Town of Dorset
DRAFT Hazard Mitigation Plan

June 16, 2015

Town of Dorset
PO Box 715
112 Mad Tom Road
East Dorset, VT 05253

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I. Introduction

A. 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 Dorset 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
- Hail
- Temperature Extremes
- Drought
- Wildfire
- Landslides and Debris Flow
- Earthquake
- Hazardous Materials Spill
- Infectious Disease Outbreak
- Invasive Species

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. 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. 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.

Based on the above goals and the assessment of hazards (Section IV), Dorset identified and prioritized mitigation actions which are specifically described in Section V.D.

II. Town Profile

The following is from the recently adopted Dorset Town Plan (2014):

"The Town of Dorset has an area of 30,656 acres or 46.04 square miles, made up of many types of land and waterways: flat valley land, swamps, rolling hills, steep mountains, streams and rivers. 14,228 acres contain slopes in excess of 20%, and 2,880 acres have elevations above 2,500 feet.[1]

The physiography of the Town may be described as two roughly north-south valleys, which contain most of Dorset's development, together with parts of three north-south mountainous areas, which define the valleys.

The eastern edge of the Town runs along the western slope of the Green Mountains. The southwestern corner of the Town occupies the northeastern slope of Mother Myrick Mountain, in the Taconic Mountain Range. Thrusting into Dorset from the north is a mountainous area, also part of the Taconic Range, extending south from Dorset Mountain, whose summit, close to the northern town line, is over 3800 feet above sea level. A spine, between 2000' and 2500' high lies between Dorset Mountain and Mount Aeolus (also called Green Peak) about five miles to the south. Land falls southerly from Mount Aeolus to become rolling land extending south to the town line.

Between the Green Mountains and the Taconics lies the well-defined and rather narrow Vermont Valley, which is Dorset's eastern valley, and is known in transportation terms as the

[1] See Map 1

‘’Route 7 corridor.’’ The southern portion of this valley is drained by the Batten Kill, which flows mostly west to the Hudson River. The northern portion of the valley is drained by the Otter Creek, which flows northerly to Lake Champlain. The divide between the two watersheds lies a short distance north of the village of East Dorset. The easterly valley contains the villages of East Dorset, South Village of East Dorset, and the cluster of houses known as North Dorset.

The westerly valley extends diagonally from approximately the midpoint of the southern town line to the midpoint of the western town line. This is the "Route 30 corridor." This valley also drains in two directions, with the watershed divide constituting a Class I wetland, known as the Dorset Marsh, southwest of Dorset Village. Towards the southeast, this drains into a branch of the Batten Kill; towards the northwest the flow is into the Mettawee River, which, like the Otter, flows into Lake Champlain. This westerly valley contains the villages of Dorset and South Dorset.

A subordinate valley, known as Dorset Hollow, is located east of Dorset Village. This valley contains considerable acreage of rolling land, and also the headwaters of the Mettawee River.”

The Town is bordered by Danby on the north, Manchester on the south, Peru on the east and Rupert on the West (Map 1). According to the 2010 U.S. Census, the population of Dorset is 2,031 persons in 235 households. These are mostly year-round residents, but the figures do include some seasonal residents. Most of Dorset is forested, consisting primarily of northern hardwood forests but also of conifer forests, generally at higher elevations (Map 2). The geography of the Town divides it roughly into two development axes, both of which radiate out from the larger urban center of Manchester to the south. Table 1 below shows the number of structures by type in Dorset.

Table 1. Number of buildings by type. Source: VCGIS 2014 E911 data

Type	Number
Single-family residential	1144
Mobile home	25
Multi-family	29
Seasonal home	64
Other residential	29
Commercial/Industrial	89
Lodging	18
Camp	52
Government	6
Fire station	2
Education	2
Library	1
House of Worship/Public gathering	5
Health clinic	1

Table 1. Number of buildings by type. Source: VCGIS 2014 E911 data	
Type	Number
Utility	4
Other	38
Total	1509

III. Planning Process

The Bennington County Regional Commission began discussions with the Town on developing a hazard mitigation plan in 2012. The Dorset Select Board decided to initiate planning in July of 2014. This is the first stand-alone hazard mitigation plan for Dorset, though Dorset was part of a multi-jurisdictional plan that expired in 2010. The planning team consisted of members listed in Table 2 below

Table 2. Planning committee members	
Name	Affiliation
Chris Brooks	Select Board Chair
Michael Conners	Select Board
Michael Oltedal	Select Board
Ryan Downey	Select Board
Steven Jones	Select Board
Danny Pinsonault	Planning Commission
Rob Gaiotti	Town Manager
Jim Hewes	Road Foreman

Table 3. Dates of planning meetings and public and agency review	
Meeting	Date(s)
Select Board initiates planning process	8-19-2014
Planning committee organization meeting	8-19-2014
Planning committee meetings	9-16-2014 10-21-2014 11-18-2014 12-16-2014
Draft made available for public and agency review by the planning committee	10-21-2014 11-18-2014 12-16-2014
Select Board approved the plan for release	12-16-2014
Redraft of plan again made available for public and agency review	1-20-2015
Select Board meeting and vote to send to FEMA	1-20-2015

The above meetings were warned and comments were solicited from members of the public, business owners and other stakeholders. The draft plan was put online on the Bennington County Regional Commission and Town of Dorset websites, and notices sent out to members of the public informing them that they could review the plan on those websites or in the Town Hall in Dorset, VT.

Comments and information on the draft plan were also solicited from the Town Road Foreman and volunteer fire personnel and a meeting was held by the Select Board to solicit comments from the public. The plan was also sent to the neighboring towns of Danby, Peru, Manchester and Rupert, and to Local Emergency Planning Committee #7, which includes Dorset, for comment. The plan was also reviewed by the Vermont Department of Emergency Management and Homeland Security. No comments were received by other agencies or communities.

The plan was submitted for review by the Federal Emergency Management Agency on _______. Following FEMA review, the Town Select Board adopted the plan on ___________.

IV. Hazard Analysis

A. Hazard Assessment

This section addresses each of the potential natural hazards based on data from the following sources:

a. Local knowledge
b. The National Climate Center 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. The Pownal and North Adams cooperative weather stations have data and temperature and precipitation normals from 1981 to 2010
g. Palmer Hydrologic Drought Index calculated from 1985 to 2014 from NOAA
h. Hazardous materials spills from VT ANR
i. Infectious disease outbreaks listed from the Vermont Department of Health (note these fluctuate, so only recent data are used)
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. FEMA 2010 Flood Insurance Study, Bennington County, Vermont and Incorporated areas, Federal Emergency Management Agency Study Number 5003CV000A

n. National Weather Service 2014. Advanced Hydrologic Prediction Service, stream gauge information for the Hoosic River near Williamstown, MA. Available via: http://water.weather.gov/ahps2/hydrograph.php?wfo=aly&gage=wilm3
o. SHELDUS records which were not as complete as NCDC and, therefore, not used.
p. Vermont Agency of Natural Resources and Vermont Agency of Agriculture, Food and Markets on invasive species.

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 less 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 is available from the North Adams, MA observer. The only stream gauge is in Bennington near the New York border.

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 as yet as far as we know. We looked at the USGS high water marks for Irene (Medalie and Olson 2013), but they were located only along the Batten Kill in Arlington and portions of the Roaring Branch and Walloomsac in Bennington; none were in Dorset. Therefore, we relied on the updated special flood hazard maps for potential flooding extent.

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 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 Dorset. 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 have been prepared and are currently under review. Map 3 shows the location of both flood hazard zones and river corridors (formerly fluvial erosion hazard zones).

Most development in Dorset is located in the valleys along the Batten Kill, Otter Creek and The Mettawee River. As headwaters, 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. Fluvial erosion can range from gradual bank erosion to catastrophic changes in the location of the river channel (Vermont River Management Program 2010).

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 shows a total of 49 flood events in Bennington County from 1990 to 2013, 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 4. Total number of flood events by type and year for Bennington County. Source: NCDC 2012			
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			
2007	1	1	2
2008			
2009	2		2
2010			
2011	3	3	6
2012			
2013	4		4
2014			
Total	22	27	49

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. Dorset has been subjected to two major tropical storms in the past twenty years.

Table 5 describes nine moderate and extreme events that have occurred since 1990, using the National Weather Service (2010) categories, which likely affected Dorset. These events were described in the National Climate Database records (2012). 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 2012					
Dates	Type	Description	Area	Category	FEMA
19-20 Jan 1996	Flood	An intense area of low produced unseasonably warm temperatures, high dew points and strong winds resulting in rapid melting of one to three feet of snow. 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. A Cooperative Weather Observer recorded 0.94” of rain in Sunderland.	Countywide	Moderate	DR-1101 1/19 to 2/2 1996
11-12 May 1996	Flood	A low pressure system intensified creating a prolonged period of precipitation. Over two inches of rain fell over much of western New England resulting in flooding along the Walloomsac River in Bennington County. A Cooperative Weather Observer recorded 3.5” of rain in Sunderland from May 10-13.	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 eight feet at the Arlington gage, and the Walloomsac River crested nearly two feet above flood stage at Bennington. The main impact was extensive flooding of fields and roadways. Route 7A north of Arlington was closed due to flooding. A Cooperative Weather Observer recorded 3.81” of precipitation in Sunderland from January 5-10.	Arlington; Bennington; Countywide	Moderate	

Table 5. Significant flood events affecting Bennington County. Source: NCDC 2012					
Dates	Type	Description	Area	Category	FEMA
16-17 Sept 1999	Flood	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 4.94” of rain in Sunderland.	Countywide	Moderate	DR-1307 9/16-21 1999
14-17 Jul 2000	Flash Flood	Thunderstorms caused torrential rainfall with flash flooding washing out sections of roadways in northeast Bennington County and southern Bennington County. Routes 7 and 67 were closed. A Cooperative Weather Observer recorded 3.39” of rain in Sunderland.	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 heavy rain, combined with snowmelt and frozen ground, lead to a significant runoff and flooding. A Cooperative Weather Observer recorded 3.38” of precipitation in Sunderland.	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 County. (Note: this event does not appear in the NCDC data.) A Cooperative Weather Observer recorded sporadic and sometimes large amounts of precipitation during that period in Sunderland.			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 snow, sleet and rain which changed to all rain. Liquid equivalent precipitation totals ranged from three to six inches leading to minor flooding across portions of southern Vermont. A Cooperative Weather Observer recorded 3.54 of rain in Sunderland.	Arlington	Minor	DR- 1698 4/15-21 2000
28-29 Aug 2011	Flood/Flash Flood	Tropical Storm Irene produced widespread flooding, and damaging winds across the region. Rainfall amounts averaged four to eight inches and fell within a twelve hour period. A Cooperative Weather Observer recorded 5.16” of rain in Sunderland. 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.	Countywide	Extreme	DR-4022 8/27-2 2011
7 Sept 2011	Flood	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 three to seven inches led to widespread minor to moderate flooding across southern Vermont. A Cooperative Weather Observer recorded 4.63” of rain between September 5th and 9th.	North Bennington; Countywide	Moderate	
29 May 2013	Flash Flood	Thunderstorms with heavy rainfall reached southern Vermont in the evening. Soils in the area were saturated, so the storms created flash floods with some road closures, primarily in the Town of Bennington.	Bennington	Minor	

Table 5. Significant flood events affecting Bennington County. Source: NCDC 2012					
Dates	Type	Description	Area	Category	FEMA
2 June 2013	Flash Flood	Thunderstorms, hail and winds brought heavy rainfall to the town of Bennington. Eight to ten inches of water was reported in downtown Bennington, primarily as a result of stormwater system blockages.	Bennington	Minor	

c. Extent and Location

The primary damages from past events have been from flooding and fluvial erosion with secondary damage from wind. There have been no NFIP-designated repetitive losses within the jurisdiction. There are nine dams within the Town, two of which are designated as having significant hazard potential. 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. Several events of that magnitude have occurred where damage was not recorded in NCDC records or local knowledge, but this does provide additional information on potential flooding extent.

Table 6. Months where rainfall exceeded the 90th percentile of monthly precipitation at the **Peru, Pownal and Sunderland** Cooperative Observer Stations from 1990 to 2013. Years in ***bold italics*** corresponded with events in Table 5.

Sunderland		Pownal	Peru
Month	Year	Year	Year
January	1990, ***1998***, 1999	***1996***, ***1998***, 1999	1990, 1999
February	2002, 2008, 2011	1990, 2008	2000, 2002, 2008
March	2001, 2007, 2008	1999, 2001, 2007	2001, 2008
April	1993, 1996, 2002, ***2007***, 2011	1990, 1993, 1996	1996, ***2007***
May	1990, 2000, 2006	1990, ***2013***	1990, 2012
June	1998, 2002, 2006	1998, 2000, 2002, ***2013***	1998, 2006, 2011, ***2013***
July	1996, 2004, 2008	2004, 2010	1996, ***2000***, 2013
August	1990, ***2003***, ***2011***	1990, 1991, ***2003***, 2011	1990, 2003, ***2011***
September	***1999***, 2003, ***2011***	***1999***, 2004, 2011	***1999***, 2003, ***2011***
October	2005, 2007, 2010	1995, 2003, 2010	1995, 2005, 2006, 2010
November	2002, 2004, 2005	2005	2002
December	1996, 2003, 2008	1990, 2003, 2011	1996

Map 3 shows the following areas potentially affected by flooding:

Special Flood Hazard Areas: these are areas mapped by FEMA and using the LIDAR derived zones currently under review. Table 7 shows the number of structures, by type, in the special flood hazard, fluvial erosion hazard zones and river corridors shown in Map 3.

River Corridors: 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. In In 2014 the Vermont Agency of Natural Resources developed a procedure for flood hazard and river corridor protection, which defines both of those areas, involves towns in protection and management and provides best management practices, including model bylaws for regulating development in those areas. River corridors were determined by calculating the "meander belt width" or area within which a river would move, using information on stream size and adding a buffer component. River corridors will be used in Act 250 review, in stream alteration permits, in activities not regulated by towns and in town ordinances if river corridors are regulated. Mapping of river corridors was accomplished primarily using geospatial data and will be modified by VT ANR river scientists using available field data.

