

Town of Berlin, VT
Local Mitigation Plan Update
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Prepared by Town of Berlin and CVRPC

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1. Introduction

The impact of expected, but unpredictable natural and human-caused events can be reduced through community planning. The goal of this Local Mitigation Plan is to make the Town of Berlin more disaster resistant.

Hazard mitigation is any sustained action that reduces or eliminates long-term risk to people and property from natural and human-caused hazards and their effects. Based on the results of previous Project Impact efforts, FEMA and State agencies have come to recognize that it is less expensive to prevent disasters than to repeatedly repair damage after a disaster has struck. This Plan recognizes that communities have opportunities to identify mitigation strategies and measures during all of the other phases of emergency management – preparedness, response, and recovery. Hazards cannot be eliminated, but it is possible to determine what the hazards are, where the hazards are most severe, and identify local actions that can be taken to reduce the severity of the hazard.

Hazard mitigation strategies and measures alter the hazard by eliminating or reducing the frequency of occurrence, avert the hazard by redirecting the impact by means of a structure or land treatment, adapt to the hazard by modifying structures or standards, or avoid the hazard by preventing or limiting development.

2. Purpose

The purpose of this Local Mitigation Plan is to assist the Town of Berlin in recognizing hazards facing their community and identify strategies to begin reducing risks from acknowledged hazards.

Berlin strives to be in accordance the strategies, goals and objectives of the State Hazard Mitigation Plan, including an emphasis on proactive pre-disaster flood mitigation for public infrastructure, good floodplain and river management practices, and fluvial erosion risk assessment initiatives.

The 2011 Berlin Local Hazard Mitigation Plan is an update of the 2005 plan. The plan has been reorganized and new sections have been added regarding:

- Plan Update Process
- Plan Maintenance
- Update of worst and non worst threat hazards
- Updates of Local Areas of Concern Map
- Status update of 2005 mitigation strategies
- Identification of new mitigation strategies

3. Community Profile

The Town of Berlin is located in the center of Washington County. It is surrounded by eight municipalities, including the urbanized areas of Montpelier and Barre City. According to the 2010 US Census, Berlin has a total population of 2,887. Approximately 25% of Berlin's

workforce is employed within the Town, with the remaining 75% working outside of the community.

The Town's major thoroughfare, Interstate 89, travels from the Town's southeastern border to its northern border with Montpelier. Two Interstate exits are located entirely within the Town, with a third just beyond its northern border. Other significant roads include Vermont 63 and Vermont 62 (both of which connect the Interstate to the eastern part of the County), US Route 302 (Barre-Montpelier Road, which follows the Stevens Branch and serves as the major connector for Barre City and Montpelier), and Vermont 12 (which follows the Dog River and serves as the major connector between Montpelier and Northfield).

Housing within the Town is widely dispersed. There are 1,236 housing units in Berlin. Since 2000 the number of housing units has increased by 5.46%. Residential growth through the Town continues to be of lower densities and scattered.

While the resident population may not be exploding, there is some evidence that the employment population (and correspondingly, the commercial/service infrastructure/square footage) is. According to the Central Vermont Chamber of Commerce, Berlin's employment is currently about three times its workforce. In addition, the Town has absorbed almost 2,000 new jobs (representing a 60 % increase) since 1990, (compared to just 327 new residents) and now hosts over 15% of the Region's workforce. Much of the new retail/service growth (including a supermarket, office supply store, motel, auto dealership) and expansion of existing business (hospital, insurance) has occurred in the "Plateau/Four corners" section of Town. Traffic studies are being performed around the mall, hospital and Route 62 intersection to address growing traffic and accident concerns.

Current zoning regulations focus non-residential development and high density residential development within this region, essentially along US Route 302 and extending westerly to Interstate 89. Berlin contains the Region's only State airport, E.F. Knapp Airport, only hospital, Central Vermont Medical Center, and only indoor mall, Berlin Mall. Zoning regulations encourage growth to stay in the northeast quadrant area, while allowing low density rural residential growth in the remainder of the town. Development in the flood hazard overlay area is highly restricted and the Town is in the process of revising the current boundaries to expand the area due to past flooding events.

In Berlin, electricity is provided by Green Mountain Power to those residents who are situated along the major transportation corridors of US 302, Vermont 62, and Vermont 12. Washington Electric Cooperative primarily serves residents that are located in the hills and along the back roads. Development along US Route 302 and the Central Vermont Medical Center segment of the Plateau Area are served by an existing water system. Community members outside of these two areas depend on ground water for domestic water supply and industrial uses.

The Berlin Volunteer Fire Department provides fire protection to the Town from two stations: Riverton (located in the western half of the Town along Vermont Route 12) and the Berlin

Corners area. Berlin is also a member of the Capital Fire Mutual Aid System which includes all of the Towns in Washington County and some surrounding communities. Ambulance service is provided by the Town of Barre Emergency Management Services. In 2003 the Berlin Volunteer Fire Department responded to 26 structure fires within the borders of the municipality.

Police service is provided by the Berlin Police Department. At present the Department staffs seven officers. The Department complaint total exceeds 6,500 annually. Vermont State Police are relied upon to provide supplemental support and the Washington County Sheriff's Department provides additional speed control on major routes.

The Town of Berlin has an approved Basic Emergency Operations Plan that was adopted in 2009 and is periodically updated.

The Town Plan includes goals and objectives in regards to flood plains, steep slope development, transportation, and public services. The Zoning Regulations include a stream protection section which has instituted a vegetated buffer strip of 75 feet from all streams and rivers and 50 feet from any wetland.

4. Planning Process and Maintenance

4.1 Planning Process

The Central Vermont Regional Planning Commission coordinated the Berlin Pre-Disaster Mitigation Plan process. The Regional Planning Commission contacted the Town Administrator, Jeff Shultz, and sent him Town Specific mitigation planning material for his review. After assessing the material, Mr. Shultz and the Regional Planning Commission held a meeting on August 09, 2011 at the Berlin Town Office Building. This meeting focused on generating an inventory of the Town's vulnerability to hazards and its current and future hazard mitigation programs, projects and activities. The Berlin Town Administrator was charged with the responsibility of soliciting the involvement of all appropriate parties based upon the nature of the mitigation materials. Attendees included:

- Jeff Shultz, Town Administrator
- Jennifer Mojo, CVRPC

Preparation for the meeting included a review of Berlin's adopted planning documents, including the Berlin Town Plan, the Berlin Zoning Regulations, Norwich University Hazard Mitigation Plan, A Report on the Seismic Vulnerability of the State of Vermont, State of VT Hazard Mitigation Plan, and the Basic Emergency Operations Plan. Additional documents reviewed include the Dog River Corridor Plan, Roxbury Mitigation Plan, Northfield Mitigation Plan, and a review of local newspaper articles. Information from these documents is incorporated into numerous sections of the plan during the planning and update process.

The meeting indicated that the Town is most vulnerable to earthquakes, flood/flash flood/fluvial erosion, high winds/hurricane, winter storms and forest fire. Moderate threat

hazards include structure fire. Previously hazards included flooding, hazardous materials and highway/transport accidents. Berlin feels hazardous materials and transport/traffic accidents are less of a threat due to Town wide changes that have been made over the past 5 years. Hazardous Materials and Transport/traffic accidents are addressed more thoroughly in the basic emergency operations plan and instead, are now attached as an appendix. The Town is making flood mitigation a priority due to the severe flood events which occurred in 2011. Flooding is the most damaging and common hazard within Berlin.

Once the draft was updated, CVRPC placed a notice for public comments of the draft update on the CVRPC blog and newsletter. The draft update was also available at Berlin Municipal offices and by request from CVRPC for public review and comments from 11/08/2011 to 12/31/2011. The announcement of the draft update in the CVRPC newsletter reached over 150 people and businesses in the Region's 23 towns, including the adjacent towns of Moretown, Montpelier, Barre City/Town, Northfield, Williamstown, and East Montpelier. No comments were received by CVRPC or Berlin Staff. Public comments submitted in the future will be reviewed by the Town Administrator (and CVRPC Staff dependant on funding) and attached as an appendix. In the future, the draft plan will be made available during Town Meeting Day and local meetings with State and local officials to allow for more public comment and review. After Approval Pending Adoption, the plan will go before the Select Board for adoption.

4.2 Plan Update Process

The Berlin Local Mitigation Plan was originally adopted by the Town as an Annex to the Central Vermont Regional Pre Disaster Mitigation Plan in November 2005 and received FEMA final approval in January 2006. The 2011 update is intended to be submitted as a standalone town PDM Plan.

The entire plan was revised and the updated. Below is a list of the revisions that have been made from the past plan and the appropriate sections for reference. New hazards identified include earthquakes, high winds/hurricanes, structure and forest fire.

