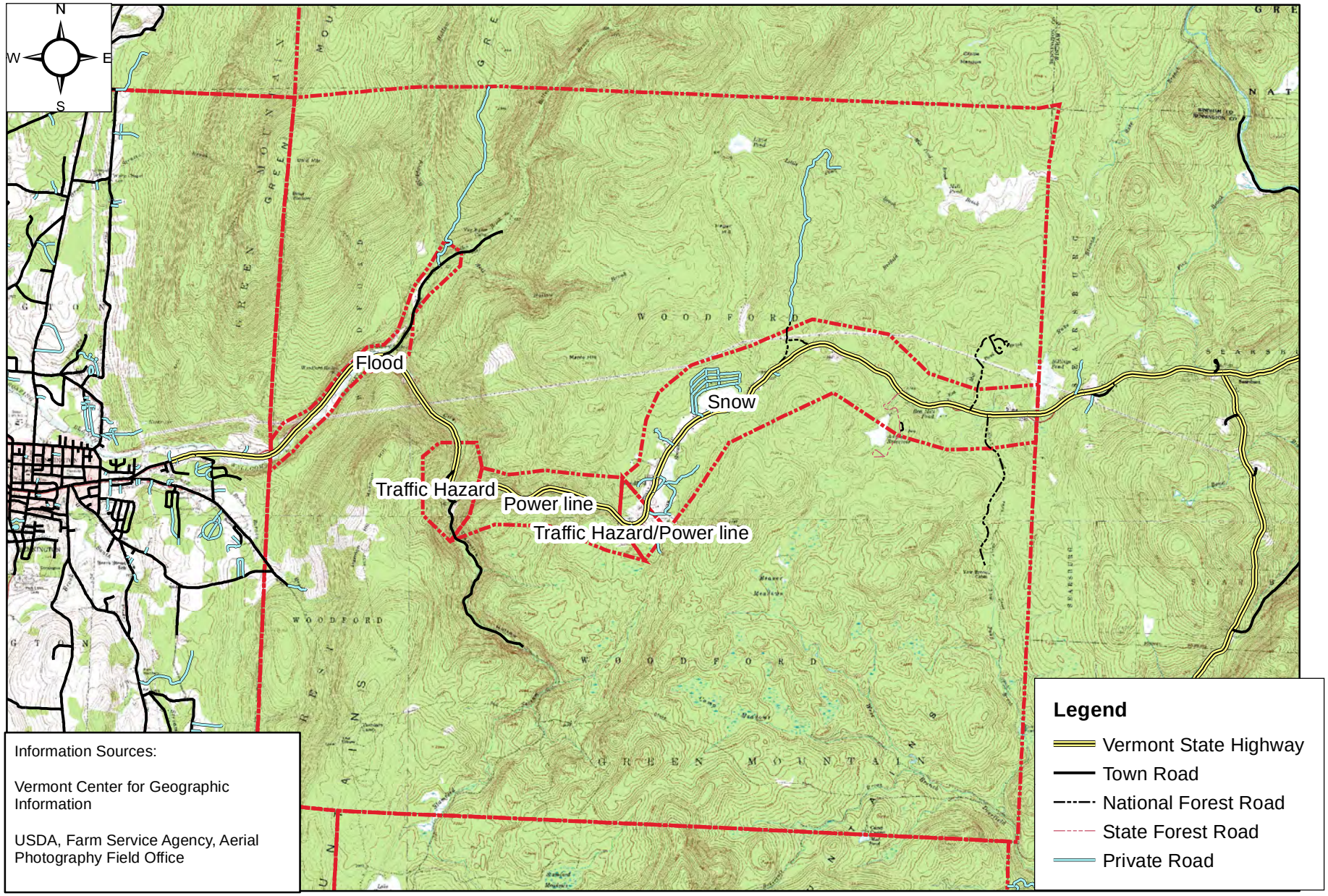
Map 3. Land Cover



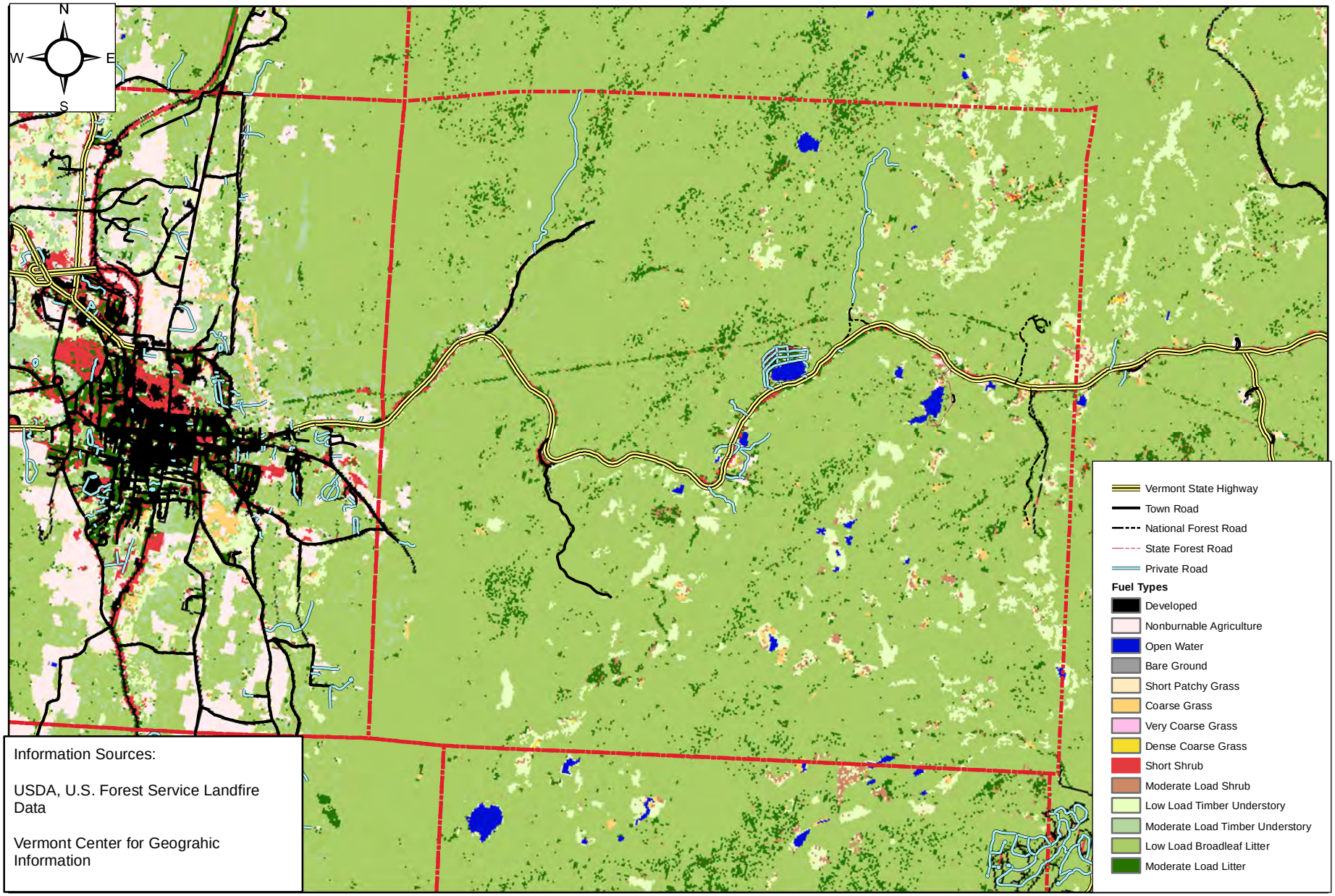