Fluvial Erosion Hazard Zone: These areas were developed prior to the statewide river corridor map through the stream geomorphic assessments involving both geospatial analyses and collection and analysis of field data. In Dorset, this area is regulated in the town bylaw along with the special flood hazard area. The river corridor is not currently regulated.

Table 7. Structures by type in flood hazard zones in Dorset, VT. Source: Vermont Center for Geographic Information www.vcgi.org

Type	Number in special flood hazard zone	Number in fluvial erosion hazard zone	River Corridor
Single-Family	17	8	25
Mobile Home	1	1	1
Seasonal Home	2	6	
Camp		3	
Other Residential	2		
Commercial	4	1	3
Lodging	1		
Government	1		2
Total	28	19	31

Tropical Storm Irene caused ten incidents of significant damage to the road and culverts along Mad Tom Road. Map 4 shows the locations of these damages.

d. Probability, Impact, and Vulnerability

Based on data from 1996 to 2014, nine moderate or major flood events have affected Bennington County, resulting in a 50-60% chance of such an event occurring. However, these have not all directly affected Dorset, so that probability should range from 10 to 50%. Dorset has a total of 1,144 single family residences, 25 mobile homes, 29 multi-family dwellings, 64 seasonal homes, 89 commercial/industrial establishments, 52 camps, 18 lodging establishments and a small number of government, church and school buildings. As shown in Table 7, there are 28 structures in the special flood hazard area, 19 in the fluvial erosion hazard zone and 31 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 would be recovered in less than seven days, though help for specific property owners may take significantly longer.

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. 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. 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 8. Total number of winter storm events by type and year for Bennington County. Source: NCDC 2014

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				2		2
2003				5		5
2004				2		2
2005	1	3		2		6
2006						0
2007		3	1	6	4	14
2008		4	2	1	11	17
2009		3		1	10	14
2010		3		1	2	6
2011				5	5	10
2012				4	2	6
2013		2		1	3	7
2014		2		4		6
Totals	1	27	2	64	41	135

Table 8 summarizes the 135 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, and 2009. 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. Table 9 describes these events.

Table 9. Significant winter storm events in Bennington County and Dorset. Source: NCDC 2014

Dates	Type	Description	Category	Area
13-14 Jan 1993	Heavy Snow	Snowfall amounts across the state ranged from six to sixteen inches. A Cooperative Weather Observer recorded 10.0" in Pownal.	High	Statewide
16-17 Feb 1993	Heavy Snow	Snowfall amounts ranged from 6 to 18". A Cooperative Weather Observer recorded 6.0" in Pownal.	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. A Cooperative Weather Observer recorded 13.0" in Pownal.	Extreme	Statewide
2-4 Mar 1994	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. A Cooperative Weather Observer recorded 8.0" in Pownal.	High	Statewide
4-5 Feb 1995	Heavy Snow	A low pressure system tracked up the east coast on 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. A Cooperative Weather Observer recorded 14.0" in Pownal.	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. A Cooperative Weather Observer recorded 7.0" in Pownal.	High	Southern Vermont
26 Nov 1996	Winter Storm	Snow and freezing rain downed trees and power lines, leaving 10,000 customers without power across southern Vermont.	High	Southern Vermont
7-8 December 1996	Winter Storm	A major storm dumped heavy, wet snow across Bennington and Windham Counties. Approximately 20,000 customers lost power. Cooperative Weather Observers reported 14.5 inches in Pownal and 12.8 inches in Sunderland during the period.	High	Southern Vermont
31 March 1997 to 1 April 1997	Winter Storm	A late season storm that changed from rain to snow brought 12 inches in Shaftsbury, 12 inches in Peru and 23 inches in Bennington. Power outages were widespread, and Route 9 between Bennington and Brattleboro was closed.	High	Southern Vermont, Bennington, Shaftsbury, Peru
29-30 December 1997	Winter Storm	Heavy snow and gusty winds caused power outages across southern Vermont. Route 7 in Bennington County was closed and there was damage to a mobile home park and cinema in Bennington.	High	Southern Vermont, Bennington, Peru
14-15 January 1999	Winter Storm	Snow, followed by sleet and freezing rain, along with very cold conditions resulted in heavy accumulations.	High	Bennington County, Dorset
18-19 February 2000	Winter Storm	Eight to fourteen inches of snow fell in Bennington and Windham Counties. 14.3 inches were recorded in Peru.	High	Southern Vermont, Peru
30-31 December 2000	Winter Storm	6-12 inches of snow fell, with 13 inches recorded in Pownal and 8 inches in Bennington.	Moderate	Southern Vermont
5 February 2001	Winter Storm	Heavy snow fell resulting in 12 inches in Bennington, 14 inches in Pownal Center and 9.6 inches in Sunderland.	Moderate	Southern Vermont
5-6 Mar 2001	Winter Storm	This was considered the largest storm since the Blizzard of '93 with two feet of snow in some areas. Cooperative Weather Observers measured 20.0 inches in Peru, 25.0 inches in Pownal and 18.1 inches in Sunderland.	High	Southern Vermont, Pownal, Peru

Table 9. Significant winter storm events in Bennington County and Dorset. Source: NCDC 2014

Dates	Type	Description	Category	Area
30-31 March 2001	Winter Storm	Heavy wet snow resulted in 9.8 inches in Sunderland and 15.0 inches in Peru while Windham County had similar amounts.	High	Southern Vermont, Sunderland , Peru
6-7 January 2002	Winter Storm	A snowstorm produced over a foot of snow across southern Vermont with 17 inches recorded in Peru, 15 inches in Pownal and 14 inches in Sunderland by Cooperative Weather Observers.	High	Southern Vermont, Pownal
17 November 2002	Winter Storm	A storm started with 2-4 inches of snow but changed to freezing rain and gusty winds. There were power outages from Arlington into New York.	High	Southern Vermont, Arlington
25-26 December 2002	Winter Storm	Snow fell at a rate of 1-3 inches/hour for a time with 16.2 inches in Sunderland, 10.5 inches in Pownal and 16.5 inches in Windham County.	High	Southern Vermont
6-8 Dec 2003	Winter Storm	The first major storm of the season produced 10-20 inches across Southern Vermont. Cooperative weather observers measured 21.5” in Pownal and 21.3 inches in Sunderland.	High	Southern Vermont, Pownal
28 January 2004	Winter Storm	Extreme southern Vermont experienced 7-13 inches of snow with 12.6 inches in Sunderland, 9 inches in Pownal and 7.5 inches in Windham County.	High	Southern Vermont, Sunderland
23 Jan 2005	Blizzard	Frequent whiteout conditions were observed by plow crews. Whiteout conditions were most prevalent across the Green Mountains. Cooperative Weather Observers recorded 8.0” in Pownal and Sunderland and 14.0 inches in Peru.	High	Countywide
15-16 Jan 2007	Ice Storm	Significant icing occurred from the freezing rain leading to widespread power outages Strengthening winds in the wake of the storm continued to exacerbate power outages across the region.	High	Southern Vermont
2 March 2007	Winter Storm	A mix of snow and sleet fell with over one foot in higher elevations and some freezing rain.	High	Southern Vermont, Woodford, Landgrove
16-17 Mar 2007	Heavy Snow	This storm brought widespread snowfall amounts of 10 to 18 inches across southern Vermont.	High	Southern Vermont
15-16 April 2007	Winter Storm	A heavy wet snow accumulated to 8 -12 inches with 12 inches in Woodford, 10.5 inches in Landgrove and 11 inches in Windham County. Gusty winds brought down power lines causing widespread outages. Damaging winds were reported by a Cooperative Weather Observer in Sunderland.	High	Southern Vermont
16-17 Dec 2007	Winter Storm	Snow, sleet and freezing rain, with total snow and sleet accumulations of 8-14 inches affected Bennington County and resulted in traffic problems and power outages. The Cooperative Weather Observer reported 12.4 inches in Sunderland along with damaging winds while 14 inches was reported in Woodford and 11.5 inches in Landgrove.	High	County wide
30-December 2007 to 2 January 2008	Heavy Snow	This storm brought heavy snow to eastern New York and western New England totaling from 6 to 12 inches across southern Vermont. Snowfall amounts ranged from 6 to 11 inches. This led to treacherous travel conditions and the closings or delayed openings of numerous schools and businesses. A Cooperative Weather Observer reported just over 12 inches in Sunderland.	High	Southern Vermont

Table 9. Significant winter storm events in Bennington County and Dorset. Source: NCDC 2014				
Dates	Type	Description	Category	Area
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 (two events reported by NCDC from 17-20 December) 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. 19 inches were reported by a Cooperative Weather Observer in Sunderland. Icing conditions followed on December 24th.	High	Southern Vermont
12 to 22 Feb 2009	Heavy Snow Winter Storm	Several events were recorded by NCDC with snowfall amounts of 6-12 inches, especially in higher elevations.	Moderate	Southern Vermont High Elevations
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. A Cooperative Weather Observers recorded 19.1” in Pownal from January 1-4, 21.5 inches in Sunderland, and 39” in Peru.	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. A Cooperative Weather Observer recorded 16.2” in Pownal.	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 and dangerous travel conditions across southern Vermont. Strong and gusty winds developed along the east facing slopes of the Green Mountains of southern Vermont with gusts up to 50 mph. Snowfall totals of 1 to 2 feet were reported across the higher terrain, with lesser amounts of 3 to 6 inches below 1000 feet. Cooperative Weather Observers recorded 23.1” in Pownal and 22.4” in Peru.	High	Southern Vermont
26-27 Dec 2010	Winter Storm	A nor’easter brought snow and blizzard conditions to southern Vermont. A Cooperative Weather Observer measured in Sunderland measured 26.0 inches while the Pownal observer measured 24.0 inches.	High	Southern Vermont,
12 January 2011	Winter Storm	Heavy snow fell across southern Vermont with snowfall accumulations ranging from 14 inches up to 3 feet with snowfall rates of 3 to 6 inches an hour for a time. A cooperative weather observer measured 20.6” in Pownal.	High	Southern Vermont, Pownal
1-2 February 2011	Winter Storm	Snow fell at a rate of 1-2 inches/hour with totals of 12-17 inches in southern Vermont. Cooperative Weather Observers reported 7 inches in Pownal and 8 inches in Sunderland.	High	Southern Vermont
29-30 October 2011	Winter Storm	An early storm produced 5-14 inches in Bennington County and 10-16 inches in Windham County.	High	Southern Vermont
29 February 2012	Winter Storm	A complex storm resulted in 8-16 inches of snow and sleet across southern Vermont between February 29th and March 1st with 4-8 inches across southeastern Bennington County.	High	Southern Vermont

Table 9. Significant winter storm events in Bennington County and Dorset. Source: NCDC 2014

Dates	Type	Description	Category	Area
18-19 March 2013	Winter Storm	A warm front brought snow to the southern Green Mountains and was enhanced by a coastal storm on the 19th. Together 4-9” fell in the values with 10-17” in the mountains.	Minor	Southern Vermont
14 Dec 2013	Heavy Snow	A coastal storm brought heavy snow and winds gusting to 40-55 mph. Snowfall amounts varied, with 18 inches recorded in Woodford, VT.	Moderate	Southern Vermont
5 February 2014	Heavy Snow	Southern Vermont received 6-12 inches of snow, particularly in higher elevations.	Minor	Southern Vermont
13 Feb 2014	Winter Storm	A complex storm with snow, freezing rain and sleet affected the area with snowfall rates of up to 3”/hour at times along with wind gusts of up to 40 mph.	Moderate	Southern Vermont
26 Nov 2014	Winter Storm	An early season storm impacted southern Vermont over Thanksgiving with 8-15” of snow.	Moderate	Southern Vermont Higher Elevations

In addition to the above a Cooperative Weather Observer recorded 18.8” in Sunderland and 16.5” in Pownal between February 14 and 15, 2007 but no damages were reported.

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 to over 20 inches (NOAA/National Climate Data Center 2012 Cooperative Weather Observer reports).

The skill of road crews in Vermont means that only the heaviest snowstorms (>12 inches) or ice storms affect the populations.

d. Probability, Impact and Vulnerability

There is a 100% probability of a moderate or greater snowstorm affecting Bennington County, including Dorset in any given year. 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. 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. 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.

b. Previous Occurrences

Table 10 below summarizes the total number of significant wind events including thunderstorms, strong winds, and tornadoes from 1996 to 2012.

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 11.