General Updates

- General reorganization/restructuring of the plan according to future FEMA/VEM checklist
 - New sections added – 4.2 Plan Update Process, 4.3 Plan Maintenance, 5.2 Earthquakes, Hurricane/Severe Storm, Wild Fire, Winter Storms 5.3 Structure Fire
- Update of all data and statistics using 2011 Town Report and US Census Data (Section 3)
- Revaluation, identification and analysis of all significant hazards (new hazards identified from 2005 plan include earthquakes, high winds/hurricanes, structure and forest fire and water supply contamination) (Section 5)
- Acknowledgment of implemented mitigation strategies since 2005 – see matrix below (section 4.2)

- Identification of on-going mitigation projects and strategies – see Existing Mitigation Programs, Projects and Activities section (section 4.2)
- Identification of new mitigation projects and strategies – see Hazard Mitigation Activity Matrix and Dog River Corridor Plan attachments

Hazard Analysis Update (Sections 5 and 6)

- New hazards added – earthquakes, structure fire, wildfire, hurricane/severe storms, winter storms
- Added location/vulnerability/extent/impact/likelihood table for each hazard to summarize hazard description (Section 5.1-5.3 – after each hazard)
- Review of Norwich Hazard Mitigation Plan and A Report on the Seismic Vulnerability of the State of Vermont to develop earthquake hazard analysis
- Review of Vermont Hazard Mitigation Plan (Section 5 – hazard analysis table)
- Review of Dog River Corridor Plan for information regarding flood/fluvial erosion hazard and mitigation project ideas (section 5.2)
- Updated federal declarations

Maps

- Added state forest layer
- Updated and added frequently flooded areas/flood prone areas

Since 2005, Berlin has started working on new flood hazard regulations. The regulations are currently in draft form and hearings are ongoing. The new regulations will not allow new development in flood plain areas. The Town is also considering drafting fluvial erosion hazard overlays and regulations in the future.

2005 Mitigation Action	2011 Status
Provide alternative access to residents living on Cedar Drive and within the Partridge Farms development	No funding to build alternative access
Institute a propane tank anchoring system for properties located within NFIP designated floodplains	Partially completed
Reconstruct or relocate dangerous intersection of VT-62 at CVH that has a higher frequency of crashes and threatens to release hazardous materials into town	Study performed by DuBois & King to develop alternatives. SB endorsed concept and sent to CVRPC. Project is on VTrans priority list and moving forward
Install and wire the town emergency operation center (Elementary School) with permanent generators	Generators have been installed at the School, Town Hall and BVFD

Continuation of Emergency Drills and Development Plans for Emergency Operations focusing on the Montpelier Jct. area	A very active drill/exercise program has been in place for the past 2 years. Berlin's Multi-year training and exercise plan will be updated in January 2012.
Install a flash flood warning system	Installed a school warning system & run by a private company. Lack of funding to install full town run system

Existing Programs, Projects and Activities

The ongoing or recently completed programs, projects and activities are listed by strategy.

Community Preparedness Activities

- Basic Emergency Operations Plan – being updated in 2012
- Current Capital Equipment Plan
- Police Department's Natural Hazard Incident Database
- Emergency Drills – Town has an emergency management committee that conducts a wide range of exercises

Hazard Control & Protective Works

- Maintenance Programs (Culvert Survey & Replacement) – inventoried in 2009
- Participant in the Capital Mutual Aid System

Insurance Programs

- Participation in NFIP

Land use Planning/Management

- Zoning Ordinance
 - Section 2.4 – Flood Hazard Overlay District – revisions in process (2010)
 - Permitted and Conditional uses along with development standards and flood hazard standards
 - Section 3.14 – Stream Protection
 - Vegetated buffer strip of 75 feet from all stream s and rivers and 50 feet from any wetland.
- Septic Site Approval Ordinance

Protection/Retrofit of Infrastructure and Critical Facilities

- Dry Hydrant Program
- Fire Safety Educational Programs for Town Residents

4.3 Plan Maintenance Process

The Berlin Local Hazard Mitigation Plan will be updated and evaluated annually at a March Select Board meeting. Updates and evaluation by the Select Board will also occur within six months after every federal disaster declaration and as updates to town plan/zoning and river corridor plans come into effect. The plan will be reviewed by the Select Board, Zoning Administrator, Town Administrator and public at the abovementioned March select board meeting. CVRPC will help with updates or if no funding is available, the Town Administrator will update the plan.

The process of evaluating and updating the plan will include continued public participation through public notices posted on the municipal website, town newsletter and CVRPC newsletter and blog inviting the public to the scheduled Select Board (or specially scheduled) meeting. Additional stakeholders invited to the meeting will be Central Vermont Medical Center, the school, and owners of the Berlin Mall. Also invited in the future will be the VT Agency of Natural Resources (VT ANR), as they are able to provide assistance with NFIP outreach activities, models for stricter floodplain zoning regulations, delineation of fluvial erosion hazard areas, and other applicable initiatives. These efforts will be coordinated by the Town Administrator.

Monitoring of plan progress, implementation, and the 5 year update process will be undertaken by the Town Administrator. Monitoring updates may include changes in community mitigation strategies; new City bylaws, zoning and planning strategies; progress of implementation of initiatives and projects; effectiveness of implemented projects or initiatives; and evaluation of challenges and opportunities. The plan is to be a “living document” to allow for new actions to be identified in the five year interim period and amended without formal re-adoption during regularly scheduled Select Board meetings. After a five year period, the plan will be undergo a formal update and submitted to FEMA for re-adoption following the process outlined the schematic found in the Attachments section.

Berlin shall also incorporate mitigation planning into their long term land use and development planning documents. It is recommended the Town review and incorporate elements of the Local Hazard Mitigation Plan when updating the municipal plan, zoning regulations, and flood hazard/FEH bylaws. The incorporation of the Local Hazard Mitigation Plan into the municipal plan, zoning regulations and flood hazard/FEH bylaws will also be considered after declared or local disasters. The Town shall also consider reviewing future Dog River Corridor planning documents for ideas on future mitigation projects and hazard areas.

5. Risk Assessment

5.1 Hazard Identification and Analysis

The following natural disasters were discussed and the worst threat hazards were identified based upon the Probability of the event and the community’s vulnerability to the event. Hazards not identified as a “worst threat” may still occur. Greater explanations and mitigation strategies of non “worst threat” hazards can be found in the State of Vermont’s Hazard Mitigation Plan.

- Hazard	Probability ¹	Community Vulnerability ²	Worst Threat
Avalanche/ Landslide	Low	No	
Dam Failures	Low	No	
Drought	Low	No	
Earthquake	Low	Yes	✓
Extreme Cold/Winter Storm/Ice Storm	High	Yes	✓
Flash Flood/Flood/Fluvial Erosion	High	Yes	✓
High Wind/Hurricane/Severe Storms	Med	Yes	✓
Ice Jam	Low	No	
Structure Fire	Med	No	
Wildfire/Forest Fire	Med	Yes	✓
Other – Highway/Transport Crashes	Med	Yes	See appendix
Other- Hazardous Materials Transport	Med	Yes	See appendix

The Town of Berlin identified the following disasters as presenting the worst threat to the community:

- Earthquake
- Flash Flood/Flood/Fluvial Erosion
- High Wind/Hurricane/Severe Storms
- Wildfire/Forest Fire
- Extreme Cold/Winter Storm/Ice Storm

Moderate Threat Hazards

- Structure Fire

A discussion of each worst and moderate threat hazard is included in the proceeding subsections and a map identifying the location of each hazard is attached (See map titled *Areas of Local Concern*.) Each subsection includes a list of past occurrences based upon County-wide FEMA Disaster Declarations (DR-#) plus information from local records, a narrative description of the hazard and a hazard matrix containing the following overview information:

¹ High Probability of happening: Near 100% probability in the next year.

Medium Probability of happening: 10% to 100% probability in the next year or at least once in the next 10 years.

Low Probability of happening: 1% to 10% probability in the next year or at least once in the next 100 years.

² Does the hazard present the threat of disaster (Yes)? Or is it just a routine emergency (No)?

Hazard	Location	Vulnerability	Extent	Impact	Probability
Type of hazard	General areas within municipality which are vulnerable to the identified hazard.	Types of structures impacted	Magnitude of hazard: Scale dependent on hazard	Dollar value or percentage of damages.	<u>High</u> : 10% to 100% probability within the next year or at least once in the next 10 years. <u>Medium</u> : less than 10% to 100% probability within the within the next year or less than once in the next 10 years.

The following hazards were found to be most significant in the Town of Berlin.

5.2 Worst Threat Hazards

Earthquake

An earthquake is a sudden release of energy in the earth's crust or upper mantle, usually caused by movement along a fault plane or by volcanic activity and resulting in the generation of seismic waves which can be destructive.

Vermont is located in a moderate hazard earthquake region. Since 1843, there have been 63 earthquakes which have had epicenters located in Vermont. The strongest of these earthquakes measured 4.1 on the Richter scale in Swanton (1943) and Middlebury (1962.) Stronger earthquakes originating in NY have also been felt in Vermont. In 1988 and 2002 quakes originating in Saguenay, Quebec (6.2) and Plattsburg, NY (5.2) were felt in Vermont.

A 1995 report titled A Report on the Seismic Vulnerability of the State of Vermont by John E. Ebel, Richard Bedell and Alfredo Urzua, states that it is very difficult to predict earthquakes in all of New England. No active faults have been identified in Berlin or New England. Hazus reports have been made for several counties in Vermont to determine the impacts of an earthquake. No such model has been made for Washington County; however, a model for Washington County could be a possible future study.

The worst anticipated earthquake expected in Berlin is difficult to estimate as there have been limited past occurrences. Based on the limited past occurrences in Vermont, an estimate of the worst anticipated earthquake in Berlin would be 6.2 on the Richter Scale. IN the future, Berlin can better monitor the USGS earthquake notices and warnings for earthquakes in the surrounding area. Records of earthquakes in Berlin and surrounding areas can be recorded using the Mercalli/Richter Scale shown below.

