THE TOWN OF NORTHFIELD 2012 MULTI-HAZARD MITIGATION PLAN

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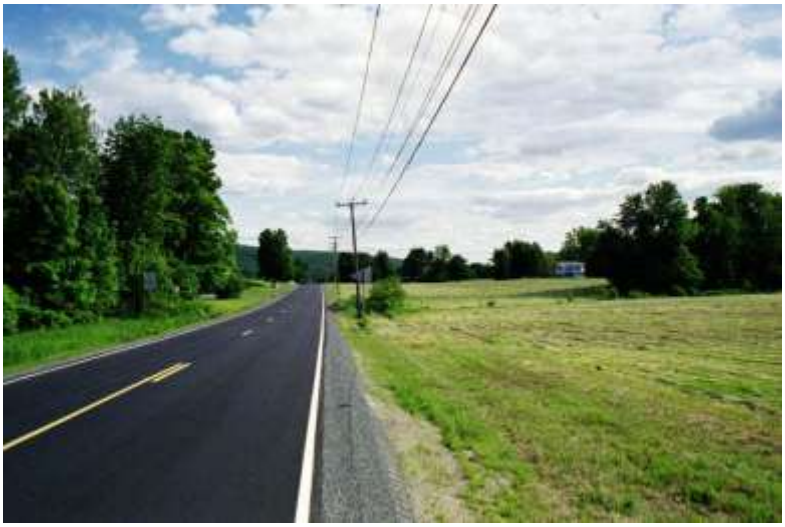

Prepared by:
The Northfield Multi-Hazard Mitigation Planning Committee

Tom Newton, Emergency Management Director
Floyd "Skip" Dunnell, Northfield Fire Chief
Len Crossman, Northfield Police Chief
Tom Walker, Superintendent of Streets
Tom Hutcheson, Town Administrator
Kathy Wright, Select Board
Bob MacEwan, Board of Health

and
The Franklin Regional Council of Governments

Peggy Sloan, Director of Planning & Development
Kimberly MacPhee, Land Use & Natural Resources Program Manager
Alyssa Larose, Land Use Planner
Mary Praus, Land Use Planner
Ryan Clary, Senior GIS Specialist

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1 - INTRODUCTION

Hazard Mitigation

The Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA) define Hazard Mitigation as any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards such as flooding, storms, high winds, hurricanes, wildfires, earthquakes, and other disasters Mitigation efforts undertaken by communities will help to minimize damages to buildings and infrastructure, such as water supplies, sewers, and utility transmission lines, as well as natural, cultural and historic resources.

Planning efforts, like the one undertaken by the Town of Northfield and the Franklin Regional Council of Governments, make mitigation a proactive process. Pre-disaster planning emphasizes actions that can be taken before a natural disaster occurs. Future property damage and loss of life can be reduced or prevented by a mitigation program that addresses the unique geography, demography, economy, and land use of a community within the context of each of the specific potential natural hazards that may threaten a community.

Preparing a Multi-Hazard Mitigation Plan before a disaster occurs can save the community money and will facilitate post-disaster funding. Costly repairs or replacement of buildings and infrastructure, as well as the high cost of providing emergency services and rescue/recovery operations, can be avoided or significantly lessened if a community implements the mitigation measures detailed in the Plan. Many disaster assistance agencies and programs, including FEMA, require that a community adopt a pre-disaster mitigation plan as a condition for both mitigation funding and disaster relief funding. For example, the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA) and the Community Rating System (CRS), are programs with this requirement.

Planning Process

The natural hazard mitigation planning process for the Town of Northfield included the following tasks:

- Review of the Gill 2004 Local Natural Hazards Mitigation Plan, assessment of relevancy of existing materials, status of action items and addition of new materials based upon MEMA recommendations and Committee input.

- Identification of the natural hazards that may impact the community, and past occurrences of hazards at the local or regional level.

- Conduct a Vulnerability/Risk Assessment to identify the infrastructure (i.e., critical facilities, public buildings, roads, homes, businesses, etc.) at the highest risk for being damaged by the identified natural hazards, particularly flooding.

- Identification and assessment of the policies, programs, and regulations a community is currently implementing to protect against future disaster damages. Examples of such strategies include:

    - Preventing or limiting development in natural hazard areas like floodplains, and wetlands;
    - Implementing recommendations in planning documents including Stormwater Management Plans, Master Plans, Open Space and Recreation Plans, Emergency/Evacuation Plans that address the impacts of natural hazards; and
    - Requiring or encouraging the use of specific structural requirements for new buildings such as buried utilities, flood-proofed structures, and lightning grounding systems.

- Identification of deficiencies in the current strategies and establishing goals for updating, revising or adopting new strategies.

- Identification of specific projects that will mitigate the risk to public safety and damages to infrastructure from natural hazards.

- Adoption and implementation of the final Natural Hazards Mitigation Plan.

The planning process for the Town of Northfield also incorporated the following procedures:

- Provide an opportunity for the public to comment on the plan during the drafting and prior to the approval of the plan. The plan update and public meetings were advertised in the Greenfield Recorder and on the Town website. Meetings were also posted at the Town Hall and at other designated public notice buildings. Public meetings were held at the Northfield Town Hall on September 8, 2011, and February 13, 2012. The final draft of the plan was made available on the Town website and at the Town Hall for public review.

- Provide an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities and agencies that have the authority to regulate development, and businesses, academia and other private and nonprofit organizations to be involved in the planning process.

- Review and incorporate, if appropriate, existing plans, studies, reports and technical information. Plans reviewed for this update include the Northfield Comprehensive Emergency Management Plan, the Four Mile Brook Watershed Assessment and Management Plan, and the Northfield Community Development Plan.

- Document the planning process, including how it was prepared, and how the public was involved.

Much of this work was carried out by the staff of the FRCOG Planning Department with the assistance of the Northfield Multi-Hazard Mitigation Planning Committee, which includes the Emergency Management Director, Town Administrator, and representatives of the Fire Department, Highway Department, Board of Health, and Select Board.

Plan Update and Changes

As indicated above in the Planning Process section, changes and updates were made to this Plan based upon MEMA recommendations and committee input. The following sections of the 2011 plan were added to and/or substantially updated:

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2 – LOCAL PROFILE[1]

Community Setting

Northfield, one of the oldest towns along the Connecticut River and in Massachusetts, is situated in the northeast region of Franklin County abutting New Hampshire. As of 2009, Northfield's population is estimated to be 3,311.[2] It is the only community along the Connecticut River to be located on both the east and west banks of water. The river is described in the Northfield Master Plan as the "most prominent feature and the greatest factor in the 300 years of [the town's] development." Rocky hills rise on either side of the waterway, creating a natural barrier that limits opportunities for economic expansion. As the Town looks to increase employment and seek out new opportunities for economic development, it will also try to maintain the rural character so prized by residents.