Table 10. Summary of wind events in Bennington County. Source: NCDC 2012

Year	High Wind	Strong Wind	Thunderstorm Winds	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			3	1		4
2003	1			1		2
2004						0
2005	1		3			4
2006	3		3			6
2007	3		6			9
2008		3	5			8

Table 10. Summary of wind events in Bennington County. Source: NCDC 2012						
Year	High Wind	Strong Wind	Thunderstorm Winds	Tornado	Funnel Cloud	Totals
2009	2		1			3
2010	5		3		1	9
2011	1		8			9
2012			3			3
2013			6			6
2014			3			3
Totals	33	5	67	3	1	109

Table 11. Significant wind events in Bennington County. Source: NCDC 2012				
Dates	Type	Description	Area	Category
21 Aug 1997	Strong Wind	Winds gusting to 40 mph downed trees in Dorset, North Bennington and Sunderland. Approximately 1,000 customers lost power.	Countywide	Moderate
1 Nov 1997	High Wind	Strong and damaging winds caused power outages in Windham and Bennington Counties with approximately 1,000 customers losing power.	Southern Vermont	Moderate
27 Nov 1997	High Wind	Passage of a cold front resulted in winds of 40-50 mph and downed trees and power lines in Windham and Bennington counties.	Southern Vermont	Moderate
31 May 1998	Thunderstorm Wind Tornado	Several lines of thunderstorms formed ahead of a front. An F2 tornado that originated in Saratoga and Rensselaer Counties followed Route 67 through North Bennington and South Shaftsbury. Damaging winds were reported by a Cooperative Weather Observer in Pownal. Large hail was reported in Shaftsbury.	Countywide; Bennington North Bennington Shaftsbury	High
6 July 1999	Thunderstorm Wind	A cold front generated thunderstorms in Southern Vermont. Power lines and trees were downed in Pownal and Stamford and significant rain fell in Sunderland. Winds were estimated to gust at 90 mph. Damaging winds were reported by the Pownal Cooperative Weather Observer.	Southern Vermont	Moderate
16 Sept 1999	High Wind	Winds from remnants of hurricane Floyd gusted to over 60 mph across Southern Vermont. Significant rains fell in Bennington, Peru and Sunderland.	Southern Vermont	Moderate
31 May 2002	Thunderstorm Wind	Thunderstorms caused damage across Bennington County. Cooperative Weather Observers reported damaging winds in Sunderland and Pownal.	Countywide	Moderate
5 Jun 2002	Thunderstorm Wind 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 assessed as an F1with winds of 80-100 mph and the other one near Wilmington, Windham County that was stronger with winds of 125-150 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.	Southern Vermont North Bennington; Pownal, Woodford	Moderate
21 July 2003	Tornado	A tornado touched down in Pownal, moved through Bennington and continued into western Windham County.	Sunderland Bennington Pownal	Moderate
16 April 2007	High Wind	Low pressure created strong winds resulting in extensive tree damage in Dorset. Damaging winds were reported by a Cooperative Weather Observer in Sunderland.	Dorset	Moderate
16 Dec 2007	High Wind	A storm brought sleet and snow as well as high winds resulting in downing of trees and power lines. Damaging winds were reported by a Cooperative Weather Observer in Dorset.	Countywide	Moderate
9 Dec 2009	Wind	A strong low pressure system tracked northeast, into the eastern	Countywide;	Moderate

Table 11. Significant wind events in Bennington County. Source: NCDC 2012				
Dates	Type	Description	Area	Category
		Great Lakes region creating strong east to southeast winds developed across southern Vermont during Wednesday morning, before gradually diminishing by Wednesday evening.	Bennington, Pownal, Shaftsbury, Sunderland, Dorset, Manchester, Dorset	
22 Aug 2010	Wind	Strong and gusty east to southeast winds occurred across southern Vermont, with the higher terrain of the southern Green Mountains being impacted the hardest. Trees and wires were reported down due to high winds in Arlington, Sunderland, Shaftsbury and Bennington. Power outages occurred across Bennington County.	Arlington, Sunderland, Shaftsbury, Bennington; Countywide	Moderate
29 May 2012	Thunderstorm Wind	Strong thunderstorm winds affected Southern Vermont. Falling trees blocked a road in Dorset	Southern Vermont	Moderate
3 July 14	Thunderstorm Wind	Scattered storms damaged trees and power lines as a cold front moved across the region.	Southern Vermont	Low

c. Extent and Location

Damaging winds, including the previous occurrences described above, are those exceeding 55 miles per hour (NOAA 2006, NOAA 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.

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 10-100% in Dorset.

4. Hail

a. 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.

b. Past Occurrences

NCDC (2014) and Cooperative Weather Observer reports eighteen hail events since 1996. Table 12 lists all, which were highly localized with little damage.

Table 12. Hail events in Bennington County. Source: NCDC 2014.		
Date	**Description**	**Area**
31 May 1998	A severe thunderstorm at Shaftsbury in Bennington County produced large hail. This was the same event involving a tornado described above.	Shaftsbury
18 July 2000	Across southern Vermont, scattered thunderstorms developed ahead of a cold front during the midday. In Bennington county, dime size hail fell at Sunderland, and nickel size hail fell at Bennington.	Bennington Dorset
4 July 2001	Half dollar sized hail (1.25") fell in Sunderland.	Sunderland
27 June 2002	Thunderstorms, developing ahead of a cold front, moved into southern Vermont during the late afternoon and early evening. One cell deposited one inch hail in the North Bennington.	North Bennington
24 May 2004	No description	Bennington
6 June 2005	One-inch hail was reported by a trained weather spotter.	Dorset Sunderland West Rupert
1 August 2005	No description	East Dorset
19 June 2006	A trained spotter reported penny-sized hail in Sunderland.	Dorset
10 May 2007	Numerous showers and thunderstorms occurred, some became locally severe, and quarter sized hail in Arlington.	Arlington
21 June 2007	A strong cold front moved through east central New York and western New England producing numerous thunderstorms, some of which were locally severe. Nickel sized hail was reported in Sunderland.	Sunderland
3 August 2007	Numerous and strong thunderstorms developed over eastern New York and western New England. Ping pong ball sized hail was reported in Shaftsbury.	Shaftsbury
10 June 2008	A cold front approaching from the west, along with a hot, moist and unstable air mass in place, led to the development of strong thunderstorms across eastern New York and western New England. Nickel size hail was reported near Rupert	Rupert
24 June 2008	The passage of an upper level trough, and weak cold front produced isolated to scattered thunderstorms during the afternoon. Large hail accompanied some of these thunderstorms with ¼" sized hail reported in Pownal	Pownal
6 August 2008	A low pressure system tracked east across northern New England during the morning hours. An upper level disturbance in the wake of this system, combined with a moist and unstable air mass in place, led to the development of isolated severe thunderstorms across portions of southern Vermont. Quarter size hail fell approximately 4 miles north northeast of Arlington.	Sunderland
15 June 2009	The combination of a passing upper level trough, and unusually cold air in the mid and upper levels of the atmosphere, led to the development of numerous thunderstorms across southern Vermont, many of which contained large quantities of hail. Quarter size hail was measured at the Bennington Morse State Airport in Bennington. In addition, nickel to quarter size hail was also reported in the city of Bennington.	Bennington
7 July 2009	A closed upper level low, and pool of unusually cold air in the mid and upper levels of the atmosphere moved over the region, leading to the development of thunderstorms across southern Vermont. Penny size hail was reported in Bennington during a thunderstorm.	Bennington
17 July 2010	A pre-frontal boundary and upper level disturbance moved across the region creating a cluster of strong to severe thunderstorms developed and moved across southern Vermont. Quarter size hail was reported during a thunderstorm in Bennington.	Bennington
1 June 2010	Multiple lines and clusters of strong to severe thunderstorms developed during the afternoon and evening hours. Half dollar size hail was reported in Arlington. 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.	Arlington Shaftsbury

Table 12. Hail events in Bennington County. Source: NCDC 2014.		
Date	Description	Area
1-2 June 2011	Multiple lines and clusters of strong to severe thunderstorms developed during the afternoon and evening hours. Half dollar size hail was reported in Arlington. Multiple reports of large hail were reported during a thunderstorm in Shaftsbury. Hail stones of 1 inch and 3 inch diameter were measured.	Arlington Bennington Shaftsbury
24 June 2013	Thunderstorms produced quarter sized hail in Manchester	Manchester

Hail was also reported by a Cooperative Weather Observers on May 25, 1999, May 8, 2000, July 18, 2000, July 5, 2001, August 4, 2001, June 2, 2002, August 1, 2008 and August 15, 2009 in Sunderland and on June 10, 2008 and May 8, 2010 in Peru.

c. 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.

d. 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, one thunderstorm per year generates hail that was recorded. So, the possibility of hail occurring in Dorset could range from 10-100%, but impacts would be localized.

5. Temperature Extremes

a. 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 88-89 degrees in Dorset (Table 13). 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 health, but could result in pipes freezing and the loss of water supplies.

Table 13. Sunderland 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	28.5	9.5	19.0	3.44
February	33.7	11.2	22.5	2.82
March	40.9	19.5	30.2	3.55
April	54.3	31.0	42.7	3.47
May	65.8	41.3	53.5	4.33
June	75.3	49.6	62.5	4.66
July	78.5	54.5	66.5	4.55
August	77.1	53.0	65.0	4.40
September	69.6	44.2	56.9	3.83
October	57.3	34.4	45.8	4.28
November	45.9	27.9	36.9	3.98
December	34.4	17.2	25.8	3.95
Annual	55.1 (Avg)	32.8 (Avg)	43.9	47.26

The station normal report for the Cooperative Weather Observer in Sunderland indicates an average of one day per year when the maximum temperature would equal 90 degrees, 55 days when the maximum temperature would be less than 32 degrees and 172 days when the minimum temperature would be less than 32 degrees.

c. 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.

d. Probability, Impact and Vulnerability

Extreme heat is relatively rare with occurrences of approximately less than one day a 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.

6. Drought

a. 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 water availability can be critical in rural communities like Pownal 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

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 14 shows periods when the index showed severe and extreme droughts using data from 1985 to 2014 though no drought conditions were recorded after 2002.

Table 14. Years and number of months when the PHDI indicated severe or extreme droughts from 1985 to 2014. 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

Table 14. Years and number of months when the PHDI indicated severe or extreme droughts from 1985 to 2014. Source: National Climate Data Center. Source: ftp://ftpncdd.noaa.gov/pub/data/cirs/climdiv/ (Richard Heims, personal communication)		
Year	Extreme	Severe
1995		2
1999		1
2001	2	1
2002	1	

c. Extent and Location

The National Climate Data Center calculates this index back to 1895. Since then, severe droughts occurred in 26 years or 22.5% while extreme drought 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 are likely to affect those properties with shallow wells. Based on well data from VT ANR, there are forty wells in Dorset with depths less than 100 feet. There are 25 public water supply wells including those of the Dorset and East Dorset Fire Departments.

d. 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. Preliminary groundwater resource mapping has been completed (De Simone and Gale 2009). That study focused on identifying potential areas where water resources could be developed and made the following findings:

1. The higher elevations where till layers were thin, provided the greatest potential for water from precipitation filtering to bedrock fractures as can pass through the shallow soil and intersect bedrock.
2. Groundwater recharge may occur at lower elevations where either permeable surface sediment is in contact with bedrock or streams flow across permeable layers.
3. Shallow or unconfined overburden aquifers, which are at or near the surface in surficial sediments were mapped with those of depths greater than 60 feet having the most potential for high yields.

Map 5 shows the areas described in 2 and 3 above. The higher elevations are basically those on the hill slopes and ridgelines above those aquifers and consist of glacial till rather than the other glacial deposits (outwash, kames, etc.) in the valleys. As can be seen, most existing wells are within areas of unconfined, overburdened aquifers. The public wells are associated with the fire departments and schools along with two lodging establishments and a restaurant. Except for long-term drought, most wells should supply sufficient water, though structures with shallow wells are most likely to be affected. According to VT ANR well data, there are 82 wells drilled to a depth of less than 100 feet. Drought may affect the potential for wildfire, which is discussed below.

7. 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 15 shows how wildfires can be categorized based on size.

Table 15. 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 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 Dorset 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%. 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).

Dorset is one of sixteen towns, two of which are in Bennington County, listed as wildland urban interface communities in the vicinity of federal lands at high risk from wildfire. The wildland-urban interface or WUI represent areas where structures directly abut wildland fuels (Federal Register 2001).

b. Past Occurrences

According to records from the Vermont Department of Forests, Parks and Recreation, from 1992 to 2010, 156 wildfires occurred in Bennington County, five of which occurred in Dorset.

c. Extent and Location

Of the five fires, three were Class A, one was Class B, and one was Class C. Low intensity fires with slow rates of spread could occur in the forested areas which comprise most of Dorset's land cover. Throughout the town there may be pockets of heavier fuel loads, such as brush, or more flammable fuels, such as cured herbaceous vegetation and shrubs. These areas are generally located in the valleys near developed areas.

d. Probability, Impact and Vulnerability

As can be seen in Map 2 Land Cover), most of Dorset consists of deciduous and coniferous forests. These types of forest tend to 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) and greater as shown in Map 6. 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.

8. 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 16 shows how landslides can be categorized.

Table 16. 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

Several small landslides occurred during Tropical Storm Irene, along the Otter Creek and on a ridge between Beech Ridge and Mad Tom notch. In addition, a portion of Dorset Mountain experienced three landslides in the 1980s.

c. Extent and Location

All of the mapped landslides would be categorized as localized. Map 4 shows locations of damages, including landslides that occurred during Tropical Storm Irene. No rockfalls were identified in Dorset by the Vermont Agency of Transportation (Eliason and Springston 2007).

d. Probability, Impact and Vulnerability

Previous landslides occurred during a major storm event, Tropical Storm Irene, and were located along Otter Creek near Mad Tom Road. Impacts can include destabilization of roads and debris jams as material that has slid from slopes then flows downstream. The probability of occurrence would be the same as for flooding with the potential proportion damaged within the town ranging from 1-10% and injuries of 1-10%. Most services would be recovered in less than seven days, though repair to some infrastructure may take significantly longer.

9. Earthquake

a. Description

Vermont has no active faults, but has experienced minor earthquakes. Table 16 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 17. 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 Dorset (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.

10. Hazardous Materials Spill

a. 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.

b. Past Occurrences

The Vermont spill site list indicates there have been 57 spills reported in Dorset since 1979, and these are listed in Table 17 below.

c. Extent and Location

All of the spills listed in Table 18 affected small sites or areas. US Route 7, VT Route 7A and VT Route 30 carry substantial traffic, and a spill on these roads could affect a large portion of the town. Of particular concern in any hazardous materials spill would be the impact on water resources. Map 7 shows the transportation system in relation to surface waters including streams and wetlands. Hazardous intersections have been identified by the Vermont Agency of Transportation and the planning committee. Roads with average grades greater than 10% also present hazards, particularly when roads are wet or during winter storms.

d. Probability, Impact and Vulnerability

Given the number of past spills, hazardous materials spills occur less than annually and affect very small areas. Increased truck traffic also increases the possibility of a major spill. However, many areas are vulnerable due to the extensive transportation system and proximity of surface and groundwater resources to that system. Most hazardous materials are transported via US Route 7 and VT Route 30. However, all local roads carry materials that could spill and affect aquatic resources as well as individual wells.

The overall likelihood of a hazardous materials spill on an annual basis is probably between one and ten percent. 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.