Mercalli/Richter Scale Comparison

Mercalli Scale	Richter Scale	Full Description
I.	0 – 1.9	Not felt. Marginal and long period effects of large earthquakes.
II.	2.0 -2.9	Felt by persons at rest, on upper floors, or favorably placed.
III.	3.0 – 3.9	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.
IV.	4.0 - 4.3	Hanging objects swing. Vibration like passing of heavy trucks. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink the upper range of IV, wooden walls and frame creak.
V.	4.4 - 4.8	Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Pendulum clocks stop, start.
VI.	4.9 - 5.4	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Books, etc., off shelves. Pictures off walls. Furniture moved. Weak plaster and masonry D cracked. Small bells ring. Trees, bushes shaken.
VII.	5.5 - 6.1	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices. Some cracks in masonry C. Waves on ponds. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
VIII.	6.2 - 6.5	Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.
IX.	6.6 - 6.9	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.
X.	7.0 - 7.3	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.
XI.	.7.4 - 8.1	Rails bent greatly. Underground pipelines completely out of service.
XII.	> 8.1	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

Berlin has had no history of earthquake damage. The extent of an earthquake is unable to be estimated due to the limited past occurrences. Past quakes not in Berlin ranged from 4.1 to 6.2 on the Richter scale. The age and building materials of many structures in Berlin makes them

susceptible to earthquake damage. Unreinforced masonry buildings and buildings with stone and concrete decorative cornices/lintels are the most susceptible. In downtown Berlin, there are several larger 4-5 story office complex buildings, as well as the Berlin Mall and Central Vermont Medical Center. Both of these buildings are major anchors of the communities and if damaged would impact public and economic health of Berlin and Washington County. Large buildings identified to be the most susceptible are Central Vermont Medical Center, Berlin Mall, and large commercial/office complexes. There are also several mobile home parks which if a mobile home is not tied down, could be greatly impacted. Route 89 also has several overpasses located in Berlin, which if damaged, would cause major traffic delays and detours.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Earthquake	Town Wide – commercially zoned areas; mobile home parks	Older/taller unreinforced masonry structures, mobile home parks, Berlin Mall, Central Vermont Medical Center, large commercial/office complexes, Rt 89 bridges	4.1-6.2 on Richter Scale (not in Berlin)	>\$5 million for buildings, >\$500,000 per bridge - 10 commercial/office complexes, 1 hospital, 1 mall, 3 highway bridges	Low

Flood/Flash Flood/Fluvial Erosion

Flooding/flash flooding/fluvial erosion is Berlin's most commonly recurring hazard. Flooding is the overflowing of rivers, streams, drains and lakes due to excessive rain, rapid snow melt or ice. Flash flooding is a rapidly occurring flood event usually from excessive rain. Fluvial erosion is the process of natural stream channel adjustments. Fluvial erosion causes erosion of sediment in some areas, while causing aggradation of sediment in other. Fluvial erosion processes occur more quickly and severely during flood events.

Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of time. If these floodplain areas were left in their natural state, floods would not cause significant damage. Development has increased the potential for flooding because rainfall that used to soak into the ground or take several days to reach a body of water now quickly runs off streets, parking lots and rooftops and through human-made channels and pipes.

History of Occurrences (within Berlin and Central Vermont from NCDC Website and FEMA DR List. Closest flood gauge is located in Montpelier, VT approximately 6 miles downstream on the Winooski River):

Date	Event	Location	Extent
8/28/2011	Flood/Tropical Storm	Statewide, Berlin	Montpelier Flood gauge at 19.05 feet (flood stage is at 15 feet) – DR 4022
5/27/2011	Flash Flood	Berlin, County Wide	Montpelier flood gauge at 17.59 feet, 3-5" of rain – DR 4001
8/02/2008	Flash Flood	Berlin, County Wide	2-5" of rain
7/11/2007	Flash Flood	Berlin, County wide	3-6" of rain in 2 hrs, DR 1715
4/14/2002	Flood	County wide, Berlin	1-3" of rain across the county
12/17/2000	Flood	County Wide, Berlin	3" of rain, \$1 M in damages
9/16/1999	Tropical Storm Floyd	County Wide, Berlin	Montpelier flood gauge at 9.30 feet, 5-7" rain county wide, DR 1307
6/27/1998	Flash Flood	Berlin, County Wide	\$2M in damages, 3-6" rain across county, DR 1228
7/15/1997	Flash Flood	County Wide	2-4" of rain, \$500k in damages
1/19/1996	Flood; ice jam	County Wide, Berlin	Montpelier flood gauge at 14.64 feet
8/10/1976	Flood	County Wide, Berlin	Montpelier flood gauge at 12.31 feet, DR 518
6/30/1973	Flash Flood	Barre Town	Montpelier flood gauge at 17.55 feet
9/22/1938	Flood, Hurricane	County Wide, Berlin	Montpelier flood gauge at 14.11 feet
11/03/1927	Flood	County Wide, Berlin	Montpelier flood gauge at 27.10 feet

Specific extent data for flood levels in Berlin is lacking as the closest flood gauge is located in Montpelier. During Tropical Storm Irene and the May 2011 events, flooding in Berlin was severe along the Dog River and Stevens Branch. The Montpelier flood gauge was 4 feet above flood stage. Flooding in certain areas was up to 5 feet (see flood map attached.) The worst flooding event in Berlin's history was the 1927 event; however, exact data from that event is not

available. In 1927 event, the Montpelier flood gauge was at 27.10 feet; however, since the 1927 flood a number of flood control dams have been installed in the region to prevent the same flooding extent. Lesser but more regular flooding occurs in Berlin, with generally 1-2 feet of water along low lying areas by the Stevens Branch and Dog River. These areas are identified on the local areas of concern map. Berlin and Barre City can work together to have a river gauge installed so that the Town may better monitor flood levels.

Four significant bodies of water exist within Berlin: the Dog River along VT Route 12, Berlin Pond, the Stevens Branch Creek along US Route 302, and the Winooski River along US Route 2, Junction Road, and Three Mile Bridge Road. Significant flooding and ice jams are common on the above mentioned rivers.

The majority of development along the US 302 corridor (Stevens Branch Creek), the lower section of the Dog River, and the Montpelier Junction area are located within the Nation Flood Insurance Program's (NFIP) designated 100-year floodplain. Based on the results of overlaying the FIRM flood maps with the location of E911 points, there are 263 properties and 118 structures located in the floodplains. There are 2 repetitive loss properties located on the Barre-Montpelier Road in Berlin. The properties are both residential – one is a single family home and the other is a 2-4 multifamily home. The effective date of Berlin's FIRM is 8/15/1984. The estimated loss for a severe flooding event for all properties located within the Town's 100-year floodplain is approximately \$77,185,800. Berlin has 47 active NFIP policies with a total coverage of \$7,161,400. The Zoning Administrator is responsible for enforcement of flood hazard regulations. The Town has not had any compliance issues; however, it was mentioned that the regulations are difficult to administer.

The Berlin mitigation meeting found the Montpelier Junction area to be particularly vulnerable to flood hazards. The Montpelier Junction area is located at the confluence of the Dog and Winooski Rivers. The entire area is situated within a designated Well Head Protection Area and most of the region is either within or near to a NFIP designated Floodplain. This area serves as the Montpelier stop for the New England Central Railroad (NECR) as well as its interchange with the Washington County Railroad. A variety of industrial uses are located within this area, including DCP Mid-Stream (120,000 gallons of pressurized propane in above ground tanks) and the Capitol Steel & Supply Company.

A second area that was highlighted during the Berlin mitigation meeting is Partridge Road on the East side of the Stevens Branch Creek. The Partridge Road Bridge provides the only access to this area which includes Partridge Farms, a single-family and condominium development, and the 30 unit Berlin Mobile Home Park. An ice dam/block occurred on the Stevens Branch Creek approximately 8 feet downstream of the Bridge on January 19, 1996. The ice dam event flooded residents of the Berlin Mobile Home Park and stranded all of the individuals on the East side of the Creek. This incident has brought attention to other properties that are located within reach of a potential ice dam/block or flooding event. The River Run Mobile Home Park is a 35 unit development that is located along a bend of the Stevens Branch Creek and within the NFIP designated 100-year floodplain. This development is susceptible to flood related events.

The River Run Mobile Home Park was again flooded in the spring 2011 flood event and most of the residents were displaced. Some residents returned; however, many did not.

As previous events have made clear, areas beyond the NFIP designated 100-year floodplain may be particularly vulnerable to these types of hazards. Channel adjustments with devastating consequences have frequently been documented wherein such adjustments are linked to historical channel management activities, floodplain encroachments, adjacent land use practices and/or changes in watershed hydrology associated with conversion of land cover and drainage activities, within and beyond the NFIP floodplain.

A corridor plan for the Dog River was developed by VT Agency of Natural Resources. The plan assesses the Dog River until its convergence with the Winooski River in Montpelier. The stretch of river in Berlin was rated in “fair” condition; the river is undergoing “high” to “moderate” bank adjustments and fluvial erosion. The fluvial erosion hazard map of Berlin is located in the appendix. The high rates of adjustment and erosion can be attributed to several factors – straightening of the river channel, development encroachments, high levels of storm water runoff, historic gravel mining and dredging activities, undersized culverts and bridges, and lack of riparian buffers greater than 25 feet. In Berlin, there are 3 undersized bridges which should be replaced in order to decrease erosion and restore the River’s health. In addition to bridge projects, the plan identifies 19 projects that could be completed in Berlin to restore and renew the River’s health. The map and associated matrix of projects is attached as an appendix.