The fertile soil of the river basin was attractive to European settlers as early as 1673, when they first attempted farming in the area. There were several unsuccessful attempts to settle the Town in the turbulent years of the late 17th and early 18th centuries, but it was only after the threat of conflict with area Native Americans was past that Northfield was able to truly settle down and become established. In the 1700s, homesteading and subsistence farming were predominant in Northfield. In the 19th Century, farming efforts grew more widespread, soon covering a large portion of the Town. In the 20th Century, many farms consolidated into larger, commercial units and small mills and shops were shut down in favor of larger businesses in adjoining towns.

Northfield's thriving downtown area has been designated a National Historic District. Northfield's former largest employer, the Northfield Mount Hermon School, vacated its Northfield campus in 2005 to consolidate facilities onto its Gill campus. The Northfield campus was purchased in 2010. The current owners are in the process of finding a school to locate on the campus. The Northfield Mount Hermon School still owns a portion of the campus and uses some of the buildings for administrative purposes. The Town has a strong interest in establishing more businesses to diversify its economic base and is also committed to maintaining its rural and historic character. Currently, the two largest employment sectors are educational services and government (public schools and town government).

According to 2005 land use data provided by MassGIS, the total land area of Northfield is approximately 21,960 acres. The Town has roughly 16,066 acres of forests, comprising 73 percent of the total land area. Approximately 1,365 acres are developed as residential, commercial, industrial, or public/institutional uses. Cropland and pasture comprise roughly 2,790 acres of land.

[1] The majority of the information for this section was obtained from the Town of Northfield's 1977 Master Plan, which was prepared by the Northfield Planning Board and the Town of Northfield Community Development Plan July 2003, prepared by the Northfield Community Development Committee and the Franklin Regional Council of Governments Planning Department.

[2] 2009 U.S. Census Population Estimates Program.

Infrastructure

Northfield's geography has been a major factor in the development of its infrastructure. Limited infrastructure and areas zoned for business uses have kept major industrial and commercial development out of the Town in the past. According to the Committee, new residential development over the last two decades has occurred both in the higher elevations of town, and on agricultural land in the south of town. However in the last few years very few building permits for new homes have been issued. According to the U.S. Census, a total of four building permits were issued in 2009 and 2010. The Committee noted that only two permits were issued in 2011. This is consistent with greater national trends, as a slow economy in the last few years has limited new residential construction nation-wide.

About 72 percent of working Northfield residents commute to jobs outside of the Town.[3]

Roads and Highways

The major arteries running through Northfield are Route 63 and Route 10, which connect Northfield with nearby towns and urban centers. Both Route 2 and New Hampshire Route 9 are close to Northfield and access to them is within a few miles. Route 142 also connects Northfield with Brattleboro and other points south and east. Access to I-91, Franklin County's major north/south route, is within five miles of Town on Route 63/10.

About 27 miles (28 percent) of Northfield's roads are gravel. The Town has a total of 97 miles of roads.[4]

The Franklin County Bikeway is a project under implementation by the Franklin Regional Council of Governments with the aim to provide a biking network throughout Franklin County, linking employment, recreational, and educational destinations. The Bikeway includes "The Northfield Connector", which utilizes shared roadway to provide a link from Montague through Erving to the Northfield Mountain Recreation and Environmental Center and downtown Northfield.

Rail

Railroads, which first came to Northfield in the mid- 1800s, have played an active role in the Town's economic and social activities. The rail line was instrumental in providing access to markets where Northfield-produced goods and products could be sold. At one time, there were at least four stations with freight and passenger service in the Town.

At present, the New England Central Railroad and the Boston and Maine Railroad, run by Pan Am Railways, run through Northfield but do not stop.

Public Transportation

The Franklin Regional Transit Authority (FRTA) operates weekly demand response door-to-door transit service for seniors and the disabled for a small fee. Fixed route service previously was

[3] Town of Northfield Community Development Plan. July 2003. Prepared by the Northfield Community Development Committee and the Franklin Regional Council of Governments.
[4] Massachusetts Department of Transportation 2007 Road Inventory GIS File.

provided between Greenfield and Northfield when the Northfield Mount Hermon School was in session. However since the closure of the Northfield campus, the service has been discontinued.

Public Drinking Water Supply

The Department of Environmental Protection identifies six public water supply systems in the Town of Northfield, three of which are community systems.[5]

The two water districts in Northfield provide drinking water to residents and businesses in Northfield Center and near the former Northfield Campus of NMH. Other areas in the Town are served by private wells. The Town's supplies outstrip demand and are expected to adequately supply future growth.

The Northfield Water District consists of a basic 'T' distribution system which was recently upgraded, with a small loop added in the Maple Street/ St. Mary's Cemetery area.

The East Northfield Water Company is owned by the Northfield Mount Hermon School and supplies water to the campus and surrounding residential homes and businesses. Water mains are adequate to provide domestic water and fire protection. The 28 million gallon Grandin Reservoir is located above the service area. Storage capacity at the reservoir is adequate to meet the needs of the next fifty years and piping systems have been upgraded. Firefighting capability is adequate.

The two water districts are interconnected, allowing them to service each other's customers in the event of an emergency. Both are gravity-fed, although the East Northfield Water Company does have an emergency generator for its treatment plant.

A third water district, titled the West Northfield Water District, exists only on paper, as a consensus has not been reached on construction of a distribution system.

Sewer Service

Northfield's sewer treatment plant was built in 1972. Designed to handle 275,000 gallons of sewage daily, by 1993 inflows and leaks had raised that to 400,000 gallons daily.

Upgrades and repairs, and the vacating of the NMH Northfield campus in 2005, have reduced use to a current average of approximately 81,000 gallons a day. The center of Town and the former NMH campus in East Northfield are served by the municipal sewer system and treatment plant. According to the 1990 U.S. Census, approximately 30 percent of Northfield homes are hooked in to the municipal sewer system.[6]

Currently, more than half of the system's capacity is unused and it is anticipated that the current plant will be sufficient for the next few decades. Average daily use will most likely be affected

[5] The Northfield Water District, East Northfield Water District and Linden Hill School are community water supply systems. The Pioneer Valley Regional School and Northfield Mountain Station are non-transient, non-community systems and the Riverview Picnic Area is transient, non-community. As is shown on the Critical Facilities and Infrastructure Map, some systems can have more than one source, such as at the Linden Hill School, which has four separate water sources for its one system.

[6] The 2000 U.S. Census did not collect data on household sewage disposal systems.

by the opening of a new school on the former NMH campus. The ability of the Town to accommodate large-scale commercial or light industrial land may require an expansion of the collection system.

Natural Resources

Northfield's land falls into three basic categories. The broad alluvial plains of the Connecticut River are excellent for agriculture, their main use. The susceptibility of these lands to flooding has kept much development from being located there.