Table 18. Hazardous materials spills in Dorset, VT. Source: http://www.anr.state.vt.us/WMID/Spills.aspx

Report #	Year	Facility Name	Address	Nature of Incident	Product Released	Quantity	Unit	Responsible Party
WMD019	2015	Roadway	US RT 7	Hydraulic Equipment Failure	Hydraulic Oil	1 to 3	Gallons	VTrans
WMD427	2014	East Dorset General Store	2045 Route 7	Release from hose	Gasoline	0.5	Gallons	East Dorset General Store
WMD550	2014	Roadway	RT 7/RT 30	Hydraulic equipment failure	Hydraulic Oil	15	Gallons	VTrans
WMD404	2014	VTrans Dorset Garage	18 Village Street East Dorset	Release from diesel piping	Diesel	1	Gallons	VTrans
WMD554	2014	VTrans Garage	18 Village St	Hydraulic equipment failure	Hydraulic Oil	3 to 5	Gallons	VTrans
WMD627	2014	VTrans Sign	Exit 4, Routes 11 & 7	Sign blew over spilling battery acid	Corrosives (Acids/Bases)	1	Gallons	VTrans
WMD073	2013	East Dorset AOT Garage	18 Village Street	Ruptured hydraulic hose on VTrans truck	Hydraulic Oil	3	Gallons	VTrans
WMD444	2013	Roadway	Intersection of Rt. 7/Village Street	Spilled diesel fuel observed in roadway by VTrans Dorset garage personnel	Diesel	2 to 5	Gallons	
WMD022	2012	Intersection of road	Rte 11 & South Rd.	Plow/salt truck accident	Lube/Gear/Transmission Oil, Motor Oil	1.5	Gallons	VTrans
WMD391	2012	Prentiss Pond	Church Street	Possible gas or paint on pond. Turned out to be algae bloom	Biological (E.G. Algae, Bio-Sheen)	Sheen	--	None
WMD460	2012	Roadway	18 Village St	Truck blew hose	Hydraulic Oil	5	Gallons	VTrans
WMD080	2011	Brownlee Property	2741 Rte 30	Delivery to unconnected fill pipe		25	Gallons	Dorr Oil
WMD063	2011	East Dorset VTrans Garage	Route 7	Deicing agent released		1200	Gallons	VTrans
WMD217	2011	JK Adams	1430 RT 30	Tank in vault leaking & oil seeping from vault		<2	Gallons	JK Adams
WMD901	2011	VTrans District Garage	Route 7	Snowplow had hydraulic hose failure	Hydraulic Oil	3	Gallons	VTrans
WMD106	2010	Power pole	1776 Rte 30	Transformer leak		10	Gallons	CVPS
WMD032	2010	Roadside	Route 7	Hydraulic oil discharge		14	Gallons	VTrans
WMD429	2009	E. Dorset Garage	off Rte. 7	Line failure		5	Gallons	VTRANS
WMD124	2009	VTrans Garage		Stained soil along shoulder		u		unknown
WMD448	2008	AOT Garage		Ruptured fitting		3	Gallons	VTrans
WMD363	2008	Diana Giddings Property	216 Village St	AST filter leak			--	Giddings
WMD140	2008	Dorset Village properties	3390 Rte 30	AST leak				Kevin O'Toole
WMD231	2008	N/A	25 Marsh Lane	Transformer spill		4	Gallons	CVPS
WMD147	2008	VTrans garage	18 Village Street	Hydraulic failure		2	Gallons	VTrans
WMD285	2008	VTrans Garage	18 Village St	Puddle under truck in parking lot.		2	Gallons	VTrans
WMD509	2008	VTrans Garage	15 Village Street	Hydraulic leak		5	Gallons	VTrans
WMD163	2007	CVPS transformer	93 Teace St	Transformer leak		<1	Gallons	CVPS
WMD549	2007	East Dorset Town Garage		Hydraulic leak		4	Gallons	VTrans

Table 18. Hazardous materials spills in Dorset, VT. Source: http://www.anr.state.vt.us/WMID/Spills.aspx

Report #	Year	Facility Name	Address	Nature of Incident	Product Released	Quantity	Unit	Responsible Party
WMD120	2006	A O T garage		Hydraulic hose failure		30	Gallons	A O T
WMD588	2006	Hawkins Residence	2116 Rt 30	Leaking UST		400	Gallons	John Hawkins
WMD271	2006	N/A	Mad Tom Rd	Transformer leak		<1	Gallons	CVPS
WMD442	2006	N/A	Spruce Lane	Hydraulic line failure		1	Gallons	CVPS
WMD193	2005	N/A	Marshall Lane	Hydraulic equipment failure		5	Gallons	CVPS
WMD015	2004	Clubb Residence	40 Cheney Rd	AST failure to basement		200	Gallons	James Clubb
WMD042	2003	AOT District garage	Rt 7	Hydraulic line leak		15	Gallons	William Daley Inc
WMD376	2001	Mettawee Mill Nursery	Route 30	AST tipped over		150	Gallons	Mettawee Mill Nursery
WMD409	1997	East Dorset Garage	Rt 7	Nozzle fell out of truck during fueling	Diesel	15	Gallons	A O T
WMD334	1997	Fiori Residence	1275 Danby Mtn Rd	Overfill of above ground tank				Dorr Oil Co
WMD122	1996	N/A	Rt 30 Dorset,rt103 Chstr	Spills from machinery over time				Bear Paw Lumber
WMD169	1995	Esposito Residence	Benedict Rd	Above ground tank leak				John Esposito
WMD094	1995	Rogers Corp	Rt 30	Dumping 1,1,1-tca				Rogers Corp
WMD217	1994	Esposito Residence		Spill while filling mower	Gasoline	0.5	Gallons	Alice Esposito
WMD122	1994	Rogers Corp	Rt 30	Dumping		400	Gallons	Roger Rumney
203	1993	Batten kill River	Rt 7	Foam in river				N/A
370	1993	N/A	Rt 30,snow Rd	Gas leak and fire	Gasoline	9000	Gallons	Haskins Gas
93	1993	Railroad Station	Rt 7	Tank Pulled W/out Notification				Connors Family
324	1992	N/A	Mad Tom Rd	Drums found		4		N/A
185	1990	JK Adams Co	Route 30	Spill		25		J.K. Adams Co.
25	1989	N/A	Rt 30	Leaking kerosene tank	Kerosene	75		Mettawee Mill Nursery
73	1989	N/A	Photo Shop	Photographic disposal in septic				John Conti
227	1989	N/A	Batten kill River	Fuel truck overturned in river	Diesel, Heating Oil	30	Gallons	Heaslip Fuel
43	1988	N/A	Route 7	Junked vehicles	Gasoline			George Connors
137	1987	N/A	Rt 30, Dorset	Paint and solvent dumping			--	Haskins Gas Service
44	1983	N/A	Snow Fall Inc					Jack Heaton
138	1983	N/A	Tin Rd Trailer Park	Oil Leak-broken Pipe	Kerosene	200	Gallons	Charles Wilson
97	1982	N/A	Rt 7	Truck accident	Diesel	150	Gallons	N/A
71	1980	N/A	Dorset Elem. School	Leaking line				N/A

11. Infectious Disease Outbreak

a. Descriptions

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

b. Past Occurrences

Infectious diseases are a regular occurrence. The Vermont Department of Health (2015) lists 9 different diseases occurring in Bennington County as of December of 2014 with Lyme disease the highest with 105 cases through the end of the year.

c. Extent and Location

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

d. 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.

12. Invasive Species

a. 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 barberry (*Berberis thunbergii*) can become a dominant, short shrub in some forests and, given that this is a thorny plant, can reduce the use of an area for recreational purposes (Vermont Agency of Natural Resources 2010).

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 19. 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/	
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	Flowering rush
*Celastrus orbiculatus**	Oriental bittersweet
*Euonymus alatus**	Burning bush
Fallopia japonica	Japanese knotweed
Hydrocharis morsus-ranae	Frogbit
*Iris pseudacorus**	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**	Purple loosestrife
*Myriophyllum spicatum**	Eurasian watermilfoil
Najas minor	European naiad
Nymphoides peltata	Yellow floating heart
*Phragmites australis**	Common reed
Potamogeton crispus	Curly leaf pondweed
*Rhamnus cathartica**	Common buckthorn
*Rhamnus frangula**	Glossy buckthorn
Trapa natans	Water chestnut
Vincetoxicum nigrum	Black swallow-wort

In addition, the Agency for Natural Resources lists the following as aquatic invasive species

Table 20. Aquatic invasive species in Vermont. Source: Watershed Management Division, Vermont Department of Environmental Conservation: http://www.vtwaterquality.org/lakes/htm/ans/lp_ans-index.htm	
Scientific Name	Common Name
Dreissena polymorpha	Zebra mussel
Alosa pseudoharengus	Alewife
Orconectes rusticus	Rusty crayfish
Didymosphenia geminata	Didymo

b. Past Occurrences

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

c. Extent and Location

The extent has not been fully mapped. In addition to the species listed above, 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. *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.

Adelges tsugae (Hemlock wooly adelgid) has dramatically reduced hemlock trees south of Vermont and was recently found in Pownal, Vt. *Agrilus planipennis* (Emerald Ash Borer) is a significant threat to forests as it kills all ash species. Borers are often dispersed through movement of firewood.

d. 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.

B. Vulnerability Analysis

The vulnerability assessment combines the results of data summarized in the previous section along with local knowledge. Table 21 summarizes the potential impacts from each hazard.

Table 21. Hazard impact summary	
Hazard	Potential Impacts
Floods and flash floods	Damage or loss of structures and infrastructure Loss of life and injury
Winter storms	Power outages Road closures
High wind events	Power outages Road closures
Hail	Property damage Crop damage or loss
Temperature extremes	Loss of life and injury Water supply loss
Drought	Water supply loss Crop damage or loss
Wildfire	Damage or loss of structures and infrastructure Loss of life and injury Loss of forest resources
Landslide and debris flow	Damage or loss of structures and infrastructure Loss of life and injury Road closures Power outages
Earthquake	Damage or loss of structures and infrastructure Loss of life and injury Road closures Power outages Water supply loss
Hazardous materials spill	Loss of life and injury Road closures Water supply loss
Infectious disease outbreak	Loss of life and injury
Invasive species	Road closures Power outages Loss of forest resources Loss of life and injury

Table 22 summarizes probabilities, area affected, and likely warning times for each hazard. Floods and flash floods have caused the greatest damage in the past and are likely to be the priority hazard in the future. In addition, threats to water supplies such as drought or hazardous materials spills could affect large portions of the community. Other hazards would likely be localized, but could affect vulnerable populations such as the elderly, the young or those who might be particularly affected by power outages or isolation during storm events. Mobile homes, particularly mobile home parks, can be particularly vulnerable to hazards (Vermont Department of Housing and Community Development 2013). There are 18 mobile homes in Dorset, but these are scattered and none are in mobile home parks.

Table 22. Vulnerability assessment for the Town of Dorset.

Hazard	Date/Event (# events)	Recurrence Interval	Geographic Area Affected	Proportion of town damaged	Injuries/ deaths	Loss of facilities/services	Vulnerable Facilities/Populations	Warning Time
Flood/Flash Flood	49 events from 1996 to 2014	10-100% probability in next ten years	Community to statewide within special flood hazard zones and river corridors	<10%	1-10%	Minimal to seven days. Roads may become impassable and power outages in some areas	Roads, bridges and culverts town wide	>12 hours
Winter storm (snow and ice)	135 events from 1996 to 2014	100% probability in any given year	Community to statewide	<10%	1-10% primarily traffic accidents	Minimal to seven days with some areas impassable and power outages in some areas	Primarily power supplies but also roads	>12 hours
High Wind Event	109 events from 1996 to 2014	10-100% occurrence in next ten years	Community to region-wide with possible isolated events	<10%	<=1%	Minimal for the entire town, but may be significant in localized areas. Power outages may occur.	Power lines primarily	3 to > 12 hours
Hail	20 events from 1996 to 2014	1-10% probability in any given year	Subarea of community	<=1%	M=1%	Minimal	Minimal	3 to 12 hours
Temperature Extremes	Annual >90 F 1 day Annual < 32 F days <32F?	1-10% probability in any given year	Community to statewide	100%	<=1%	Minimal	Elderly and ill individuals without adequate heating or air conditioning	>12 hours

Table 22. Vulnerability assessment for the Town of Dorset.

Hazard	Date/Event (# events)	Recurrence Interval	Geographic Area Affected	Proportion of town damaged	Injuries/ deaths	Loss of facilities/services	Vulnerable Facilities/Populations	Warning Time
Drought	Severe droughts have occurred in 25 years from 1895 to 2014	1-10% probability in any given year	Community to statewide	<10%	<=1%	Minimal but water could be unavailable for significant lengths of time.	Homes with shallow wells lose water	>12 hours
Wildfire	Three events: 1994, 2002, 2010	1-10% probability in any given year	Subarea of community	<10%	<=1%	Minimal	Likely confined to the upland forests.	None or minimal
Landslide/Debris Flow	Small scale events along The Otter Creek. Several small post-Irene slides	1-10% probability in any given year	Subarea of community	<10%	<=1%, but traffic accidents possible	Minimal depending on scale and ability to remove material	Most likely along streams and affecting properties adjacent or downstream.	None or minimal
Earthquake	2011	<1% probability in any given year	Community to region-wide	<10%	<=1%, but larger in a significant earthquake	Minimal	Town wide	None or minimal
Hazardous Materials Spill	57 events from 1979 to 2015	1-10% probability in any given year	Site-specific with wider affects if spills affect water resources	<=1%	<=1%	Minimal	Water supplies and aquatic resources	None or minimal
Infectious Disease Outbreak	Annual	1-10% probability in any given year	Community to state-wide	<=1%	<=1%	Minimal	Varies with type of infectious disease	None or minimal

Table 22. Vulnerability assessment for the Town of Dorset.