In both the spring 2011 floods and tropical storm Irene, Berlin experienced severe flooding as a result of flooding in the Dog River and 4-5” of rain falling in a very short period. A greater explanation of areas damaged is provided in the High Wind/Hurricane/Severe Storms section of this plan.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Flood/flash flood/fluvial erosion	Along Dog River, Stevens Branch, Winooski River, Montpelier Junction, Route 302 development, Route 12 development, see Severe storms locations	Properties in floodplain, mobile home parks, culverts, bridges, roadways	5-7 feet of water during TS Irene, 4-5” of rain in a 24 hr period	\$700,000 in past FEMA claims; \$77,185,800 for floodplain properties	High

High Winds/Hurricanes/Severe Storms














History of Occurrences (within Berlin and Central Vermont from NCDC Website and FEMA DR List. Closest flood gauge is located in Montpelier, VT approximately 6 miles downstream on the Winooski River):

Date	Event	Location	Extent
8/28/2011	TS Irene	Statewide	~6" rain , Montpelier flood gauge at 19.05 feet (flood stage is at 15 feet) DR 4022
5/27/2011	Severe Storm, flash flooding	Berlin, County Wide	1" hail, 3-5" of rain, 50 knot winds, DR 4001
7/21/2008	Severe storms, flooding	Berlin, County Wide	
8/25/2007	Severe Storms	Berlin, County Wide	55 knot wind gusts, 1" hail
7/9/2007	Severe Storms, hail, flooding	Berlin, County Wide	1"-2.75" hail, DR 1715
6/19/2006	Severe storms	County Wide, Berlin	50 knot winds, downed trees and power lines
8/1/2005	Severe Storm	Berlin, County Wide	1" hail, 55 knot winds
9/16/1999	Tropical Storm Floyd	Statewide	Tropical Storm, DR 1307
6/27/1998	Severe Storms	County Wide, Berlin	\$2M in damages, 3-6" rain across county, DR 1228
5/29/1998	Severe Storms	County Wide, Berlin	50 knot winds, heavy rains, downed trees and power lines
7/15/1997	Severe Storms	County Wide, Berlin	2-4" of rain, Not a historical crest
8/4-6/1995	Severe storms, flooding	County Wide, Berlin	DR 1063 Heavy rain, flooding – no NCDC/FEMA info
7/23/1990	Severe Storms, flash flooding	County Wide, Berlin	DR 875 Heavy rain, flooding – no NCDC/FEMA info
8/4/1989	Severe Storms, Flooding	County Wide, Berlin	DR 840 Heavy rain, flooding – no NCDC/FEMA info
6/7/1982	Severe Storms	New England	14" of rain, \$276 M damages
8/5/1976	Hurricane Belle	Statewide	Gale force winds, 2 deaths, DR 518
7/3/1964	Hail	County Wide, Berlin	1.5" hail
9/22/1938	Hurricane	Statewide	Category 1 force winds

Hurricanes and tropical storms are violent rain storms with strong winds that have large amounts of rainfall and can reach speeds up to 200 mph. Hurricane season is between the months of June and November. These types of storms originate in the warm waters of the Caribbean and move up the Eastern seaboard where they lose speed in the cooler waters of the North Atlantic. High wind events are sustained winds over 40 mph and/or gusts greater than 58 mph. A severe thunderstorm is a thunderstorm that contains any one or more of the following three weather conditions: hail that is 3/4 of an inch or greater in diameter, winds 58 miles per hour or greater, and/or tornadoes. Severe storm events can occur late spring and early summer as temperatures increase in the summer season. The frequency and intensity of hurricanes, tropical storms, and severe storms is expected to increase with climate change.

Similar to flooding, the extent of severe storms is not well documented in the Berlin. The impact of storms is usually flood related. See extent for flooding in the above flood section. Wind extent from storms is not well documented as there is no monitoring station in Berlin. Estimates for wind are gathered from county wide data off the NCDC website. An estimate of the worst anticipated wind extent based on past occurrences would be Category 1 force hurricane winds and H8 hail according to the Hail/Torro scale. In the future, Berlin can install a monitoring station or train spotters to better gather data for wind events. Data for wind and storm events can be evaluated using the following scales to ensure continuity of records:

Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

Saffir-Simpson Scale for Hurricane Classification				
Strength	Wind Speed (Kts)	Wind Speed (MPH)	Pressure (Millibars)	Pressure
Category 1	64- 82 kts	74- 95 mph	>980 mb	28.94 "Hg
Category 2	83- 95 kts	96-110 mph	965-979 mb	28.50-28.91 "Hg
Category 3	96-113 kts	111-130 mph	945-964 mb	27.91-28.47 "Hg
Category 4	114-135 kts	131-155 mph	920-944 mb	27.17-27.88 "Hg
Category 5	>135 kts	>155 mph	919 mb	27.16 "Hg
Tropical Cyclone Classification				
Tropical Depression		20-34kts		
Tropical Storm		35-63kts		
Hurricane		64+kts or 74+mph		

Combined NOAA/TORRO Hailstorm Intensity Scales

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H0	Hard Hail	up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33-0.60	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.20	Nickel to Quarter	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.2-1.6	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4	Lime or Egg	Aircraft bodywork dented, brick walls pitted
H7	Very destructive	2.4-3.0	Tennis ball	Severe roof damage, risk of serious injuries
H8	Very destructive	3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	4+	Softball and up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

On Aug 28, 2011, Tropical Storm Irene hit Vermont and proceeded to deposit 4-5" of rain over Berlin. Total damages from the storm have not yet been calculated. Roads that received the greatest damage were:

- Rowell Hill Rd
- Lovers Lane - bridge
- Jones Brook Rd
- Three Mile Bridge Rd - bridge
- Junction Rd
- Browns Mill Rd
- Muzzy Rd
- Chase Rd
- McCarty Rd
- West Hill Rd
- Chandler Rd
- Cox brook Rd
- Paine Turnpike South
- Belknap Rd
- Mirror Lake Rd
- Brookfield Rd
- Coos Trail
- Marvin Rd
- Winter Rd
- Route 12

The majority of damage was road and culvert washouts. The total damage estimate from Irene still has yet to be determined. The damage was due to flooding from the extreme amounts of rain at once and overflow of the Dog River. A mobile home park on Route 12 was flooded as a result of the Dog River. As a result of the Irene damages, the Town is interested in buying out property on the corner of Muzzy Road and Route 12.

During the 2011 Spring Floods, roads that were damaged include:

- Addison Rd
- Goodnow Rd
- Highland Ave
- River Run Manor Rd
- Vine St
- Rowell Hill Rd
- Darling Rd
- West Hill Rd
- Crosstown Rd
- Mirror Lake Rd
- Brookfield Rd
- Muzzy Rd
- Chase Rd
- Barlett Rd
- Window Moses Rd
- Bennington Rd

Again, damages were primarily road and culvert washouts from heavy rains and overflow of the Dog River and Stevens Branch. The River Run Mobile Home Park was completely flooded during this event and displaced the majority of residents.

Hazard	Location	Vulnerability	Extent	Impact	Probability
High Winds/Hurricane/Tropical Storm/Severe Storm	Town wide for wind, other impacts – see above for specific road damages	Large trees, power lines, culverts/bridges, mobile home	4 feet above flood stage on Montpelier flood gauge during Irene, 4-5" of rain in	To be determined for Irene; \$700,000 in past FEMA claims	Medium

			24 hrs		
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Wild Fire/Forest Fire

FEMA indicates there are three classes of wild land fires – surface fires, ground fires and crown fires, with the most common type indicated as a surface fire. Surface fires burn slowly along the forest floor, killing and damaging trees. Ground fires burn on or below the forest floor and are usually caused by lightning. Crown fires move quickly by jumping along the tops of trees. Crown fires can spread quickly during windy conditions. In Berlin, there have been no known occurrences of wildfires; however, changing land use patterns and weather conditions may increase Berlin’s vulnerability. The rural nature and vast tracts of forested land can make Berlin susceptible to forest fires. During rare drought occurrences, fire danger may be high.

The extent worst anticipated forest fire to be expected in Berlin would be an 800 according to the Keetch-Byram Drought Index; however this is only an estimate due to the limited past occurrences. The impact of forest fires on Berlin depends on the severity of event. Much of Berlin is forested and agricultural lands meaning the area which could burn could be the majority of the Town if fire danger conditions were high. Currently Berlin has over 7,000 acres enrolled in the VT Current Use program (lands designated a forest or agriculture uses) although close to another 10,000 acres of forested/agricultural lands are not enrolled in the program. For the next plan update, Berlin can work with the US Forest Service and State Forest Agency to develop estimations of extent if a forest fire were to occur and identify target areas. Extent in the future can be measured using the following scales, counting the number of high fire rating days and the actual number and size of fires.