Map 4 Flood Zones



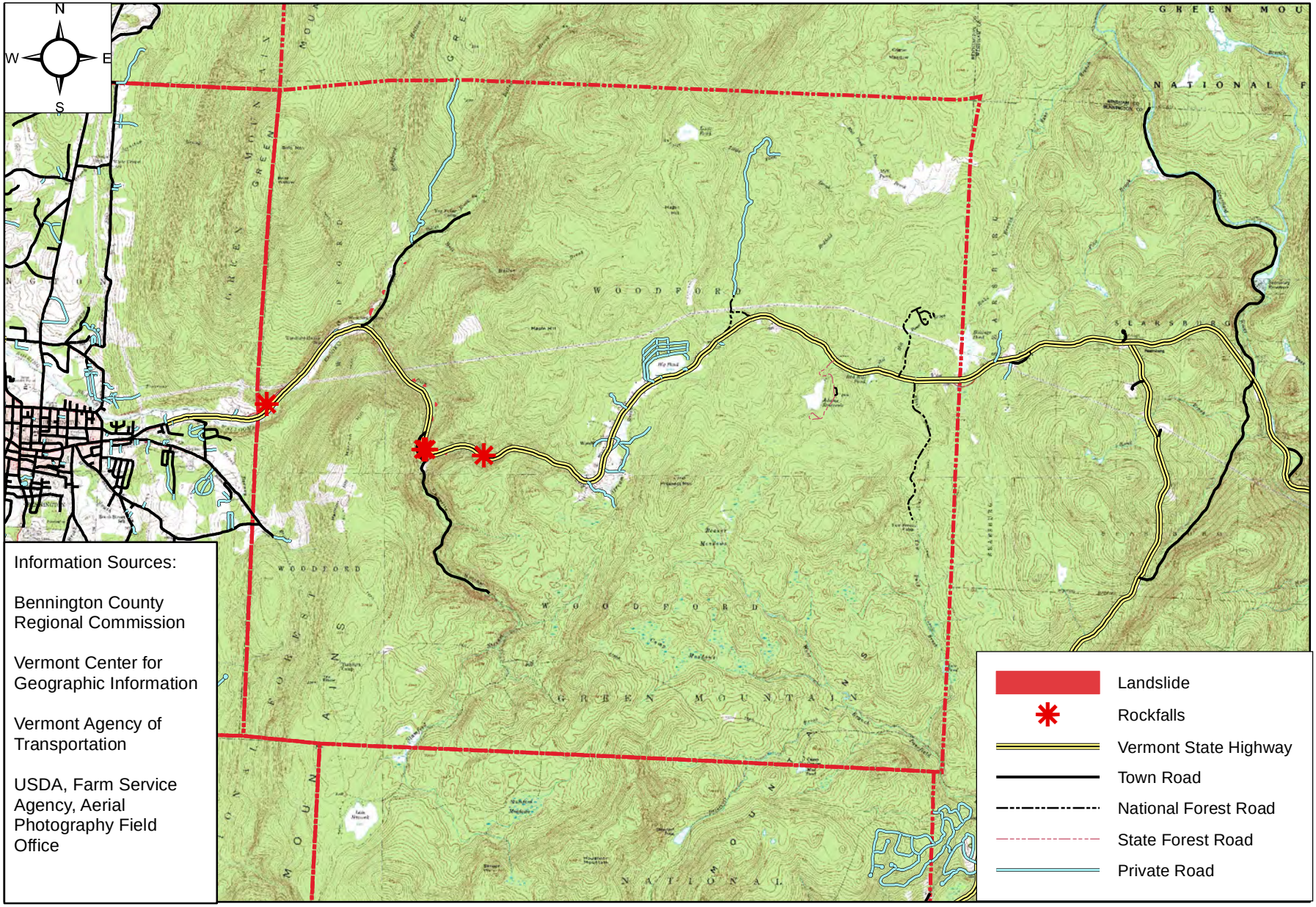
Map 5. Hazard Zones



Map 6. Wildland Fuel Types



Map 7. Rockfalls and Landslides



Map 8. Critical Facilities