Hazard	Date/Event (# events)	Recurrence Interval	Geographic Area Affected	Proportion of town damaged	Injuries/ deaths	Loss of facilities/services	Vulnerable Facilities/Populations	Warning Time
Invasive Species	Ongoing	100% probability in any given year	Community to state-wide	1-10%	<=1%	Power outages from tree fall	Forests, roadsides, water bodies and streams	>12 hours

V. Mitigation Programs

A. Mitigation Goals for the Town of Dorset

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. 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. Significantly reduce the economic impacts incurred by municipal, residential, 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.

B. Review of Existing Plans and Programs that Support Hazard Mitigation in Dorset

1. Dorset Town Plan (adopted 2014)

The 2014 Town Plan identifies the following goals which support hazard mitigation planning:

<u>Land Use and Economy</u>

a. Encourage a pattern of development which can reasonably be provided with needed public facilities and services.

b. Limit development to areas along or near existing public roads, thus avoiding unnecessary new road mileage and costly servicing. This applies equally to second homes which may, in the future, be occupied by year-round residents. Access roads will remain private with recorded maintenance agreements.

c. Provide for review of subdivisions of land to ensure proper design of roads, proper site development, and protection of agricultural and forestry lands, natural resource and natural hazard areas, and water resources.

d. Accommodate the changing needs of the Town through a continuous and comprehensive planning program.

Transportation

a. Provide for safe, convenient, economic, and energy efficient transportation systems within the Town.

b. Control development along Route 7/7A, with the aim being to maintain the present alignment, avoiding duplication of this road through the Town by extension of limited access Route 7.

c. Encourage the State in its various transportation planning studies to carry out all highway improvements and reconstructions in the Town in a safe manner, and with sufficient width to provide for bicycle use.

d. Encourage State and federal implementation of traffic calming measures along major corridors through the village areas in addition to law enforcement.

Natural, Scenic, Historic Resources

a. Protect aquifers and recharge areas, groundwater and our Class A and B streams, so that the Town may have a continuing supply of pure water for domestic (which includes drinking water) and recreational use.

b. Keep the rugged and poorly accessible mountain and forest areas free from development, reserved for forestry and other uses appropriate to their character.

c. Retain as much permanent open space as possible through cluster development, preservation of natural resource lands and natural hazard areas, and encouragement of agricultural and forest practices.

d. 4. Count as developable land, whether for cluster or traditional subdivision, only the net developable area after removing wetlands, flood hazard areas, steep slopes 20% or greater, public water aquifers, spring recharge areas, and other similar resource lands.

Energy Conservation

a. Promote energy conservation, and the use of renewable and/or alternative energy resources.

Wise Use of Natural Resources and Efficient Use of Extractive Resources

a. Allow reasonable and responsible use of the Town's underground extractive resources, in a manner which minimizes negative impacts on the surrounding area.

b. Require rehabilitation and redevelopment of extractive sites as they are completed.

c. Protect natural resources including agricultural and forest lands, wetlands, water resources, wildlife habitats, fragile areas, and rare plant habitats.

Housing

a. Encourage the development of housing that will be safe, sanitary, and conveniently located**,** and will not impact negatively on neighboring development in terms of health and safety.

Public Facilities and Services

a. Provide for public facilities and services needed to serve the Town.

b. Allow for the expansion of public and/or private community water supply where practical, and protect current and future water supply sources.

c. Control the rate of development of residential units so that public facilities and services such as emergency services, schools, water systems, and local government are not overburdened by sudden increases in demand, thus allowing for planned capital budgeting for those facilities and services.

Surface Water and Flood Resiliency Policies and Actions

Surface Waters Policy: The ecological and hydrological integrity of rivers, streams and wetlands should be maintained to provide key ecosystem services such as water purification, pollutant abatement, nutrient dispersal and cycling and flood water retention. Rivers, streams and wetlands should also be protected to allow for continued recreational use and to provide valuable scenic resources. Development within identified Special Flood Hazard Areas and Fluvial Erosion Hazard Zones should be avoided. The Town, BCRC and Vermont ANR should work cooperatively to complete and maintain updated flood hazard and fluvial erosion hazard maps and identify specific areas of concern.

Actions:

a. The Town and organizations including the Vermont Agency of Natural Resources, BCRC, the Batten Kill Watershed Alliance, the Bennington County Conservation District and others should work together to maintain and enhance the ecological integrity of rivers, streams, wetlands and upland forests.

b. An undisturbed buffer of natural vegetation should be established between rivers, streams and other water bodies to reduce nutrient input and attenuate overland flow. This buffer should be at least 50 feet for streams such as Gilbert Brook with minimal potential for lateral or vertical adjustment or 100 feet for streams such as The Mettawee with significant potential for such adjustment.

c. Developments or activities that would adversely affect the quality of the Town's surface waters shall be prohibited.

Flood Resiliency Policy: To protect the public health, safety and welfare, new development should be avoided in identified Special Flood Hazard Areas and Fluvial Erosion Hazard Zones.

Flood Resiliency Actions:

a. The Town should maintain current flood hazard regulations to control and limit development in flood hazard areas. These regulations are designed to protect property and the health and safety of the population against the hazards of flood water inundation, and to protect the community against the costs which may be incurred when unsuitable development occurs in areas prone to flooding. Development in flood hazard areas must be carefully controlled in accordance with the Town's flood hazard regulations.

b. New development in Special Flood Hazard Areas and the Fluvial Erosion Hazard Zones should be avoided where possible. Any new development that does occur should be designed and sited so as to avoid any increase in flooding or erosion.

c. Support acquisition by public entities or conservation organizations of buffers and Fluvial Erosion Hazard Zones, especially those identified in hazard mitigation and river corridor plans.

d. Dorset should adopt the most recent Town Road and Bridge Standards from the current 2014-2016 VTrans Orange Book: Handbook for Local Officials and updates as they are developed. Bridge and culvert repairs and replacements should be designed following hydraulic studies to avoid constrictions that would accelerate flow and to allow for passage by aquatic organisms.

e. Existing and local bridges and culverts that would impede flow during flooding events should be reconstructed or replaced.

f. Forested lands should be protected to assure that precipitation can be absorbed by forest soils and litter and the peak flow attenuated. Acquisition of land or easements or Current Use assessment should be used to protect these areas, especially along the tributaries.

g. The Town should collaborate with other municipalities, the BCRC, and the States of Vermont and New York in planning for the use and protection of regional water resources such as the Batten Kill and Mettawee. This could involve an inter-municipal agreement between these towns and communities in New York State for the long-term protection of these resources and to address flood hazards.

h. The Town should provide outreach to property owners within the flood zones to support flood proofing or buy-outs of structures subject to repeated flooding and eligible for funding under the FEMA Hazard Mitigation Grant Program.

i. The Town should participate in the FEMA Community Rating System program by implementing projects that would ultimately lead to rate reductions in flood insurance premiums for residents and businesses.

j. The Town should encourage owners in flood hazard zones to secure propane tanks, fire wood, boats and other items that could float away in a flood, thereby creating hazards for those downstream.

k. The Town should maintain a current Local Emergency Operations Plan that provides for emergency response and flood preparedness.

l. The Town should adopt a hazard mitigation plan that fulfills FEMA requirements.

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

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

a. 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).

b. 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. Hazard Mitigation Plan for the Bennington Region (Multi-Jurisdictional)

Dorset was one of 13 jurisdictions in Bennington County that adopted a multi-jurisdiction hazard mitigation plan in 2005. The Dorset annex listed the following actions:

Table 23. Status of actions from the 2005 Bennington County Multijurisdictional Hazard Mitigation Plan for Dorset.

Mitigation Action	Who is Responsible	Approx. Time Frame & Potential Funding Sources	Initial Implementation Steps	Status
Update Rapid Response Plan at least annually	Select Board & Em Mgt Director	• Short Term • Local Resources	Technical assistance from BCRC	Revised annually
Upgrade stormwater 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	Town has upgraded numerous stormwater structures. Action retained for others identified needing upgrading.
Assess Mad Tom Beaver Dam.	Select Board, Road Foreman, Private Owners	• Med. to Long Term • Local & State Resources • PDM-C Funds	Assistance from BCRC, VEM, ANR, private residents & land owners; conduct assessments and explore options	On-going
Flood-proofing structures within Flood Hazard Areas	Select Board, Private Owners	• Med. to Long Term • Local & State Resources • PDM-C Funds	Conduct assessment of needs and options	Retained in this plan Table 26)

The mitigation priorities have not changed since the 2005 hazard mitigation plan. Dorset updated their Local Emergency Operations Plan in 2015. The town has been upgrading culverts and other drainage structures over time as a result of flood damage. Phase I and II geomorphic assessments have been completed for both the Batten Kill and Mettawee River and river corridor plans completed listing restoration actions. The town has been working with the Bennington County Regional Commission, Bennington County Conservation District, The Batten Kill Watershed Alliance and Vermont Agency of Natural Resources to implement these river corridor plans. There are no repetitive loss properties in Dorset, and no owners have expressed interest in flood proofing. This action will be retained if structures needing flood proofing are identified. In addition, while numerous culverts have been upgraded, further work may be needed, so this action is also retained (Table 26).

Based on an analysis of E911 data from 2005, no additional dwelling units, government buildings, commercial structures of public gathering places were constructed in the current special flood hazard zone since the 2005 Bennington County All-Hazards Plan was completed.

BCRC maintains GIS data that can be used by the town for planning and which has been used by the town for this plan.

4. Vermont Hazard Mitigation Plan (2013)

The Vermont Hazard Mitigation Plan (2013) identified a series of hazards shown in Table 24 below along with those we considered in this plan. The Dorset plan tracks the state plan except some hazards are combined and a few, including nuclear plant accident, were not considered.

Table 24. Comparison of hazards considered in the draft Vermont Hazard Mitigation Plan vs. the Dorset Hazard Mitigation Plan

VT Hazard Mitigation Plan	Alternative
Atmospheric Hazards	**Natural Hazards**
Drought	Drought
Earthquake	Earthquake
Flooding	Flooding/Flash Floods/Fluvial Erosion/Ice Jams
Fluvial Erosion	*See Flooding/Flash Floods/Fluvial Erosion/Ice Jam*
Hail	Hail
High Winds	High Winds
Hurricane/Tropical Storm	*See High Winds and Flooding/Flash Floods/Fluvial Erosion/Ice Jams*
Ice Storm	*See Severe Winter Weather/Ice Storm*
Ice Jams	*See Flooding/Flash Floods/Fluvial Erosion/Ice Jam*
Infectious Disease Outbreak	Infectious Disease Outbreak
Landslide/Debris Flow	Landslide/Debris Flow
Severe Thunderstorm	*See High Winds and Flooding/Flash Floods/Fluvial Erosion/Ice Jams*
Severe Winter Weather	Severe Winter Weather/Ice Storm
Temperature Extremes	Temperature Extremes
Tornado	*See High Winds*
Wildfire	Wildfire
Technological Hazards	**Technological Hazards**
Dam Failure	Dam Failure
Hazardous Materials Spill	Hazardous Materials Spill
Invasive Species	Invasive Species
Nuclear Power Plant Accident	Not addressed
Rock Cuts	*See Landslide/Debris Flow*

Table 24. Comparison of hazards considered in the draft Vermont Hazard Mitigation Plan vs. the Dorset Hazard Mitigation Plan	
VT Hazard Mitigation Plan	Alternative
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. There are no vulnerable state facilities in Dorset.

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. Dorset 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. The Town also restricts development within the fluvial erosion zone. Currently there are 23 policies in place for a total of $6,854,200.00. There have been two claims since 1978 for a total of $2,549.00. There are no repetitive loss structures (Flood Ready Vermont 2015). In some cases, land may fall into a fluvial erosion hazard zone but not in the flood zones identified in FEMA flood map. Therefore, property owners who own land in the fluvial erosion hazard zone should be encouraged to purchase flood insurance.

The Town bylaws have been reviewed and amended to reflect changes in the flood insurance maps prepared by FEMA. The current FIRM is dated November 29, 1977. 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 Town has an active program to maintain roads and bridges and has upgraded bridges and culverts based on hydraulic studies completed by the Agency of Transportation. The Town has two emergency shelters: The Dorset School and the East Dorset Fire Station. The locations of critical facilities are shown on Maps 3, 5, and 7.

Table 25 lists the capabilities of Dorset. The Select Board is the legislative authority and develops the town budget. The Town Manager is responsible for day to day management and planning. The Select Board also appoints the Emergency Management Director and members of the Planning Commission and adopts bylaws and ordinances. Vermont has a town meeting form of government, and the budget is approved by voters at town meeting day.

Table 25. Town Of Dorset capabilities for hazard mitigation	
Town Capability	Responsible Party (ies)
Development of annual town budget	Select Board; Town Manager
Emergency management	Select Board; Town Manager; Emergency Management Director; Dorset and East Dorset Fire Departments
Outreach to residents and businesses through mailings, web site and newsletters	Town Manager; Town Clerk; Select Board; Emergency Management Director
Town road, bridge, and culvert construction and maintenance	Road Foreman
Implementation and update of the Town Plan	Planning Commission; Select Board
Implementation of bylaws, including flood, bylaws	Town Zoning Administrator; Planning Commission

Dorset is a small town with limited ability to expand services. Dorset can use outside contractors to implement specific construction programs, and members of the Select Board can assist in developing outreach materials. The Emergency Management Director participates as a member of Local Emergency Planning Committee #7 and receives information and training on emergency and disaster management. The Town can get support from the Vermont Department of Homeland Security and the Bennington County Regional Commission. In addition, the U.S. Forest Service has capabilities in wildfire management and the Vermont Agency of Transportation provides training and maintains state roads.

D. Mitigation Projects

Table 26 lists mitigation actions for each hazard. Some will be implemented by the Town of Dorset and others by agencies such as the Vermont Agency of Transportation. The following criteria were used to establish 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 cost while avoiding or mitigating potential impacts to natural, cultural, social and economic resources. Costs considered included a) likely capital and maintenance costs of the action, b) potential short and long-term impacts to natural, cultural and scenic resources and c) potential short and long-term impacts to residents and businesses from implementing the action.