Higher above the river are deposits left at the end of the ice age. These areas are the sites of most of the Town's residential areas. The highest elevation in Northfield is mainly covered with forest, highly suitable for recreation and wildlife and sparsely developed.

Water Resources

Northfield lies in the Connecticut River watershed. Northfield has about 742 acres covered by wetlands, which are fed by nearby brooks and rivers[7]. Wetlands are essential for promoting water quality and biodiversity of both plant and animal species. The Town also has a fairly substantial amount of open water within its borders (approximately 749 acres). The rivers and wetlands in Northfield are buffered in accordance with the Massachusetts Wetlands Protection Act. The Connecticut River is supportive of recreational use.

Cultural and Historic Resources

The importance of integrating cultural resource and historic property considerations into hazard mitigation planning is demonstrated by disasters that have occurred in recent years, such as the Northridge earthquake in California, Hurricane Katrina in New Orleans, or floods in the Midwest. Closer to home, the June 1, 2011 tornado, which ripped through Springfield, Monson and other towns in Hamden and Worcester Counties, caused injuries, loss of life and widespread damages to historic properties. The effects of a disaster can be extensive—from human casualty to property and crop damage to the disruption of governmental, social, and economic activity. Often not measured, however, are the possibly devastating impacts of disasters on historic properties and cultural resources. Historic structures, artwork, monuments, family heirlooms, and historic documents are often irreplaceable, and may be lost forever in a disaster if not considered in the mitigation planning process. The loss of these resources is all the more painful and ironic considering how often residents rely on their presence after a disaster, to reinforce connections with neighbors and the larger community, and to seek comfort in the aftermath of a disaster.[8]

Cultural and historic resources help define the character of a community and reflect its past. These resources may be vulnerable to natural hazards due to their location in a potential hazard area, such as a river corridor, or because of old or unstable structures. The 2010 Northfield Comprehensive Emergency Management Plan identifies the Dickinson Memorial Library, the

[7] 2005 MassGIS Land Use Data.

[8] Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning, State and Local Mitigation Planning How-To Guide, FEMA 386-6 / May 2005.

Field Library, and the Northfield Historical Society as cultural resources in Northfield that are historical buildings containing archives, art, and artifacts that would be difficult or impossible to replace if destroyed. The Schell Bridge over the Connecticut River is also identified as a cultural resource.

Northfield has five sites listed on the National Register of Historic Places. The Northfield Main Street Historic District includes 1,249 acres and 47 buildings. Other sites listed on the Register are the Alexander Simeon Jr. House, King Philip's Hill, Northfield Center Cemetery, and Pine Street School. While designation on the National Register of Historic Places is honorary in nature and does not provide any protective measures for the historic resources, designated sites may qualify for federal and state funding if damaged during a natural or manmade hazard.

The information presented below on historically significant landscapes in Northfield was drawn from a number of sources, especially the 1992 Franklin County Rural Historic Landscape Preservation Plan Report, prepared by the Franklin County Commission (now the FRCOG).

Table 2-1: Significant Historical Landscapes in Northfield

Location	Type of Landscape
Route 63: NH State line south to turnout before Rt. 10 sign	Agricultural
Route 63: Turnout before Rt. 10 sign south to House #263 on right	Forest
Route 63: House #263 on right south to Rt. 10 intersection	Village
Route 63: Rt. 10 intersection to Erving Town line	Agricultural
Multiple Properties along Routes 63 and 10	Agricultural
Multiple Properties along Route 142, West Northfield Area	Agricultural
Multiple Properties along Caldwell Road	Agricultural
Multiple Properties along East Northfield Road	Agricultural
Multiple Properties along Great Meadow Road	Agricultural
Multiple Properties along Old Wendell Road near Erving line	Agricultural
Multiple Properties along Pine Meadow Road	Agricultural
Multiple Properties along River Road	Agricultural
Multiple Properties along Upper Northfield Farms Road	Agricultural
Multiple Properties along Connecticut River	Agricultural
Cow Plain, between Pine Meadow Road and Millers Falls Road	Agricultural
King Philip's Hill	Community Development
Pratt Hollow	Forest

Sources: Franklin Regional County of Governments and Pioneer Valley Planning Commission, Connecticut River Scenic Farm Byway Corridor Management Plan, 1998; Town of Northfield, Pathway to Tomorrow: A Master Plan for Northfield, 1977; 2003 Northfield Community Development Committee.

Community Facilities and Resources

It is important for communities to determine which areas or specific populations in their community may need special attention in times of an emergency. In addition to the infrastructure previously described, these critical facilities are identified on the Critical Facilities and Infrastructure Map on page 70.

Critical Facilities

A community's critical facilities include important municipal structures (i.e., town hall), emergency service structures (i.e., municipal public safety complex, shelters, and medical

centers), and locations of populations that may need special assistance (i.e., nursing homes, day cares, schools, prisons) and major employers or other areas where there is a dense concentration of people. In Northfield, the identified critical facilities include town hall, the Police Headquarters, Fire Station, the Northfield Waste Water Treatment Plant, a Verizon communication tower, the DPW Headquarters, Camp Northfield, Linden Hill School, Northfield Elementary School, Northfield Head Start-Better Start, Northfield Mount Hermon Day Care, Pioneer Valley Regional School, and Squakheag Village senior housing.

Natural Hazard Emergency Shelters

The Comprehensive Emergency Management (CEM) Plan for Northfield was created in August 2010 by town officials and the Massachusetts Emergency Management Agency. The document "outlines an emergency management program for planning and response to potential emergency or disaster situations," which includes emergency shelters to accommodate victims of natural hazards. The CEM Plan identifies the Northfield Elementary School and the Pioneer Valley Regional School as emergency shelters in town.

In the 2004 Local Natural Hazards Mitigation Plan, the Town Hall was the only shelter identified for flood victims. However, the Town Hall has limited facilities, which make it less than ideal as a shelter. Concerns were also raised about the need to have shelters available on both sides of the Connecticut River, in the event that flooding cuts off the east and west sides of the Town from each other. Accordingly, since the previous plan, the Town has identified two alternate shelters to the Town Hall. Pioneer Valley Regional School's (PVRS) possession of a backup generator as well as its kitchen and shower facilities led to its identification as a new shelter. The school was built in 2002 and is in compliance with the current earthquake standards of the Massachusetts State Building Code. Northfield Elementary School has also been identified as a shelter, and a backup power generator and wiring has been installed there for this purpose. The elementary school has kitchen facilities and its middle section was built in 1990 and is also in compliance with the current earthquake standards of the Massachusetts State Building Code.

The Emergency Management Director and town officials should periodically review the available shelters to determine each shelter's potential occupancy, accessibility via evacuation routes, susceptibility to hazards (such as floods and high winds), and access to back up utilities.