Fire Danger Rating System		
rating	basic description	detailed description
CLASS 1: Low Danger (L) COLOR CODE: Green	fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
CLASS 2: Moderate Danger (M) COLOR CODE: Blue	fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
CLASS 3: High Danger (H) COLOR CODE: Yellow	fires start easily and spread at a rapid rate	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.

CLASS 4: Very High Danger (VH) COLOR CODE: Orange	fires start very easily and spread at a vary fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
CLASS 5: Extreme (E) COLOR CODE: Red	fire situation is explosive and can result in extensive property damage	Fires under extreme conditions start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.
source: http://www.wfas.net/content/view/34/51/		

The Keetch-Byram Drought Index (KBDI) is basically a mathematical system for relating current and recent weather conditions to potential or expected fire behavior. This system was originally developed for the southeastern United States and is based primarily on recent rainfall patterns.

The KBDI is the most widely used drought index system by fire managers in the south. It is also one of the only drought index systems specifically developed to equate the effects of drought with potential fire activities.

*The result of this system is a drought index number ranging from 0 to 800 that accurately describes the amount of moisture that is **missing**. A rating of zero defines the point where there is no moisture deficiency and 800 is the maximum drought possible.*

These numbers correlate with potential fire behavior as follows:

0 - 200 Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.

200 - 400 Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possibly through the night.

400 - 600 Fire intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.

600 - 800 Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn thorough the night and heavier fuels will actively burn and contribute to fire intensity.

The State of Vermont does have a Forest Management plan in place which addresses forest fire concerns. The 2010 State Forest Management Plan includes several goals regarding forest fire prevention. The Plan states that although the risk of forest fire is low in the State of Vermont, that the State still performs controlled burns on a small during the spring season. To help prevent local forest fires, the State works with local planning commissions to develop Community Wildlife Protection Plans. These plans help towns to identify and mitigate wildfire risk. A common mitigation measure prescribed in the plan is through controlled burns with onsite State support.

The Forest Division also runs the Town Forest Fire Warden program. This program requires towns to have appointed fire wardens. The forest fire program focuses on prevention, fire awareness and fire fighter safety. The Town Fire Department is in charge of issuing burn permits.

Boyer Forest area is located on Cross Town Road. The Town is also responsible for several municipal forest areas and maintaining recreation paths through the area. No camping is allowed at the municipal forest. The greatest threat of a forest fire comes from human error – such as smoking and improper campfire etiquette. However, lightning is also a threat as much of Berlin is forested and many forested tracts of land have very limited access.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Wildfire	Town Wide – areas outside commercial development area	Large Parcels of forested land, homes near urban forest interface, power lines	Estimate – 800 on Keetch-Byram Drought Index	17,000 acres of forested/agricultural land	Medium

Extreme Cold/Winter Storm/Ice Storm

History of Occurrences (county wide)

Snow and/or ice events occur on a regular basis. Recent significant events have included (from NCDC website and FEMA DR List):

Date	Event	Location	Extent
3/6/2011	Winter storm	County wide, Berlin	12-18" of snow, 10,000 customers lost power statewide
2/23/2010	Winter Storm	County wide, Berlin	20" of snow and 50,000 customers

			lost power statewide
2/22/2009	Winter Storm	County Wide, Berlin	16" of snow, 30 mph wind gusts
2/1/2008	Winter storm	County wide, Berlin	3-7" of snow and ice ¼-1/2" thick, 50 mph wind gusts
2/14/2007	Winter storm	County wide, Berlin	22" of snow
2/14/2006	Winter storm	Berlin, County Wide	30" of snow
1/4/2003	Winter storm	County wide, Berlin	19" of snow
3/5/2001	Winter storm	County wide, Berlin	15-30" of snow
12/31/2000	Winter storm	County wide, Berlin	10" of snow
1/15/1998	Winter storm	County wide, Berlin	10-12" snow (not a DR in Washington County)
12/29/1997	Winter storm	County wide, Berlin	21" of snow
12/7/1996	Winter Storm	County wide, Berlin	12" of snow
3/21/1994	Winter storm	County Wide, Berlin	5-11" of snow
11/1/1993	Winter storm	County wide, Berlin	15" of snow
1/3/1993	Freezing Rain	Statewide	

A winter storm is defined as a storm that generates sufficient quantities of snow, ice or sleet to result in hazardous conditions and/or property damage. Ice storms are sometimes incorrectly referred to as sleet storms. Sleet is similar to hail only smaller and can be easily identified as frozen rain drops (ice pellets) that bounce when hitting the ground or other objects. Sleet does not stick to wires or trees, but in sufficient depth, can cause hazardous driving conditions. Ice storms are the result of cold rain that freezes on contact with the surfaces coating the ground, trees, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. Periods of extreme cold tend to occur with these events.

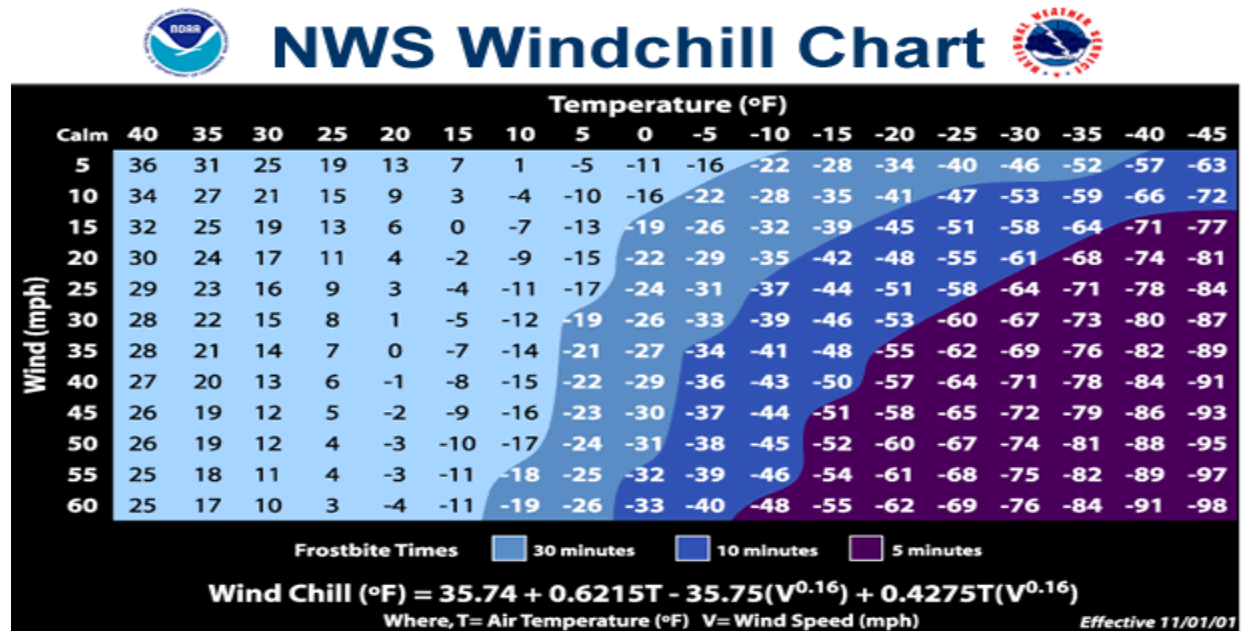
For the next plan update, Berlin will more closely monitor winter storms and collect data to determine the worst extent possible on the Town. Based on past occurrences, the worst anticipated winter weather Berlin could experience would be 2-3' of snow with more at higher elevations and several days of power outages. The worst recent storm was in March 2011 and after that the Blizzard of 1888. Extent data can be based on volumes of snow, winter weather alerts issued, or wind chill factor. See tables below for descriptions and scales.

Extent Scale - Winter Weather Alerts

Winter Weather advisory	This alert may be issued for a variety of severe conditions. Weather advisories may be announced for snow, blowing or drifting snow, freezing drizzle, freezing rain, or a combination of weather events. ch
Winter storm watch	Severe winter weather conditions may affect your area (freezing rain, sleet or Heavy snow may occur separately or in combination).
Winter Storm Warning	Severe winter weather conditions are imminent.
Freezing rain or	Rain or drizzle is likely to freeze upon impact, resulting in a coating of ice

freezing drizzle	Glaze on roads and all other exposed objects.
Sleet	Small particles of ice usually mixed with rain. If enough sleet accumulates on the ground, it makes travel hazardous.
Blizzard Warning	Sustained wind speeds of at least 35 mph are accompanied by considerable falling or blowing snow. This alert is the most perilous winter storm with visibility dangerously restricted.
Frost/freeze warning	Fro Below freezing temperatures are expected and may cause significant damage to plants, crops and fruit trees.
Wind Chill	A strong wind combined with a temperature slightly below freezing can have the same chilling effect as a temperature nearly 50 degrees lower in a calm atmosphere. The combined cooling power of the wind and temperature on exposed flesh is called the wind-chill factor.

Wind Chill Extent Scale



One of the major problems associated with ice storms is the loss of electrical power. Major electric utility companies have active, ongoing programs to improve system reliability and protect facilities from damage by ice, severe winds and other hazards. Typically, these programs focus on trimming trees to prevent encroachment of overhead lines, strengthening vulnerable system components, protecting equipment from lightning strikes and placing new distribution lines underground.

Other major problems include closed roads and restricted transportation.