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 26. Mitigation actions

Hazard	Type[2]	Actions	Responsible Parties	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 Select Board	2015 to 2017	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	Town Planning Commission; Zoning Administrator	2015 to 2017	Town general fund	High
All Hazards	Education and Awareness	Identify and develop methods to communicate with populations vulnerable to potential hazards, particularly drought, extreme temperatures and infectious diseases, but also those in need of assistance for evacuation and/or sheltering	Town Emergency Management Director	2015 to 2017	Town general fund	High
All Hazards	Local Planning and Regulations	Assess 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	2015 to 2017	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	2015 to 2017	Town general fund	Medium
Floods and Flash Floods	Local Planning and Regulations	Adopt and enforce updated flood hazard and fluvial erosion hazard zone bylaws	Town Planning Commission; Zoning Administrator	2015 to 2017	Town general fund	High
Floods and Flash Floods	Local Planning and Regulations	Participate in the Community Rating System to help reduce flood insurance premiums	Town Select Board	2016 to 2018	Town general fund	High
Floods and Flash Floods	Local Planning and Regulations	Encourage appropriate stormwater and erosion control measures in new developments	Town Planning Commission	2015 to 2020 (ongoing)	Town general fund	High
Floods and flash floods	Local Planning and Regulations	Prepare draft contract for company to provide services if debris pile up bridges and culverts to prevent blockages and resulting flooding.	Town Select Board; Town Road Foreman	2015 to 2017	Town highway fund	High

[2] Follows FEMA 2013 Mitigation ideas; a resource for reducing. Federal Emergency Management Agency, U.S. Department of Homeland Security, Washington, DC

Table 26. Mitigation actions

Hazard	Type[2]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Priority
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 Road Foreman	2015 to 2020 (ongoing)	Town highway fund	High
Floods and flash floods	Structure and Infrastructure Projects	Adopt the 2013 and updates to the Vermont Town Road and Bridge Standards	Town Select Board	2015 to 2017and as updated	Town general 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 Road Foreman	2015 to 2020 (ongoing)	Town highway fund State of Vermont AOT FEMA HMGP, PDM, FMA	High
Floods and flash floods	Structure and infrastructure projects	Make necessary repairs to the Lower Squirrel Hollow Retaining Wall to protect the road from continued erosion	Town Road Foreman	2016 to 2019	Town highway fund State of Vermont AOT FEMA HMGP, PDM, FMA	High
Floods and flash floods	Structure and infrastructure projects	Replace Lower Squirrel Hollow Road undersized culvert to alleviate erosion and flood damage.	Town Road Foreman	2016 to 2019	Town highway fund State of Vermont AOT FEMA HMGP, PDM, FMA	High
Floods and flash floods	Structure and infrastructure projects	Replace Mad Tom Road undersized culvert to alleviate bank erosion and road damage.	Town Road Foreman	2016 to 2019	Town highway fund State of Vermont AOT FEMA HMGP, PDM, FMA	High

Table 26. Mitigation actions

Hazard	Type[2]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Priority
Floods and flash floods	Structure and infrastructure projects	Inventory and assess East Dorset beaver complexes and water levels given past damage to Mad Tom Road.	Town Road Foreman	2016 to 2019	Town highway fund State of Vermont AOT FEMA HMGP, PDM, FMA	High
Floods and flash floods	Structure and infrastructure projects	Replace Lane Road undersized culvert to assure road remains passable given potential flooding	Town Road Foreman	2016 to 2019	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	2015 to 2020 (ongoing)	FEMA HMGP, PDM, FMA	High
Floods and flash floods	Structure and infrastructure protection	Implement corridor protection, buffer plantings, structure and berm removal and other projects listed in the 2007 Batten Kill corridor plan (Field 2007)	Town Select Board; Batten Kill Watershed Alliance	2015 to 2020 (ongoing)	FEMA HMGP, FMA, PDM Vermont Ecosystem Restoration Program, Vermont Watershed Grant	Medium to High

Table 26. Mitigation actions

Hazard	Type[2]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Priority
Floods and flash floods	Natural Systems Protection	Acquire lands or work with conservation organizations to acquire lands subject to frequent flooding or wetlands within or adjacent to flood prone areas to provide flood storage	Town Select Board; Batten Kill Watershed Alliance: Vermont Land Trust	2015 to 2020 (ongoing)	State of Vermont Watershed Grants, Vermont Ecosystem Restoration Program, Nonprofit organizations	Medium
Winter storms	Education and Outreach	Provide educational materials on sheltering in place and preparation for winter storms, including long-term power outages	Town Emergency Management Director	2015 to 2017	Town general fund	High
Winter storms	Education and Awareness	Provide materials for residents on methods to protect property from wind events	Town Emergency Management Director; Zoning Administrator	2016 to 2018	Town general fund FEMA HMGP, PDM, FMA	High
Winter storms	Local Planning and Regulations	Develop agreements with adjacent towns for sharing of highway equipment	Town Select Board; Town Road Foreman	2015 to 2017	Town general fund	High
Winter storms	Structure and Infrastructure Projects	Place utilities underground for critical facilities	Town Select Board	2015 to 2018	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	Town Emergency Management Director	2015 to 2017	Town general fund	High
High wind events	Local Planning and Regulation	Require boats, propane tanks and other items stored outdoors to be secured	Town Planning Commission; Zoning Administrator	2015 to 2017	Town general fund	Medium
High wind events	Local Planning and Regulation	Encourage appropriate plantings to avoid future damage from downed trees	Town Emergency Management Director	2015 to 2017	Town general fund	Medium

Table 26. Mitigation actions

Hazard	Type[2]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Priority
High wind events	Local Planning and Regulation	Encourage protection and planting of wind breaks in new developments	Town Emergency Management Director; Zoning Administrator	2015 to 2018	Town general fund	Medium
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	2015 to 2020 (ongoing)	FEMA HMGP, PDM	Medium
High wind events	Structure and Infrastructure Projects	Place utilities underground for critical facilities	Town Select Board; Private Owners	2016 to 2018	FEMA HMGP, PDM	Medium
Hail	Structure and Infrastructure Projects	Retrofit existing buildings to minimize hail damage	Town Select Board; Private Owners	2017 to 2019	FEMA HMGP, PDM	Low
Temperature extremes	Education and Awareness	Identify vulnerable community members through a survey and outreach	Town Emergency Management Director	2015 to 2017	Town general fund FEMA HMGP, PDM	High
Temperature extremes	Local Planning and Regulation	Develop cooperative agreement with Manchester for sheltering of vulnerable populations	Town Select Board; Emergency Management Director	2015 to 2017	Town general fund	High
Drought	Local Planning and Regulation	Monitor drought conditions	Town Emergency Management Director	2015 to 2020 (ongoing)	Town general fund	Medium
Drought	Education and Awareness	Provide educational materials on dealing with drought	Town Emergency Management Director	2016 to 2018	Town general fund FEMA HMGP, PDM	Medium
Drought	Natural System Protection	Develop improved assessment of groundwater sources and amend bylaws to assure their protection	Vermont Geological Survey Town Planning Commission	2017 to 2019	FEMA HMGP, PDM State of VT	Medium

Table 26. Mitigation actions

Hazard	Type[2]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Priority
Drought	Local Planning and Regulation	Incorporate planning for droughts in the emergency management plan	Town Emergency Management Director	2015 to 2017	Town general fund	Medium
Wildfire	Education and Outreach	Acquire materials from Firewise for homeowners and provide to Dorset to make available for landowners	BCRC	2015 to 2017	BCRC	Medium
Wildfire	Education and Outreach	Provide information on outdoor burning safety prior to the spring and fall fire seasons	Fire wardens	2015 to 2020 (ongoing)	Fire wardens	Medium
Wildfire	Education and Outreach	Provide a review of properties where owners request assessment of their properties for wildfire safety and adequate defensible space	BCRC, Dorset Fire Departments	2015 to 2020 (ongoing)	BCRC, Arlington FD	Medium
Wildfire	Education and Outreach	Encourage owners to maintain defensible space around structures and to mow fields along road edges to prevent wildfire	Town Emergency Management Director; Dorset Fire Departments	2015 to 2020 (ongoing)	Town general fund	Medium
Wildfire	Local Planning and Regulations	Encourage defensible space around structures	Town Planning Commission	2015 to 2020 (ongoing)	Town general fund	Medium
Wildfire	Structure and Infrastructure Projects	Assure adequate water supplies are available including areas identified as gaps in the 2013 Community Wildfire Protection Plan	Town Select Board; Emergency Management Director, Dorset Fire Departments	2015 to 2020 (ongoing)	Town general fund /State of Vermont grants for dry hydrants/ Vermont Department of Parks, Forestry and Recreation	Medium
Wildfire	Natural Systems Protection	Implement fuel reduction, particularly in grass fields	Dorset Fire Departments/Green Mountain National Forest	2015 to 2020 (ongoing)	Arlington FD/Green Mountain NF	Medium

Table 26. Mitigation actions

Hazard	Type[2]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Priority
Landslide and debris flow	Local Planning and Regulations	Map known landslides and identify potential landslide areas	Town/BCRC/State of Vermont	2016 to 2018	FEMA HMGP, PDM	High
Landslide and debris flow	Local Planning and Regulations	Adopt fluvial erosion hazard bylaws	Town Select Board; Town Planning Commission	2015 to 2017	Town general fund	High
Landslide and debris flow	Structure and Infrastructure Projects	Implement visual monitoring in potential landslide areas	Town Emergency Management Director	2016 to 2018	Town general fund	High
Landslide and debris flow	Structure and Infrastructure Projects	Stabilize and replant stream corridor areas subject to landslides	Batten Kill Alliance	2015 to 2020 (ongoing)	State of VT Watershed grants	High
Earthquake	Education and Awareness	Educate property owners on proper construction techniques to reduce potential damage from earthquakes	Town Zoning Administrator	6-24 months	Town general fund	Medium
Hazardous materials spill	Local Planning and Regulation	Complete an assessment of hazardous materials and potential accident locations. Based on DEC info.	LEPC 7	2017 to 2019	State of VT DEC funds	High
Hazardous materials spill	Structure and Infrastructure Projects	Work with VT AOT to identify and mitigate high accident intersections	VT AOT	2016 to 2019	State AOT funds	Medium
Hazardous materials spill	Natural Systems Protection	Identify groundwater source areas and develop ordinances to protect those areas	Vermont Geological Survey	2016 to 2019	VT Geological Survey funds	Medium
Infectious disease outbreak	Local Planning and Regulations	Monitor disease occurrences and potential outbreaks, partnering with the VT Dept. of Health	Town Health Officer	2015 to 2020 (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	2016 to 2019	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 Select Board	2015 to 2020 (ongoing)	Town general fund	Medium

Table 26. Mitigation actions						
Hazard	Type[2]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Priority
Invasive species	Local Planning and Regulations	Complete surveys for ash trees vulnerable to Emerald Ash Borer in town highway ROW	BCRC; Bennington County Conservation District	2015 to 2018	FEMA HMGP, PDM VT Department of Forests, Parks and Recreation	Medium
Invasive species	Local Planning and Regulations	Survey for invasive species (e.g., Japanese knotweed)s along streams to identify potential erosion areas	Batten Kill Watershed Alliance/ Dorset Conservation Commission	2016 to 2018	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	Town Planning Commission	2015 to 2020 (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	2015 to 2017	Town general fund /State of Vermont Department of Parks, Forestry and Recreation	High

E. Monitoring, Evaluating and Updating This Plan

1. 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 intends to involve the public in the implantation, review and update of this plan. 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, the U.S. Forest Service 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 the public involvement, agency review and adjacent town review requirements of Vermont statutes.

2. Plan Evaluation and Update

The Dorset Select Board will be responsible for serving as or creating a planning team for evaluating and updating the plan. At least one year before the five year period covered by this plan, the planning team will initiate a review of the plan by:

1. Updating the descriptions and analyses of events using new information since completion of the 2015 draft.
2. Identification of any new buildings or infrastructure or changes in critical facilities.
3. Estimation of potential probability and extent of hazards based on any new information since completion of the 2015 plan and the updated Town Plan.
4. Review of completed hazard mitigation projects.
5. Identification of new projects given the revised hazard evaluation.
6. Review of any changes in priorities since adoption of the 2015 plan.
7. Revision of the assessment of risks and vulnerability from identified hazards.
8. Development and use of criteria to assess the potential benefits and costs of identified actions for use in prioritizing those actions.
9. Integration of the updated plan into the Dorset 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 Dorset 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. 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, Dorset 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.

3. Local Emergency Operations Plan

The Local Emergency Operation Plan (LEOP) provides contact information and lists the steps to setting up an incident command structure, assessing risks and vulnerabilities, and providing for resources and support. The plan primarily forms the basis for managing emergencies using the Incident Command System. This plan must be updated by May 1 of each year. During the update process, events of the past year will be used to expand the plan as needed. Most events in the Town of Dorset involve accidents, structure fires, weather events that may close roads or down powerlines or involve search and rescue activities. Where such events point to actions that could serve to mitigate such hazards, these can be incorporated into the LEOP as well as used to amend the hazard mitigation plan, the Town Plan, the budget or road maintenance and construction plans.

VI. References and Sources of Information

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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. 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://vcgi.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://vcgi.vermont.gov/
National Land Cover Data originally from USGS.

Map 3. Vermont Center for Geographic Information, http://vcgi.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/

Map 4. Vermont Center for Geographic Information, http://vcgi.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/

Map 5 Vermont Center for Geographic Information, http://vcgi.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/
Surficial Geology and Hydrogeology of Dorset, Vermont, David DeSimone and Marjorie Gale 2009, http://www.anr.state.vt.us/dec/geo/DorsetMain.htm

Map 6. Vermont Center for Geographic Information, http://vcgi.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 7. Vermont Center for Geographic Information, http://vcgi.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/
Surficial Geology and Hydrogeology of Dorset, Vermont, David DeSimone and Marjorie Gale 2009, http://www.anr.state.vt.us/dec/geo/DorsetMain.htm
Vermont Agency of Transportation accident location data.