3 – RISK ASSESSMENT

Natural Hazard Identification and Profile

Historical research, conversations with local officials and emergency management personnel, available hazard mapping and other weather-related databases were used to identify the natural hazards which are most likely to have an impact on the Town of Northfield.

FLOODING

General Description

The average annual precipitation for Northfield and surrounding areas in northwestern Massachusetts is 44 inches.[9] There are three major types of storms that bring precipitation to Northfield. Continental storms that originate from the west continually move across the region. These storms are typically low-pressure systems that may be slow-moving frontal systems or more intense, fast-moving storms. The second major storm type are coastal storms. There are two kinds that bring major precipitation and wind – nor'easters and hurricanes. Nor'easters bring heavy rain, high winds, ice storms or blizzards into New England from the coast of Maine and Canada. In late summer or early fall, hurricanes may reach Massachusetts from the south and result in significant amounts of rainfall. The third type of storm is the result of local convective action. Thunderstorms that form on warm, humid summer days can cause locally significant rainfall.

Floods are classified as either *flash floods*, which are the product of heavy, localized precipitation in a short time period over a given location or *general floods*, which are caused by precipitation over a longer time period in a particular river basin. There are several local factors that determine the severity of a flooding event, including: stream and river basin topography, precipitation and weather patterns, recent soil moisture conditions, amount of impervious surface area, and the degree of vegetative clearing. Floods occur more frequently and are one of the most costly natural hazards in the United States.

Flash flooding events typically occur within minutes or hours after a period of heavy precipitation, after a dam or levee failure, or from a sudden release of water from an ice jam. Most often, flash flooding is the result of a slow-moving thunderstorm or the heavy rains from a hurricane. In rural areas, flash flooding often occurs when small streams spill over their banks. However, in urbanized areas, flash flooding is often the result of clogged storm drains (leaves and other debris) and the higher amount of impervious surface area (roadways, parking lots, roof tops).

In contrast, *general flooding* events may last for several days. Excessive precipitation within a watershed of a stream or river can result in flooding particularly when development in the

[9] Massachusetts Department of Conservation and Recreation 2009 precipitation data, http://www.mass.gov/dcr/watersupply/rainfall/index.htm.

floodplain has obstructed the natural flow of the water and/or decreased the natural ability of the groundcover to absorb and retain surface water runoff (e.g., the loss of wetlands and the higher amounts of impervious surface area in urban areas).

A floodplain is the relatively flat, lowland area adjacent to a river, lake or stream. Floodplains serve an important function, acting like large "sponges" to absorb and slowly release floodwaters back to surface waters and groundwater. Over time, sediments that are deposited in floodplains develop into fertile, productive farmland like that found in the Connecticut River Valley. In the past, floodplain areas were also often seen as prime locations for development. Industries were located on the banks of rivers for access to hydropower. Residential and commercial development occurred in floodplains because of their scenic qualities and proximity to the water. Although periodic flooding of a floodplain area is a natural occurrence, past and current development and alteration of these areas will result in flooding that is a costly and frequent hazard.

Fluvial erosion hazard (FEH) zones are areas along rivers and streams that are susceptible to bank erosion caused by flash flooding. Any area within a mapped FEH zone is considered susceptible to bank erosion during a single severe flood or after many years of slow channel migration. While the areas of the FEH zones often overlap with areas mapped within the 100-year floodplain on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs), the FIRMs only show areas that are likely to be inundated by floodwaters that overtop the riverbanks during a severe flood. However, much flood-related property damage and injuries is the result of bank erosion that can undermine roads, bridges, building foundations and other infrastructure. Consequently, FEH zones are sometimes outside of the 100-year floodplain shown on FIRMs. FEH zones can be mapped using fluvial geomorphic assessment data as well as historic data on past flood events. Both the FIRMs and FEH maps should be used in concert to understand and avoid both inundation and erosion hazards, respectively.[10]

Location and Extent

Franklin County has several major rivers and numerous tributaries which are susceptible to flood events. The major rivers in the region include the Connecticut, the Deerfield, and the Millers – of these, the Connecticut River flows through Northfield. Flooding poses a significant threat to life and public health and can cause severe property damage. Snowmelt, rain and ice jams caused the great flood of 1936 when the level of the Connecticut River rose 19 feet. It caused major devastation to towns along its banks, leaving 430,000 people in western Massachusetts homeless and causing $500 million in property damage ($6.5 billion in today's dollars). Table 3-1 shows occurrences of flooding in Franklin County since 1993 and Table 3-2 shows occurrences of flooding specific to Northfield, both taken from NOAA data and local input.

On August 27 and 28 2011, Tropical Storm Irene brought heavy rain to the region, causing extensive and long term damage to Franklin County towns. According to the National Weather Service, up to 9.92 inches of rain fell during the storm, though amounts varied significantly across Franklin County. Rivers, streams, and brooks throughout the county reached and surpassed flood levels. Rising water gathered debris that clogged culverts, roads and bridges were washed out, and homes and businesses were flooded, and in some cases, literally washed

[10] *Ammonoosuc River Fluvial Erosion Hazard Map for Littleton, NH*. Field Geology Services, 2010.

downriver. After the storm, Franklin, Berkshire, Hampshire and Hampden Counties were declared a disaster area by President Barack Obama, freeing up federal funds to assist towns with emergency work and road, bridge, and facility repairs. Up to 75 percent of repair costs can be covered by federal funds, as well as the cost of approved hazard mitigation efforts.

FEMA preliminary damage assessment (PDA) from the storm totals a cost of $27,713,911 statewide for municipal public damage, not including damage incurred by state-owned infrastructure. Franklin County's PDA estimates a total of $22,816,077 in damages, or 82% of the cost of all local public damage statewide. At the writing of this plan, these are very rough preliminary estimates of the total cost of the storm. More detailed numbers will become available as FEMA analyzes the particular damage in each town.

In Northfield there are approximately 2,283 acres within the 100 year floodplain. The 2010 Northfield Comprehensive Emergency Management Plan identifies the north end of Town near the State boat ramp and the Lower Farms area as flood prone areas in Northfield.

Previous flooding events in Northfield include roads flooded after heavy rains in June 1996, though no damages were reported.[11] Additionally, the flood damage caused by Tropical Storm Floyd in 1999 prompted the Town to seek funding from the Massachusetts Emergency Management Agency (MEMA) to clean up the worst of the storm damage. Approximately $45,000 - $50,000 was spent by the Town to clean up storm damage.