By observing winter storm watches and warnings, adequate preparations can usually be made to lessen the impact of snow, ice and sleet, and below freezing temperature conditions on the Town of Berlin. Providing for the mass care and sheltering of residents left without heat or electricity for an extended time and mobilizing sufficient resources to clear broken tree limbs from roads, are the primary challenges facing community officials. Berlin should plan and prepare for these emergencies. That planning and preparedness effort should include the identification of mass care facilities and necessary resources such as cots, blankets, food supplies and generators, as well as debris removal equipment and services. Berlin Elementary School is the town shelter.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Winter Storm/Ice Storm	Town Wide	Utilities, trees, roads, old/under insulated structures	18+” snow in 24 hrs during March 2011 storm, depends on severity	Additional plowing/salting costs (\$10,000/yr)	Medium

5.3 Moderate Threat Hazards

Structure Fire

Berlin’s fire department responded to 14 building fires, 11 outside fires, 10 carbon monoxide alarms, 12 smoke/steam calls in 2010. Although many structures in Washington are less than 100 years old, many residents heat their homes with wood or pellet burning stoves. The remoteness and distance from fire and emergency services of many homes also increases the likelihood of a home being completely, opposed to partially, destroyed by a fire. 2 major events that occurred were a chimney/roof fire on West Hill Road and a shed fire on Route 12. The rural nature of the Town and remoteness of many single family homes increases response times and the likelihood of greater damages. Also, the Berlin Mall and Central Vermont Medical Center are of concern as they are anchors within the community.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Structure Fire	Town wide with emphasis on areas outside the commercial districts	Wood structures especially older than 100 yrs, homes that use wood burning stoves for heat	57 fire related calls in 2010	\$180, 000 per home based on median grand list value,	Medium

6. Mitigation

6.1 Town Plan Goals that Support Hazard Mitigation

- Facilitate development in the more level portions of the Town and discourage development in the steep and mountainous areas;
- Ensure that development does not adversely affect the rivers and streams from impacts such as erosion, contaminated runoff, or septic discharge. Minimum setbacks and vegetated buffers should be established to protect all streams from development; and
- Ensure that development is designated and sited so as to not cause pollution contamination or other damage to aquifers or recharge areas.

The goal for this Hazard Mitigation Plan is:

- To take actions to reduce or eliminate the long-term risk to human life and property from earthquakes, extreme cold/winter storm/ice storm, floods/flash floods/fluvial erosion, high wind/hurricane/severe storms/tropical storms, and wildfire/forest fire.

Specific hazard mitigation strategies related to goals of the Plan include:

- Ensure existing and future drainage systems are adequate and functioning properly
- Preserve and prevent development in areas where natural hazard potential is high
- Provide residents with adequate warning of potential hazards
- Ensure that all residents and business owners are aware of the hazards that exist within Berlin and ways they can protect themselves and insure their property
- Ensure that emergency response services and critical facilities functions are not interrupted by natural hazards

6.2 Proposed Hazard Mitigation Programs, Projects and Activities

Hazard mitigation programs, projects and activities that were identified for implementation at the Town Local Hazard Mitigation meeting:

Hazards Mitigated	Mitigation Action	Local Leadership	Prioritization	Possible Resources	Time Frame
Flooding, Severe Storms	Purchase property on corner of Muzzy Rd and Route 12	Select board, Property Owners, Town Admin	High	HMGP	ASAP – no more than 2 years
Earthquakes	Review and adapt building codes so that new structures are	SB, Town Admin	Low	Town funds	4-5 years

	earthquake resistant				
Earthquakes, flooding, severe storms	Installation of mobile home tie downs	SB, property owners	Med	HMGP	2-3 years
Flooding, severe storms	Replacement and upgrade of culverts on West Hill Rd	Town Admin, Road Foreman	High	HMGP and Town Funds	1-2 years
Winter Storms/ Severe Cold	Provide training to residents on how to insulate homes (pipes, attics) for extreme cold spells	SB, PC, Fire Dept	Medium	EMGP	2 years
Winter storms/ extreme cold/ice storms	Upgrade electrical systems in municipal buildings and shelters to prevent surge/equipment damage from fluctuating current during ice and wind storms	Fire Dept, Select Board	Med	General Funds, EMGP, DPIG	3-4 years
NFIP Compliance	Work with elected officials, the State and FEMA to correct existing compliance issues and prevent any future NFIP compliance issues through continuous communications, training and education	Select Board, PC	Med	HMGP, general fund	2 years
NFIP Compliance, Flooding, Severe storms	Base flood elevation home inspections - inspect foundations at time of completion prior to framing to determine if lowest	Zoning Admin, Town Admin, Planning Commission	Med	HMGP, general fund	3-4 years

	floor is at Base Flood Elevation				
NFIP Compliance	Public outreach – make and distribute NFIP pamphlets at Town Offices, Fire Department, and Police Department	Select Board, Town Admin	Med	HMGP, general fund	2-3 years
Flooding, Severe Storms	Projects outlined in Dog River Corridor Plan (see attached)	Select Board, PC, ANR	Med	HMGP, EPA	2-3 years
Wild Fire	Remove taller and dead trees from land in State and municipal forest	Road crew, ANR, PC	Low	General fund	4 years
Wild fire, structure fire	Develop alternative water supplies/dry hydrants in south section of town and more remote areas	Select board, fire department	Low	VT NRCS	4 years
Wild Fire	Distribute public education materials about reducing wild fire risk	Fire Dept, Select Board	Med	USDA	3-4 years

VEM also emphasizes a collaborative approach to achieving mitigation on the local level, by partnering with ANR, VTrans, ACCD, Regional Planning Commissions, FEMA Region 1 and other agencies, all working together to provide assistance and resources to towns interested in pursuing mitigation projects and planning initiatives.

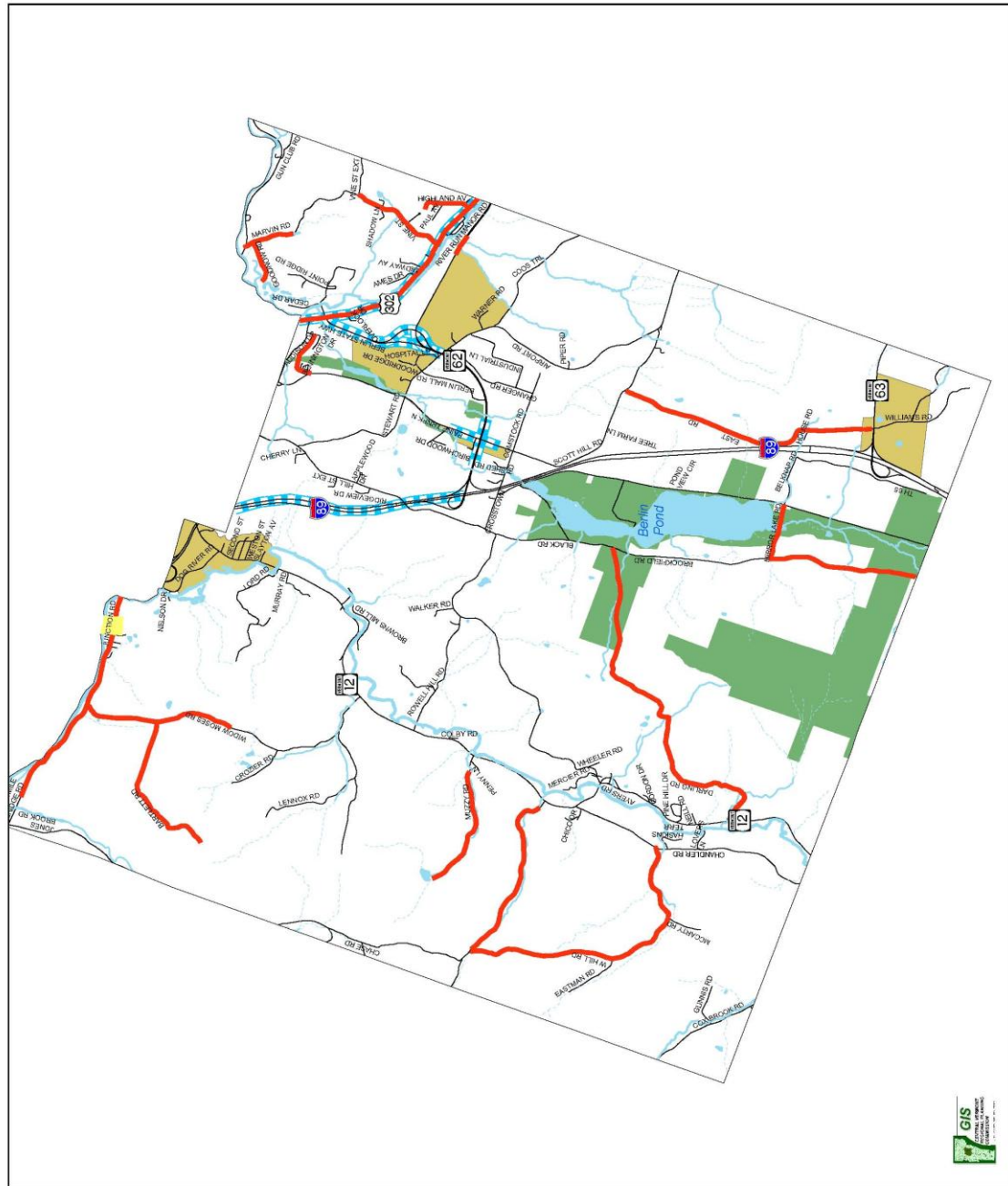
The mitigation activities are listed in regards to local leadership, possible resources, implementation tools, and prioritization. Prioritization was based upon the economic impact of the action, the Community's need to address the issue, the action's cost, and the availability of potential funding. The action's cost was evaluated in relation to its benefit as outlined in the STAPLEE guidelines.