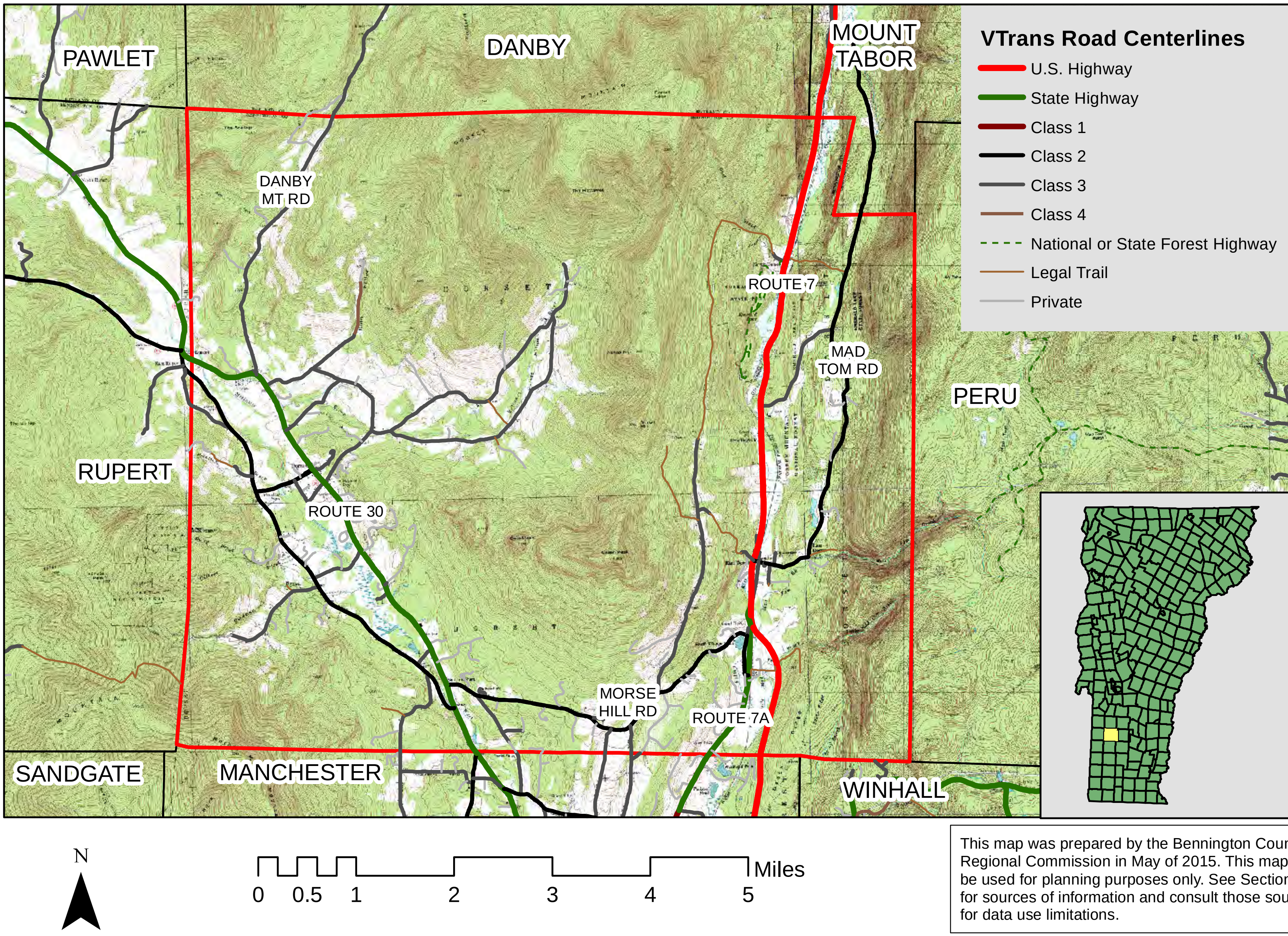
C. Personal Communication Sources

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

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

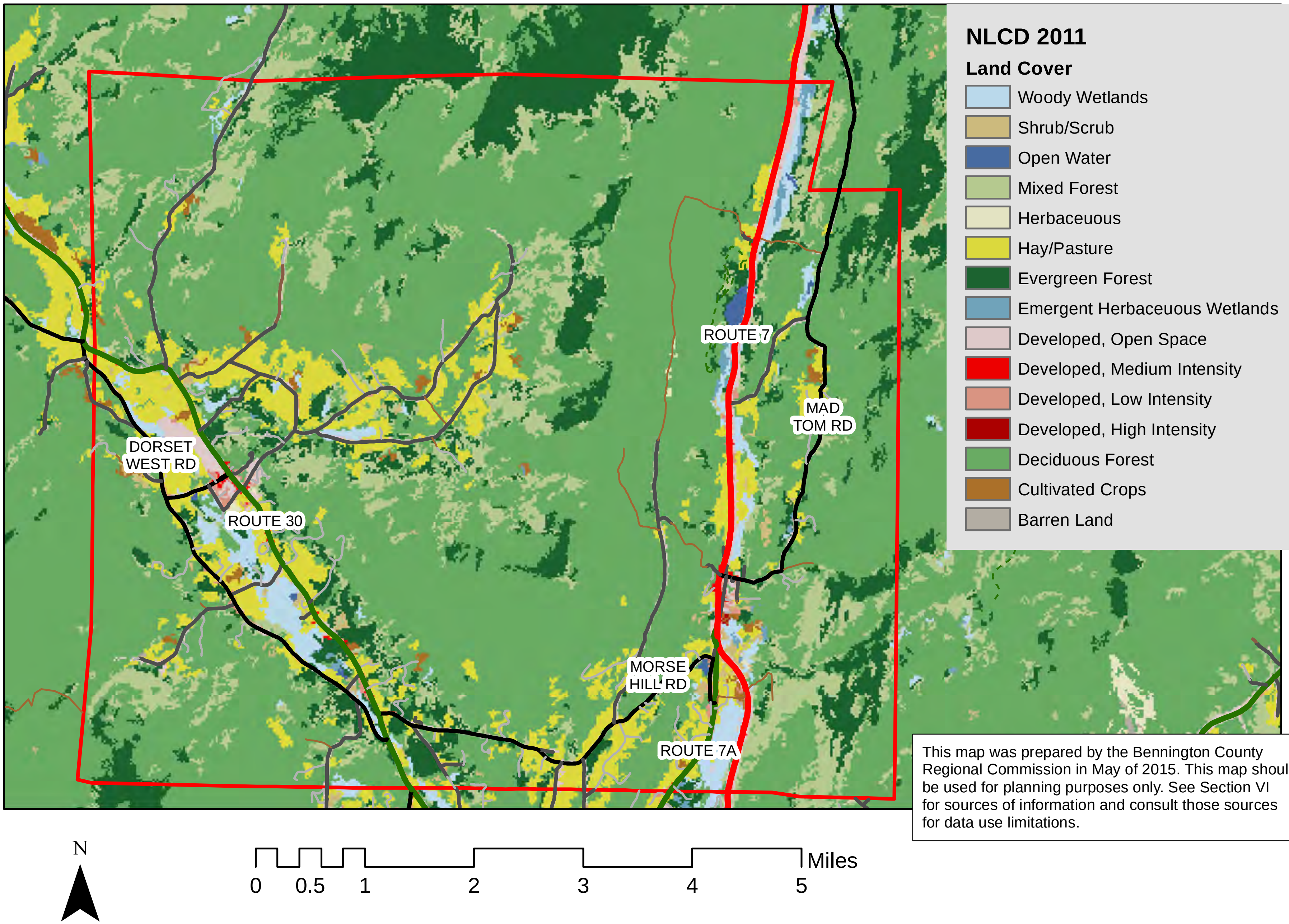
George Springston, Norwich University, Northfield, VT gsprings@norwich.edu

Map 1. Town of Dorset



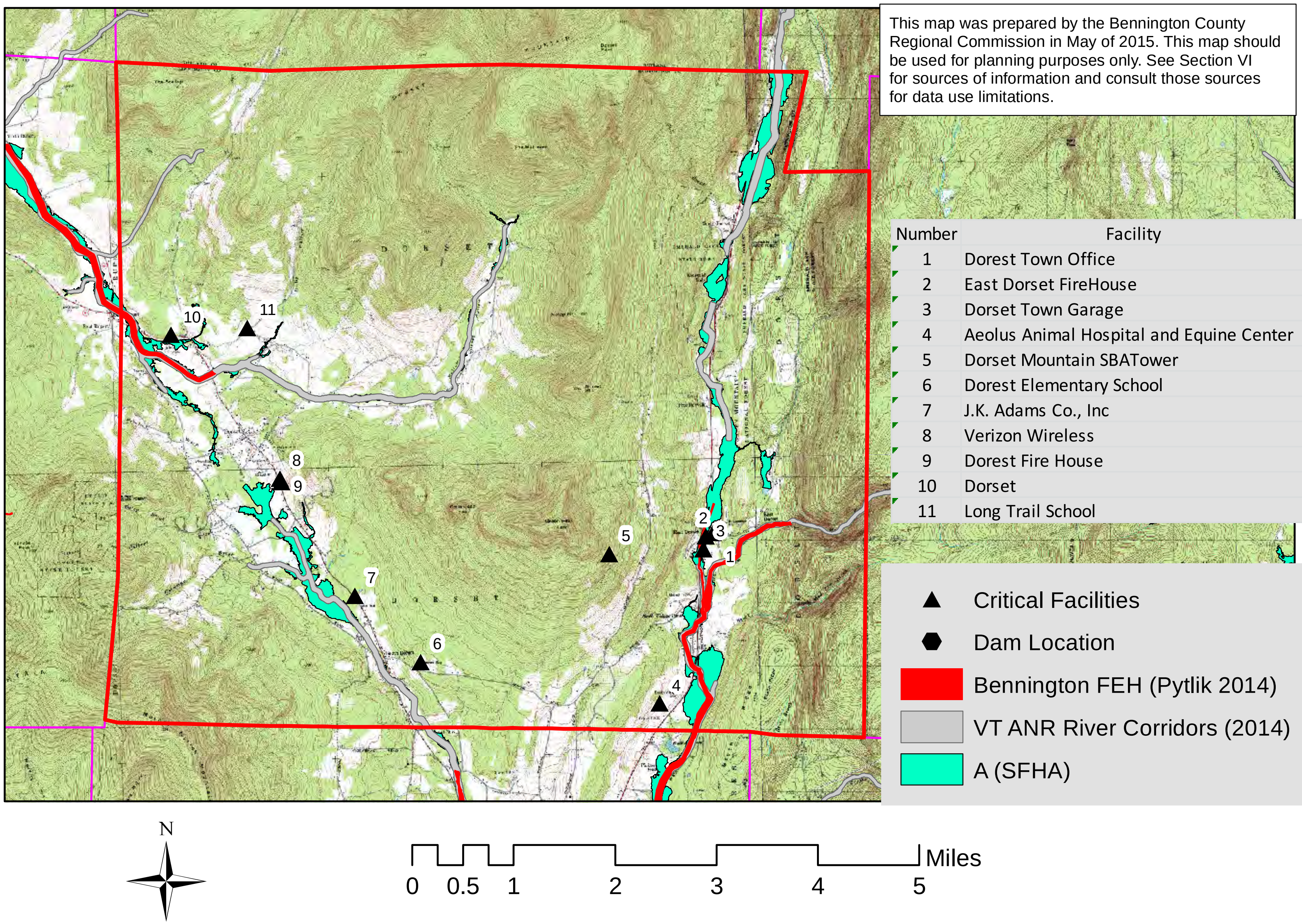
This map was prepared by the Bennington County Regional Commission in May of 2015. This map should be used for planning purposes only. See Section VI for sources of information and consult those sources for data use limitations.

Map 2. Town of Dorset Land Cover



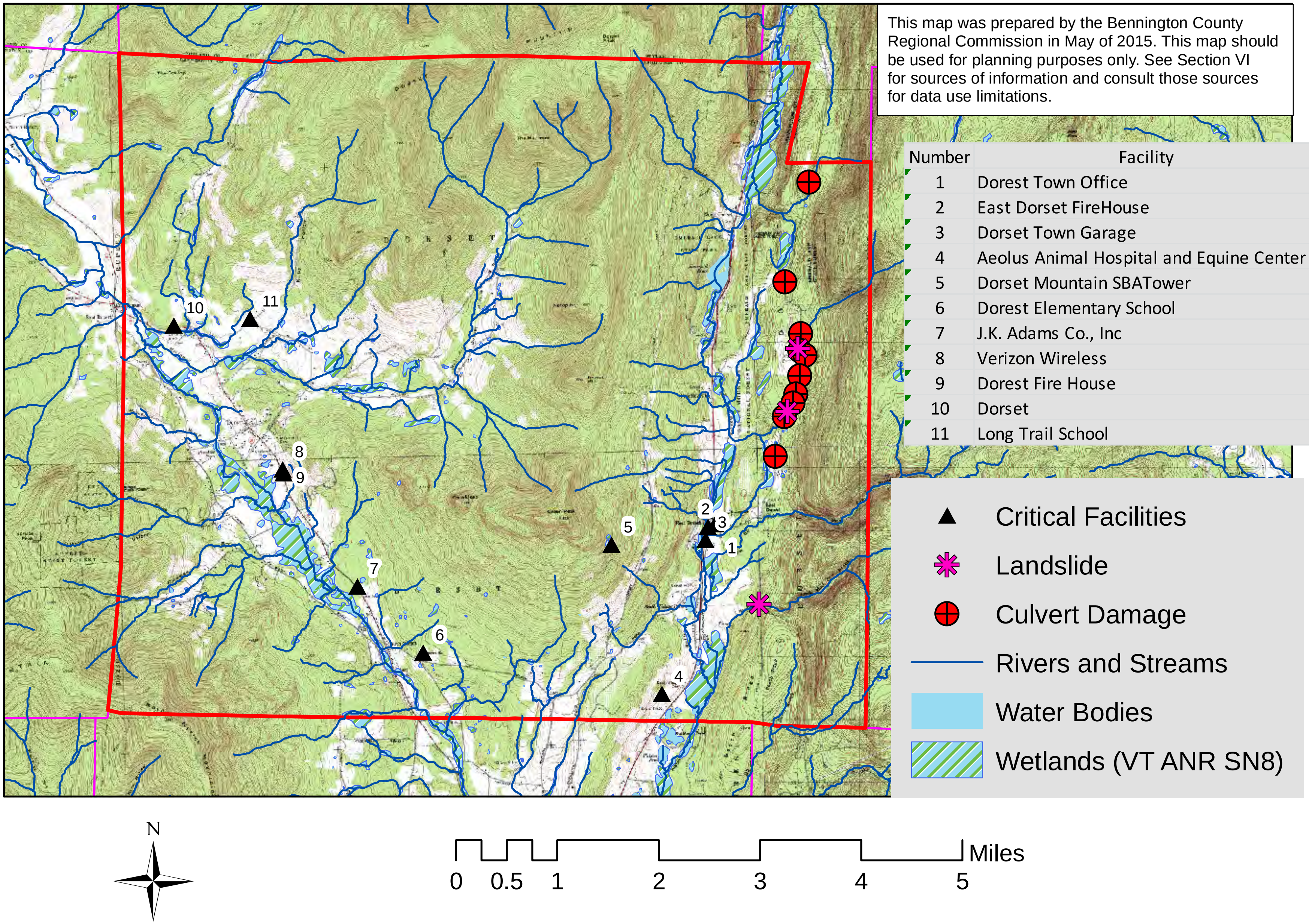
This map was prepared by the Bennington County Regional Commission in May of 2015. This map should be used for planning purposes only. See Section VI for sources of information and consult those sources for data use limitations.