Tropical Storm Floyd dumped approximately 9 inches of rain over the Four Mile Brook watershed in the southern section of town and surrounding areas during a 24-hour period in September 1999. The brook responded by overtopping its banks and flowing down Four Mile Brook Road. The road was severely undercut and scoured by the raging water which then deposited its load of sediment (road material, fill, etc.) into the existing downstream stream channel for an estimated distance of 1,000 linear feet. Several homes were also flooded during this storm event. During the summer of 2000, several intense rainfall events caused additional flooding, erosion and sedimentation of the brook.[12]

In 2005 the Franklin Regional Council of Governments (FRCOG) was awarded a 604(b) Water Quality Management Planning Grant from the Massachusetts Department of Environmental Protection (DEP) to conduct an assessment of the Four Mile Brook Watershed, including a fluvial geomorphic assessment and development of conceptual designs to manage flow and mitigate bank erosion at several high hazard areas of Four Mile Brook adjacent to Four Mile Brook Road. The project resulted in the development of a Watershed Management Plan that includes recommendations for roadway improvement and stream restoration projects, as well as other Best Management Practices that will prevent nonpoint pollution in the watershed.[13] The Four Mile Brook Watershed Management Action Plan can be found in Appendix IV.

The Town is committed to finding a long-term solution to the erosion and sedimentation problems and to investigating innovative approaches to reducing nonpoint pollution in the

[11] NOAA Climatic Data Center. http://www4.ncdc.noaa.gov
[12] Franklin Regional Council of Governments website: http://www.frcog.org/services/natural_res/natres_4mile.php.
[13] *Four Mile Brook Watershed Assessment*. Franklin Regional Council of Governments, June 2008.

watershed. Currently the Town is implementing stormwater Best Management Practices at six priority locations in the watershed in order to address sediment loading to the brook from uncontrolled runoff. The Four Mile Brook Watershed Management Plan recommends implementing designs to manage flow and bank erosion, developed as part of the fluvial geomorphic assessment of the watershed, in three high hazard areas along the brook as the next highest priority. This recommendation in particular would help mitigate future damage to the road and property from flooding events.

Northfield was spared from the worst of the damage due to Tropical Storm Irene in 2011, however flooding did occur in a number of areas, including School Street, Warwick Road, Glen Road, Four Mile Brook Road, and Glenwood Avenue. The Committee identified these same areas as places that experience chronic flooding during any heavy rain storm or when the water table is high.

The section of the Connecticut River located in Northfield is part of the Turners Falls Power Pool, a 22-mile long reach of the Connecticut River between the Turners Falls Dam in Montague and the Vernon Dam in Vernon, Vermont that serves as the lower reservoir in support of the Northfield Mountain Pumped Storage Hydroelectric Project, owned by FirstLight Power Resources. The hydrodynamics of the Turners Falls Power Pool are primarily controlled by the three hydroelectric generating facilities: Turners Falls Dam, Vernon Dam, and the Northfield Mountain Pumped Storage Project. The joint operations of the Turners Falls facility and the Northfield Mountain Pumped Storage Project have resulted in larger and faster pool fluctuations, which have significantly changed the daily regime of this reach of the Connecticut River. Typical pool fluctuations average 3.5 feet per day at the dam. Much higher pool fluctuations, on the order of 9-10.5 feet at the dam, may occur over the course of the weekly pump/release cycle. Erosive forces have destabilized many sections of bank resulting in slumping and mass wasting of large sections of bank and the loss of trees and other riparian vegetation on the top of the banks.[14]

A number of areas along the Connecticut River in Northfield have been identified as heavy erosion areas, with resulting loss of farmland. Since 1996, a variety of bioengineering techniques have been used to stabilize eroding river banks in the power pool, including locations in Northfield. The multi-phase project is being implemented through a collaboration of FirstLight Power Resources, the Franklin Regional Council of Governments, the Massachusetts Department of Environmental Protection, and other local and regional stakeholders.[15]

SEVERE WINTER STORMS

General Description

Severe winter storms can pose a significant risk to property and human life because the rain, freezing rain, ice, snow, cold temperatures and wind associated with these storms can disrupt utility service, phone service and make roadways extremely hazardous. Severe winter storms can be deceptive killers. The types of deaths that can occur as a result of a severe winter storm

[14] Connecticut River Watershed Restoration website: http://www.restoreconnriver.org/index.php.
[15] Ibid.

include: traffic accidents on icy or snow-covered roads, heart attacks while shoveling snow, and hypothermia from prolonged exposure to cold temperatures. Infrastructure and other property are also at risk from severe winter storms and the associated flooding that can occur following heavy snow melt. Power and telephone lines, trees, and telecommunications structures can be damaged by ice, wind, snow, and falling trees and tree limbs. Icy road conditions or roads blocked by fallen trees may make it difficult to respond promptly to medical emergencies or fires. Prolonged, extremely cold temperatures can also cause inadequately insulated potable water lines and fire sprinkler pipes to rupture and disrupt the delivery of drinking water and cause extensive property damage.

Location and Extent

Franklin County regularly experiences severe winter storm events between the months of December and April. According to the National Climatic Data Center (NCDC), there have been a total of 111 snow and ice events reported in Franklin County between February 1, 1993 and February 26, 2010, including heavy snow, snow, ice storms, snow squalls, freezing rain and winter storms.[16] The NCDC web site has more detailed information about each of the listed storms. Seven out of the 111 snow and ice events that impacted Franklin County (as well as other areas of Massachusetts) resulted in Presidential Disaster Declarations or Emergency Declarations, which then made the state, residents and businesses eligible for federal disaster relief funds. Table 3-2 lists the 7 recent severe winter disasters that have led to Presidential Disaster or Emergency Declarations in Massachusetts.

Table 3-2: Major Winter Storm Disasters and Emergency Declarations Impacting Franklin County, 1993-2009

Disaster Name	Date of Event	Declared Areas	Disaster #/Type of Assistance	Federal Share Disbursed	Non-Federal Share Disbursed	Total Disburse-ment
Blizzards, High Winds and Record Snowfall	March 1993	All 14 Counties	FEMA-3103-EM (PA)	$1,284,873	$183,649	$1,468,522
Blizzard	January 1996	All 14 Counties	FEMA-1090-EM (PA)	$16,177,860		$16,177,860
Snowstorm	March 2001	Counties of Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, and Worcester. The cost share is 75% federal and 25% local.	FEMA-3165-EM (PA)	$21,065,441		$21,065,441
Snowstorm	February 2003	All 14 Counties. The cost share is 75% federal and 25% local.	FEMA-3175-EM (PA)	$28,868,815		$28,868,815
Snowstorm	Decembe r 2003	Counties of Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire,	FEMA-3191-EM (PA)	$35,683,865		$35,683,865

[16] http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Disaster Name	Date of Event	Declared Areas	Disaster #/Type of Assistance	Federal Share Disbursed	Non-Federal Share Disbursed	Total Disburse-ment
		Middlesex, Norfolk, Plymouth, Suffolk, and Worcester				
Snowstorm	January 2005	All 14 Counties	FEMA-3201-EM (PA)	$49,945,087		$49,945,087
Severe Winter Storm	Decembe r 2008	Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Suffolk, and Worcester *(Figure as of 9/8/2009)	FEMA-3296-EM-MA	$66,509,713		
Severe Storms and Flooding	Decembe r 2008	All 14 Counties (6 month lock-in $7,200,000)	FEMA-1813-DR-MA(PA)			

Notes: **Public Assistance (PA) Project grants.** Supplemental disaster assistance to states, local governments, certain private non-profit organizations resulting from declared major disasters or emergencies.