Berlin understands that in order to apply for FEMA funding for mitigation projects that a project must meet FEMA benefit cost criteria. The Town must also have a FEMA approved Hazard Mitigation Plan as well.

A High prioritization denotes that the action is either critical or potential funding is readily available and should have a timeframe of implementation of less than two years. A Medium prioritization is warranted where the action is less critical or the potential funding is not readily available and has a timeframe for implementation of more than two years but less than four. A Low prioritization indicates that the timeframe for implementation of the action, given the action's cost, availability of funding, and the community's need to address the issue, is more than four years.

Attachments

- Local Area of Concerns Map
- Dog River Corridor Plan Matrix and Maps
- Previous Hazards
- 5 Year Plan Review/Maintenance
- Adoption Certificate



Dog River Corridor Plan Maps and Projects

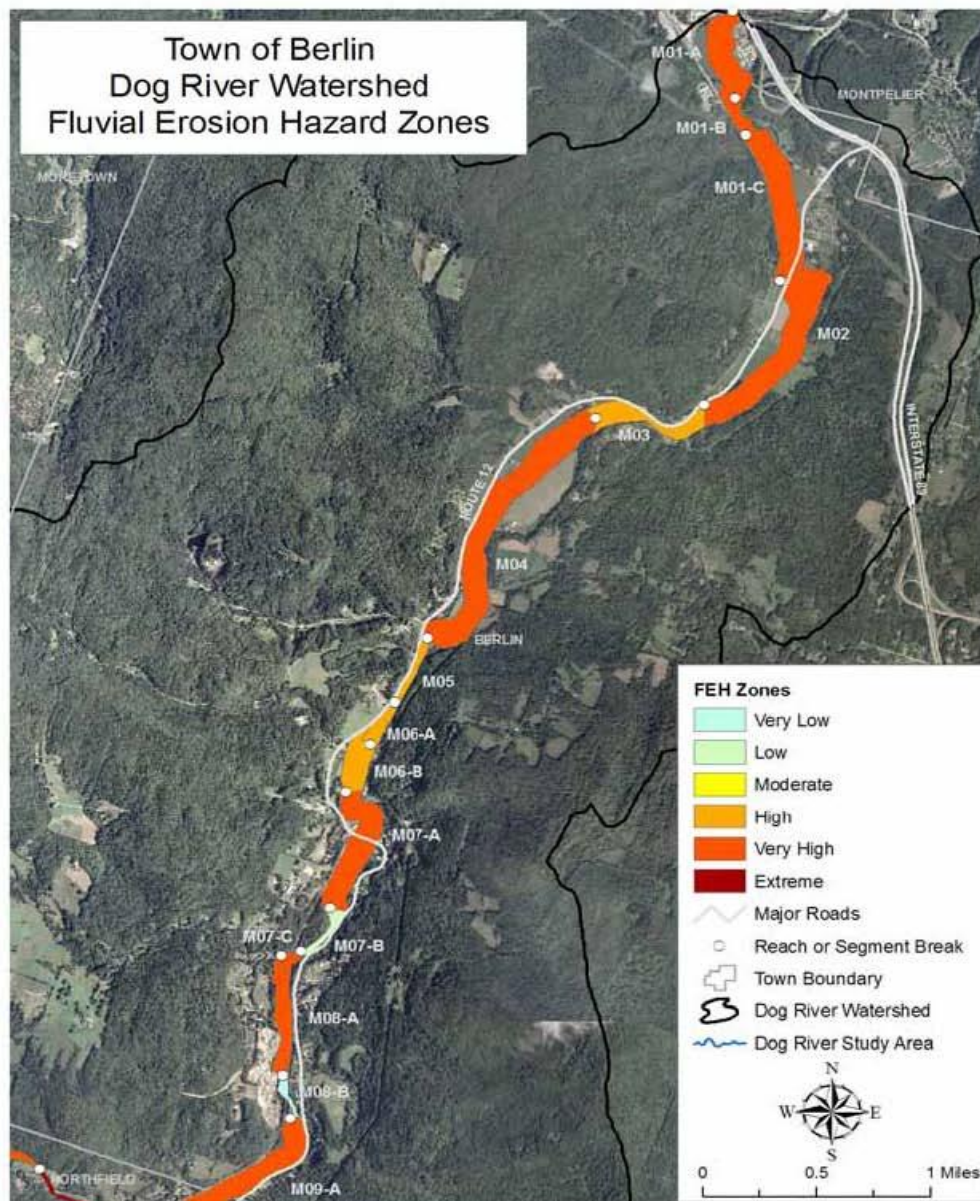


Figure 7.1. Draft Fluvial Erosion Hazard Zone Map for the Town of Berlin - Dog River watershed

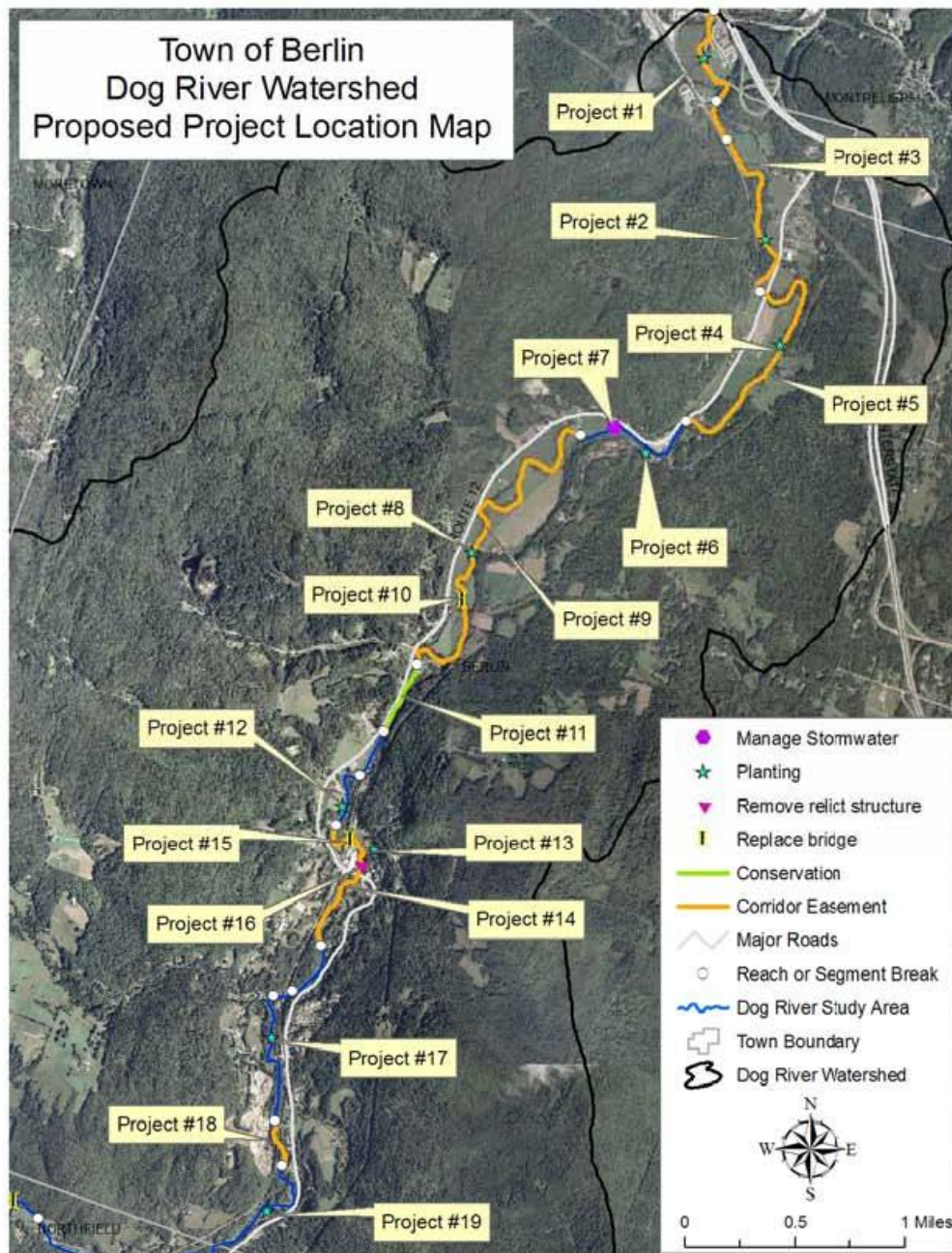


Figure 7.4 Proposed project location map for the Town of Berlin, Dog River Watershed

Table 7.1. Dog River Site Level Opportunities for Restoration and Protection – Town of Berlin