Map 3. Town of Dorset Special Flood Hazard Zones, Fluvial Erosion Hazard Zones and River Corridors



Number	Facility
1	Dorest Town Office
2	East Dorset FireHouse
3	Dorset Town Garage
4	Aeolus Animal Hospital and Equine Center
5	Dorset Mountain SBATower
6	Dorest Elementary School
7	J.K. Adams Co., Inc
8	Verizon Wireless
9	Dorest Fire House
10	Dorset
11	Long Trail School

Map 4. Town of Dorset Tropical Storm Irene Damages



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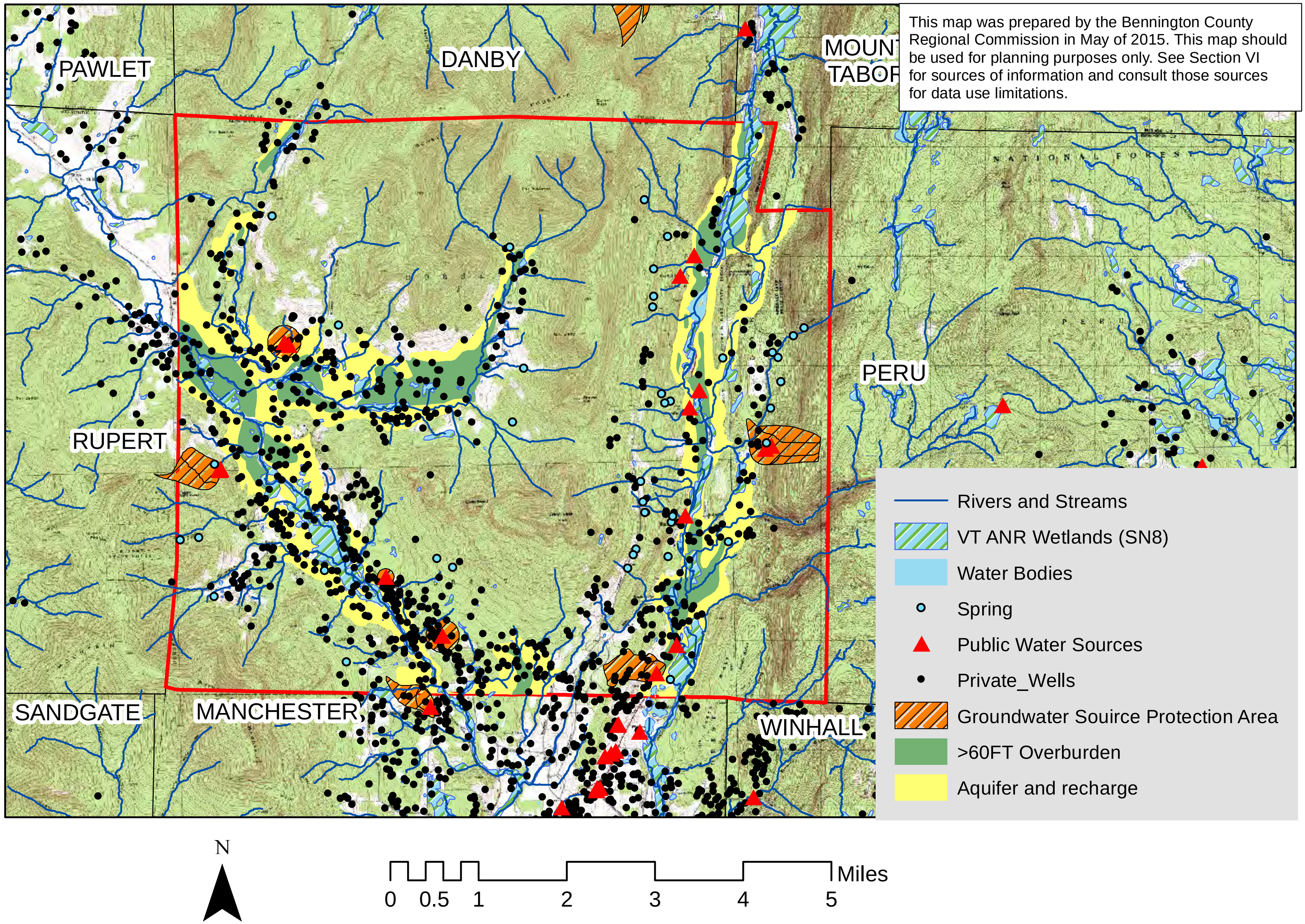
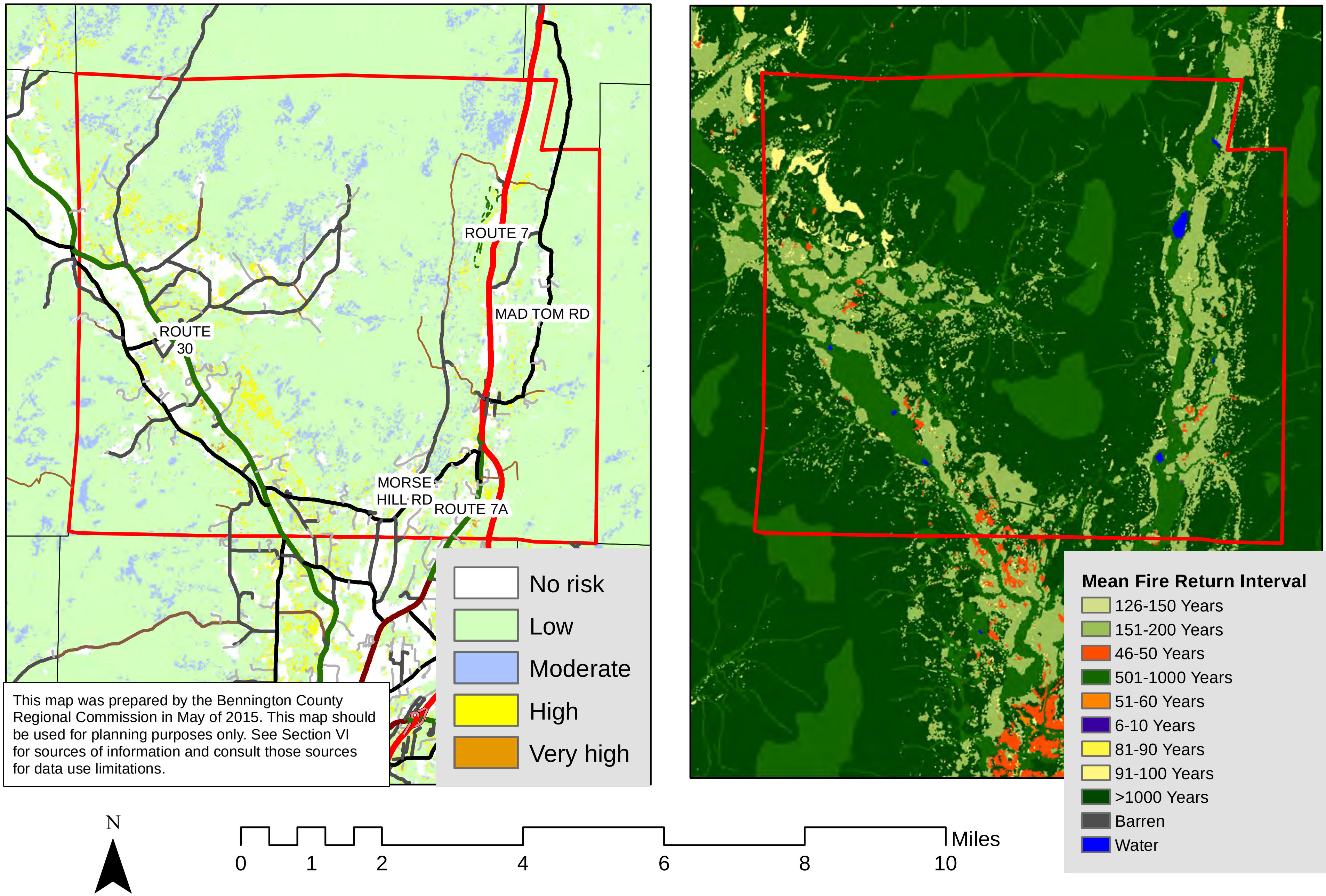
Map 5. Town of Dorset Surface and Groundwater Resources



Map 6. Town of Dorset Wildland Fire Potential



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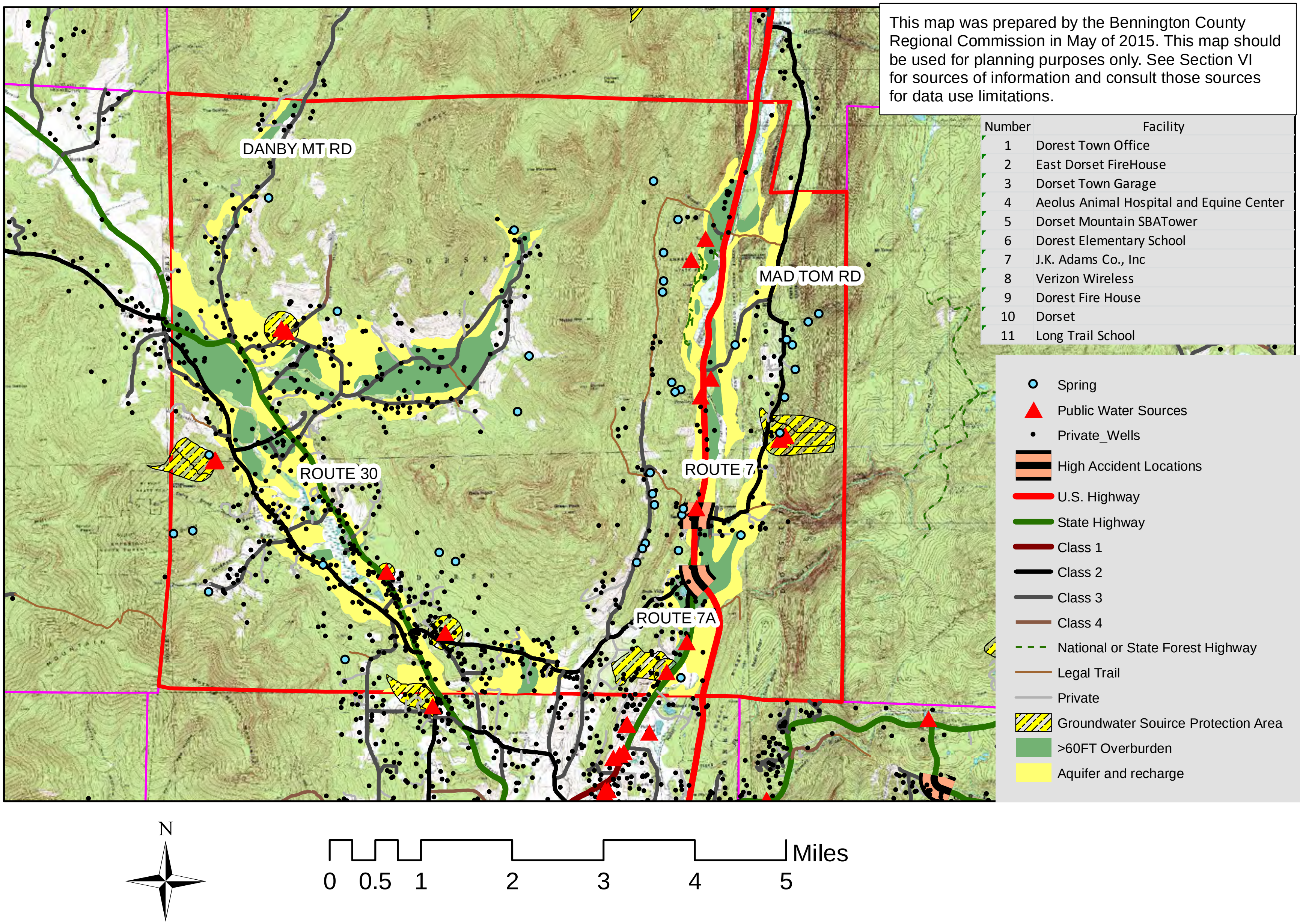
Map 7. Town of Dorset Hazardous Spills Vulnerability



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