Although ice storms occur much less frequently than snow storms (4 out of 111 in the NCDC database), the effects can be devastating. On December 11, 2008, Franklin County residents awoke to a landscape coated with ice. Half an inch of ice accumulated on exposed surfaces across Franklin County. This major ice storm affected interior Massachusetts and southern New Hampshire as well as much of northern New England. The ice buildup on exposed surfaces combined with breezy conditions resulted in numerous downed trees, branches, and power lines, which resulted in widespread power outages. More than 300,000 customers were reportedly without power in Massachusetts and an additional 300,000 were without power in the state of New Hampshire. Because of the breadth of this storm (from Pennsylvania to Maine), extra crews to reinstate power were harder to come by. Power crews from states as far away as South Carolina, as well as local National Guard teams, were called out to help with power restoration and clean up. While most people had their power restored within a week, others were still without power at Christmas (nearly 2 weeks later).

During this period, temperatures were mostly below normal and at least one major snowstorm affected the same area. At the time of this snowstorm, which dumped 7 – 12 inches of snow in eastern Franklin County and 9 – 14 inches of snow in western part of the county, over 100,000 customers were still without power in the two states combined. Two days later, on December 21, 2008, 5 – 7 inches of new snow blanketed eastern Franklin County. In Northfield, the higher elevations were impacted by the ice storm. Trees were downed and power was out in parts of the town. A shelter was opened, and the town provided housing for the National Guard in the Town Hall for one or two nights.

On October 29, 2011, an early snowstorm caused extensive power outages throughout the Connecticut River valley. Heavy snow accumulating on top of trees that still had full canopies caused trees, branches and limbs to fall on power lines. According to Western Massachusetts Electric Company (WMECO), which provides electricity to Northfield and a large portion of

Franklin County, it was the worst storm in the company's history, with over 150,000 customers left without power.[17] A state of emergency in Massachusetts was declared by the governor on Saturday night, and then by President Obama on Tuesday.[18] In Northfield, as of Sunday, October 30, 81% of town was without power. As of Thursday, November 3, WMECO estimated that 12% of Northfield customers were still without power.[19] A shelter was opened at the Pioneer Valley Regional School, which remained open for three days. Many trees were damaged or downed during the storm in Northfield, resulting in several months of tree work to clean up the damage.

Given Northfield's location, severe winter storms will continue to impact the town. Northfield can mitigate the impacts of such storms with continued attention on preparedness.

HURRICANES AND TROPICAL STORMS

General Description

Hurricanes are violent rainstorms with strong winds that can reach speeds of up to 200 miles per hour. Hurricanes generally occur between June and November and can result in flooding and wind damage to structures and above-ground utilities. August, September, and the first half of October are when most hurricanes occur in New England. In Massachusetts, major hurricanes occurred in 1904, 1938, 1954, 1955, 1960 1976, 1985, and 1991. The last hurricane to make landfall in New England was Hurricane Bob, a weak category 2 hurricane, in August 1991. Tropical storms are defined as having sustained winds from 34-73 mph and can cause flooding and similar wind related damages as hurricanes.

Location and Extent

In Franklin County, Hurricane Bob (1991) caused roughly $5,555,556 in property and crop damages.[20] Between 1990 and 2008, 16 tropical storms impacted Franklin County, causing almost $600,000 in property damages.[21] During the writing of this plan, Tropical Storm Irene caused significant damage throughout Franklin County, which was declared a disaster area by President Obama a little over a week after the storm. The major impacts of the storm came from heavy rains and flooding (see the Flooding section on page 12 for more information). Wind gusts did cause power outages in parts of the county, including some power outages in Northfield. There were no other wind-related damages reported in Northfield due to the storm.

While there have been no reports of hurricane events in Northfield, a substantial hurricane could impact the entire town, damaging or destroying property and crops, and potentially causing injuries or death to the residents of town.

[17] "WMECO's Worst Storm," John Tilton and Anita Phillips. *The Recorder*, November 1, 2011.
[18] "Storm Recovery Slow," Recorder Staff. *The Recorder*, November 2, 2011.
[19] Western Massachusetts Electric Company Outage Report, 11/3/2011.
[20] Spatial Hazard Events and Losses Database (SHELDUS), http://webra.cas.sc.edu/hvri/
[21] Ibid.

TORNADOS, MICROBURSTS, AND THUNDERSTORMS

General Description

The category of Tornados, Microbursts and Thunderstorms includes associated storm effects of hail and lightning. Tornados are swirling columns of air that typically form in the spring and summer during severe thunderstorm events. In a relatively short period of time and with little or no advance warning, a tornado can attain rotational wind speeds in excess of 250 miles per hour and can cause severe devastation along a path that ranges from a few dozen yards to over a mile in width. The path of a tornado may be hard to predict because they can stall or change direction abruptly.

Of additional concern are microbursts, which often do tornado-like damage and can be mistaken for tornados. In contrast to the upward rush of air in a tornado, air blasts rapidly downward from thunderstorms to create microbursts.[22] Thunderstorms can occur frequently in Western Massachusetts, sometimes accompanied by strong winds, hail and lightning.

Location and Extent

Within Massachusetts, tornados have occurred most frequently in Worcester County and in communities west of Worcester, including towns in eastern Franklin County. On June 1, 2011, a tornado ripped through western and central Massachusetts, killing one person and injuring four others. In an area where tornados are rare, this event was a reminder that tornados do, in fact, impact the region. The fearsome storm downed trees, ripped roofs from hundreds of homes, and damaged many historic properties. On June 15, President Obama signed a disaster declaration for Hampden and Worcester counties which provided federal funds for affected residents and properties.

Preservation groups – including Preservation Massachusetts and the Springfield Preservation Trust – have assisted hardest hit communities, especially Springfield and Monson. In part, these preservation groups are helping to inventory properties and to encourage towns not to rush to demolish historic structures. The groups are also offering a list of resources property owners can consult to assist them in making decisions about repairing historic properties. MEMA also conducted a briefing for historic property owners and encouraged representatives of Historical Commissions, Historical Societies, libraries, museums, and other non-profit organizations dedicated to preserving historic structures communicate with town officials and FEMA and MEMA staff throughout the disaster recovery process.