Project #, Reach	Condition and Channel Evolution Stage	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#1 M01-A	Fair D II c	Recreational fields along east bank and agricultural fields along west bank	Improve buffer along both banks	High priority due to town land and one private landowner	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Recreation/ agriculture to forested buffer	Landowners, City of Montpelier
#2 M01-C	Fair D II c	Field on east bank	Improve riparian buffer	Moderate priority due to three landowners	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Field to forested buffer	landowners
#3 M01	A) Fair, D II c B) Fair, F III C) Fair, D II c	Natural attenuation reach	Corridor Easement	High priority for corridor easement	Increased sediment and flood attenuation	Potentially high costs due landowners	No additional structures within corridor	Landowners, CREP
#4 M02	Fair D II c	Runs through agricultural land	Improve riparian buffer	High priority due to one landowner	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Agricultural land to forested buffer	Landowners, CREP
#5 M02	Fair D II c	Natural attenuation reach	Corridor Easement	High priority for corridor easement	Increased sediment and flood attenuation	Potentially high cost for corridor easement	No additional structures within corridor	Landowners, CREP
#6 M03	Good D II c	Runs along farm land at upper end or reach and along Route 12 at lower end.	Improve riparian buffer	Low priority due to multiple landowners	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Agricultural land to forested buffer	Landowners
#7 M03	Good D II c	Adjacent to Route 12	Manage stormwater	High priority to reduce sedimentation	Improved water quality and habitat	Moderate costs to design and maintain stormwater improvements	Not known	Town of Berlin
#8 M04	Fair D II c	Runs through agricultural land	Improve riparian buffers	Moderate priority due to two landowners	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Agricultural land to forested buffer	Landowners, CREP
#9 M04	Fair D II c	Natural attenuation reach	Corridor Easement	High priority for corridor easement	Increased sediment and flood attenuation	Potentially high cost for corridor easement	No additional structures within corridor	Landowners, CREP
#10 M04	Fair D II c	Undersized railroad bridge causing significant planform adjustment and aggradation	Replace undersized railroad bridge	Low priority due to railroad	Improved geomorphic compatibility	High cost for design, permitting and replacement	Wider span may take more space away from agricultural land	Railroad

Table 7.1. Dog River Site Level Opportunities for Restoration and Protection – Town of Berlin

Project #, Reach	Condition and Channel Evolution Stage	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#11 M05	Good F I	Good geomorphic condition in narrow valley with Route 12 and railroad in corridors	Conservation	Moderate priority due to multiple landowners	Flood attenuation	Low to moderate cost for conservation	None	landowners
#12 M06-B	Good D II c	Runs along residential property	Improve riparian buffers on small area of west bank	High priority due to one landowner	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Residential land to forested buffer	landowners
#13 M07-A	Fair D II c	Runs along some conserved land in Berlin and through residential property	Improve riparian buffers	Moderate priority due to multiple landowners	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Residential land to forested buffer	Landowners
#14 M07-A	Fair D II c	Natural attenuation segment with some conserved land	Corridor Easement	High priority for corridor easement	Increased sediment and flood attenuation	Potentially high cost for corridor easement	No additional structures within corridor	Landowners, Berlin Conservation Commission
#15 M07-A	Fair D II c	Undersized railroad bridge causing adjustment problems in channel	Replace undersized railroad bridge	Low priority due to railroad and private landowner	Improved geomorphic compatibility	High cost for design, permitting and replacement	Wider span may take up more space	Railroad, landowners.
#16 M07-A	Fair D II c	Old abutment causing channel constriction	Remove old abutment	Low priority due to private land	Improved geomorphic compatibility	High cost for design, permitting and construction	None	Landowners, ANR
#17 M08-A	Fair D II c	Runs through some residential land	Improve riparian buffers	High priority due to one landowner	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Residential land to forested buffer	Landowners
#18 M08-B	Good F I	Bedrock dominated segment in good condition	Protect River Corridor	High priority due to one landowner and railroad	Flood attenuation asset	Moderate cost for easement	No additional structures in corridor	landowners
#19 M09-A	Fair D II c	Along Route 12 and agricultural land	Improve riparian buffers on east bank	High priority due to one landowner	Improved habitat and geomorphic stability	Relatively low cost for native plant materials and labor	Agricultural land to forested buffer	Landowners, CREP

Hazardous Materials

History of Occurrences:

May 1, 2003 - #2 Heating Oil – 2-3 Gallons
September 18, 2002 – Sewage – 20 Gallons
February 16, 2002 - #2 Heating Oil – 50 Gallons
April 28, 2001 – Mineral Oil – 5 Gallons
October 22, 2000 – Gasoline – 25 Gallons
September 6, 2000 – Transmission Fluid – Unknown

The Berlin PDM meeting found the Montpelier Junction area to be particularly vulnerable to hazardous material events. Located at the confluence of the Dog and Winooski Rivers, and at the interchange of Central Vermont's most significant railroads, the Montpelier Junction area contains a variety of industrial uses. The Capitol Steel & Supply Company is located within the area's NFIP designated 100-year floodplain and Duke Energy's Berlin Propane Terminal (120,000 gallons of pressurized propane in above ground tanks) is located just beyond the floodplain, in addition to various storage facilities in and out of the floodplain. The railroad transports a variety of materials that could pose a threat to the area, in addition to the hazardous materials located onsite. The Berlin Police Department estimates that 100,000 gallons of additional propane sits in railcars and approximately 30 trucks make stops in Montpelier Junction daily. These mobile sources are in addition to the three Tier II sites that are depicted on the Hazardous Analysis Map. Areas potentially affected by a hazardous material incident in this area are the North Berlin Well Head Protection Area, the Winooski River, the New England Central Railroad, the Washington County Railroad, Interstate 89, the Montpelier Wastewater Treatment Plant, the RNC Mobile Home Park, and potentially the Vermont State House. The distance between this area and Berlin's fire stations adds to the area's vulnerability.

Highway/Transport Accidents

History of Occurrences:

- Approximately 600 accidents/year

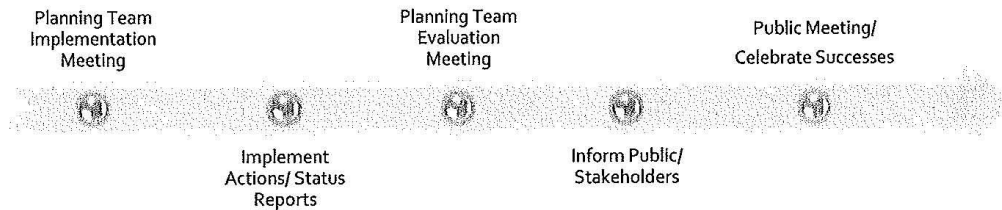
The Town of Berlin experiences the highest concentration of vehicular accidents within Central Vermont. This number is highly correlated with the number of travelers on Berlin's roadways. According to the Berlin Police Department, approximately 20,000 vehicles per day travel through Berlin on Interstate 89. Operator inattention contributes to the majority of accidents. Driving Under the Influence (DUI) is the second largest cause for accidents within Berlin.

According to the Berlin PDM meeting, Berlin's most accident prone intersection is the confluence of the Berlin and Montpelier spurs of Vermont 62. Other accident prone intersections are the junction of Fisher Road and Vermont 62 and Paine Turnpike and Vermont 662. In addition, Interstate 89 north of Exit 7 experiences a higher than average number of accidents due to its steep grade (Areas of Local Concern Map).

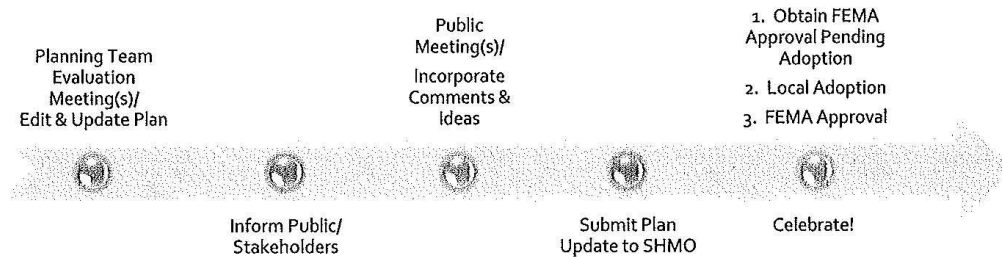
5-Year Plan Review/Maintenance



After Plan Adoption-Annually Implement and Evaluate



Fifth Year, and After Major Disaster Evaluate and Revise



Certificate of Adoption

The Town of Berlin
Select Board
A Resolution Adopting the Local Hazard Mitigation Plan
Sept 25, 2012

WHEREAS, the Town of Berlin has worked with the Central Vermont Regional Planning Commission to identify hazards, analyze past and potential future losses due to natural and manmade-caused disasters, and identify strategies for mitigating future losses; and

WHEREAS, the Berlin Local Hazard Mitigation Plan contains several potential projects to mitigate damage from disasters that could occur in the Town of Berlin; and

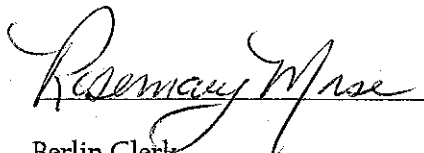
WHEREAS, a duly-noticed public meeting was held by the Town of Berlin Select Board on Sept 25, 2012 to formally adopt the Berlin Local Hazard Mitigation Plan;

NOW, THEREFORE BE IT RESOLVED that the Berlin Select Board adopts the Berlin Local Hazard Mitigation Plan Update.


Chair of Select Board


Member of Select Board

ATTEST


Berlin Clerk