The most recent tornado reported in Northfield was on July 3, 1972, and was ranked F1 (Moderate Tornado) on the Fujita Scale of Tornado Intensity. The tornado was approximately three miles long and touched down on the Connecticut River to the southeast of Caldwell Road in Northfield. The extent of damage it caused is unknown. Since the 1950s, there have been over twenty tornados in Franklin County. In the last fifteen years, three tornados have been reported in Franklin County, in the towns of Heath, Charlemont, and Wendell. The July 2006 tornado in Wendell was rated F2 (Strong) on the Fujita Scale with winds estimated near 155 mph.[23]

[22] *http://www.fema.gov/regions/vii/2003/03r7n06a.shtm*
[23] NOAA National Climate Data Center, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

According to data supplied by the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center, from July 1996-May 2010, the Town experienced two microbursts, resulting in a total of $30,000 in damages. In August of 1997, a microburst occurred in Northfield with an estimated thunderstorm wind gust of 80 to 90 mph, causing $10,000 worth of damage. The damage occurred on Pine Meadow Road off of Route 63, where winds downed trees, utility poles, and wires, causing damage to several structures. A microburst on June 26, 2005 caused $20,000 in damages, with wind gusts reported at 100 mph or higher. The wind brought down between 80-100 trees, with the worst damage occurring on School Street, South Street and Vernon Road. Over 2,000 utility customers lost power due to the storm.

According to the same database, nine thunderstorms produced damaging winds in Northfield between 1996 and 2010. Most notably, on May 26, 2010, strong thunderstorm winds caused damages throughout the Connecticut River Valley with numerous trees and wires down and widespread power outages. The storm resulted in a total of $20,000 in damages in Northfield.

WILDFIRES AND BRUSHFIRES

General Description

According to FEMA, there are three different classes of wildland fires: *surface fires*, *ground fires* and *crown fires*.[24] The most common type of wildland fire is a surface fire that burns slowly along the floor of a forest, killing or damaging trees. A ground fire burns on or below the forest floor and is usually started by lightening. Crown fires move quickly by jumping along the tops of trees. A crown fire may spread rapidly, especially under windy conditions. While wildland fires have not been a significant problem in Northfield, there is always a possibility that changing land use patterns and weather conditions will increase a community's vulnerability. For example, drought conditions can make forests and other open, vegetated areas more vulnerable to ignition. Once the fire starts, it will burn hotter and be harder to extinguish. Soils and root systems starved for moisture are also vulnerable to fire. Residential growth in rural, forested areas increases the total area that is vulnerable to fire and places homes and neighborhoods closer to areas where wildfires are more likely to occur.

Location and Extent

According to the Massachusetts Fire Incident Reporting System, one brush fire was reported in Northfield between 2004 and 2009, the lowest number reported for Franklin County towns during this period. In 2009, 472 burn permits were issued in Northfield according to Shelburne Control. Northfield has roughly 16,066 acres of forests, comprising 73 percent of the total land area, and could be at risk for wildfire, particularly if there are significant areas of blown down trees, serving as a potential fuel source. The Committee noted that due to the 2008 ice storm and the 2011 October snow storm, there is currently a large amount of timber down in the forests, constituting a potentially large fuel source for a fire.

[24] FEMA, "Fact Sheet: Wildland Fires," September 1993.

DAM FAILURE

General Description

Although dams and their associated impoundments provide many benefits to a community, such as water supply, recreation, hydroelectric power generation, and flood control, they also pose a potential risk to lives and property. Dam failure is not a common occurrence but dams do represent a potentially disastrous hazard. When a dam fails, the potential energy of the stored water behind the dam is instantly released, oftentimes with catastrophic consequences as the water rushes in a torrent downstream flooding an area engineers refer to as an "inundation area." The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area.

Many dams in Massachusetts were built in the 19th Century without the benefit of modern engineering design and construction oversight. Dams can fail because of structural problems due to age and/or lack of proper maintenance. Dam failure can also be the result of structural damage caused by an earthquake or flooding brought on by severe storm events.

The Massachusetts Department of Conservation and Recreation (DCR) is the agency responsible for regulating dams in the state (M.G.L. Chapter 253, Section 44 and the implementing regulations 302 CMR 10.00). Until 2002, DCR was also responsible for conducting dam inspections but then state law was changed to place the responsibility and cost for inspections on the owners of the dams. In accordance with the new regulations, which went into effect in 2005, dam owners must register, inspect and maintain dams in good operating condition. Owners of High Hazard Potential dams and certain Significant Hazard Potential dams are also required to prepare, maintain and update Emergency Action Plans. State legislation is currently pending that would set up a loan fund to assist owners in inspecting and maintaining their dams.

The state has three hazard classifications for dams:

- *High Hazard Potential*: Dams located where failure or improper operation will likely cause loss of life and serious damage to homes, industrial or commercial facilities, important public utilities, main highways, or railroads.

- *Significant Hazard Potential*: Dams located where failure or improper operation may cause loss of life and damage to homes, industrial or commercial facilities, secondary highways or railroads or cause interruption of use or service of relatively important facilities.

- *Low Hazard Potential*: Dams located where failure or improper operation may cause minimal property damage to others. Loss of life is not expected.

Owners of dams are required to hire a qualified engineer to inspect and report results using the following inspection schedule:

- Low Hazard Potential dams – 10 years
- Significant Hazard Potential dams – 5 years
- High Hazard Potential dams – 2 years

The time intervals represent the maximum time between inspections. More frequent inspections may be performed at the discretion of the state. Dams and reservoirs licensed and subject to inspection by the Federal Energy Regulatory Commission (FERC) are excluded from the provisions of the state regulations provided that all FERC-approved periodic inspection reports are provided to the DCR. All other dams are subject to the regulations unless exempted in writing by DCR.

There are several programs available to owners of dams to assist with repair or removal of dams on their property. The Natural Resources Conservation Service (NRCS), a program of the U.S. Department of Agriculture, offers two funding opportunities for qualifying private landowners to cover part of the cost of establishing and maintaining conservation practices that enhance and improve wildlife habitat and restore natural ecosystems, including dam removal or repair. Additionally, the Massachusetts Department of Fish and Game (DFG) Riverways Program works with dam owners (both public and private) to remove failing or unnecessary dams on rivers with high habitat value and where there is community support. Riverways provides (1) technical assistance (2) technical services from pre-approved consulting firms and/or, (3) funding. Riverways works closely with Conservation Commissions, DEP and other permitting agencies to make sure dam removal projects are consistent with state and federal laws and regulations.[25]

Beaver Dams

Along with manmade dams, failure of beaver dams can cause flooding as well. Alteration of the landscape by beavers is a natural process that creates habitat for shore birds, mammals and rare amphibians. However, beaver ponds can flood structures, roads and utilities, causing costly and potentially dangerous situations. Beaver activity can also pollute drinking water supplies. Mitigation measures suggested by Massachusetts Division of Fish and Wildlife (MassWildlife) and other agencies can help communities and homeowners deal with nature's master builders.

Until 1996, when a ballot initiative passed restricting the practice, Massachusetts residents were permitted to trap beavers. That change in policy caused a spike in the beaver population, which, in turn, led to a sharp increase in complaints about beaver activity and its effects. The law was modified in 2000 so that town Board of Health members could issue emergency trapping permission outside of the usual trapping season.

In 2011, a bill is under consideration with the State Legislators which would give individuals and towns an additional option when they are having issues with beavers. Under this new bill, a special permit could be obtained from the State Department of Fisheries and Wildlife. The bill does not aim to repeal the bill that bans trapping but rather allows the issuing of an emergency permit under the provisions allowed within the laws of the State. The proposed bill also calls for the State to begin keeping better records of all permits issued and how many beavers are trapped each year.

An increased beaver population, combined with land development reducing beaver habitat, means that humans and beavers continue to clash. Several mitigation measures, when applied

[25] For more information on these programs and other available funding sources, see www.ma.nrcs.usda.gov and http://www.mass.gov/dfwele/der/riverways/resources/riverfactsheets.htm.

thoughtfully, legally and with maintenance measures in mind, can help with beavers' negative effects, while preserving beavers' positive impact on the land.[26]

State law makes it illegal for any person to disturb or tear open a beaver dam or beaver lodge without written permission from MassWildlife and the local Conservation Commission or Department of Environmental Protection. Permits are needed to disturb a beaver dam for any reason in Massachusetts. Even dams that cause flooding require permits to be breached.[27]

While trapping beaver can have short-term benefits, the right conditions for beaver habitat will eventually lure new beavers. It may be best to combine trapping with measures that discourage beaver activity that's bad for humans. Techniques used to mitigate the flooding damage caused by beaver include breaching of beaver dams, protecting road culverts with fences or guards, and controlling water levels with water flow devices. All these techniques require a certain degree of effort and regular maintenance to insure water levels that can be tolerated (thereby preserving the positive aspects of the associated wetland). See the MassWildlife publication *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts* for details on these mitigation measures. The following techniques were adapted from that publication.

- Dam breaching is an immediate but very short-term solution to flooding problems caused by beaver. Potato hoes or stone hooks are the best tools for dismantling dams by hand. Shovels and spading forks are ineffective. Good water control is possible if the breach is kept shallow and broad so that the water level falls slowly. Opening a deep breach creates a dangerous situation and may cause serious flooding and erosion downstream. Tractor- or truck-mounted excavators may be used by town, county or state highway employees to remove large amounts of material from beaver dams but care should be taken to avoid downstream flooding. Neighbors should be told where, when, and why a dam excavation is going to be done. If the method is justified and must be used, it is best done in mid-summer when the water level is low.
- Beavers build dams instinctively. When they sense running water, they start to build or repair dams. Culverts, especially ones made out of metal, will amplify the sound of the water rushing through them. Thus, beaver will commonly block road culverts with sticks, mud and rocks. This can cause flooding upstream. Culverts blocked from the inside are difficult to clean and potentially dangerous. The use of meshes and grills, placed on both the upstream and downstream ends of the culvert, can prevent beavers from entering. Several strategies are listed in *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts.*
- Water Level Control Devices (WLCDs) keep beavers away from an intake pipe that lowers the water level of the pond. It's been estimated that only 4.5% of beaver problems in Massachusetts will respond to these devices. Using and maintaining a WLCD in conjunction with trapping young beavers can allow coexistence for years. Several types of WLCDs are available. For construction details, see *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts.*

[26] *Otsego County* (NY) *All Hazards Mitigation Plan*, 2010.

[27] Langlois, S.A. and T.A. Decker. 2004. *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts* (Rev. Ed.). MA Division of Fisheries and Wildlife. 18pp.

Location and Extent

The 2010 Northfield CEM Plan lists only one dam in the Northfield area: the Mt. Hermon School Upper Reservoir Dam, a high hazard potential dam. The Mt. Hermon School Upper Reservoir Dam could affect up to an estimated 850 people if the former Northfield Mt. Hermon School campus was in use and impacted.[28]

The MA DCR Office of Dam Safety provided information about three dams in Northfield for the Northfield 2012 Local Multi-Hazard Mitigation Plan: Nelson Mills Pond Dam; Mt. Hermon School Upper Reservoir Dam (identified as the Grandin Reservoir Dam in the DCR records); and Perry Pond Dam. The Nelson Mills Pond Dam is owned by the Town and is listed as a significant hazard dam. As already mentioned, the Mt. Hermon School Upper Reservoir Dam is listed as a high hazard dam, and is owned by the Northfield Mount Hermon School (NMH). NMH also owns the Perry Pond Dam, which has a low hazard designation. According to the 2005 Northfield Local Hazard Mitigation Plan, the Perry Pond Dam has been breached.

The Lily Pond Dam and Nelson Mills Pond Dam are listed as low hazard dams. The committee disagrees with the low hazard rating given by the Office of Dam Safety to the Lily Pond Dam and feels that high hazard would be a more appropriate classification, as the failure of the Nelson Mills Pond Dam would inundate Route 142 (Mount Hermon Station Road), rendering it impassible for evacuation efforts on the west side of town.

Mt. Hermon School Upper Reservoir Dam

The most significant of these dams is the Mt. Hermon School Upper Reservoir Dam, which is owned by Northfield Mt. Hermon School and is situated on its former Northfield Campus. This is a high hazard dam that has a storage capacity of 28 million gallons of water, and is used to supply water to the school and residents of East Northfield. According to the DCR, at the time of the June 2010 inspection of the dam, it was reported to be in fair condition. The dam is inspected every two years, with the most recent inspection occurring on March 19, 2012.

In 1998, the Army Corps of Engineers completed a dam failure analysis for the Mt. Hermon School Upper Reservoir Dam. The analysis focused on the impact of a dam failure to the culvert on Winchester Road, to the southwest of the reservoir. The analysis concluded that a dam breach of this type would cause flooding with appreciable property damage in one house with a possible attendant loss of life. The peak discharge would cause a maximum stage of 391.4 feet, 3.4 feet over the road. As this report was completed in 1998, it is possible that these conclusions do not adequately address the potential for damage to the residential area of East Northfield on and around Winchester Road. The Critical Facilities and Infrastructure Map on page 70 indicates residential development in this area that is potentially inconsistent with the relatively low estimate of damage. The Committee noted that if the dam were to fail, it would likely impact approximately six residents on Louisiana Road.

An Emergency Action Plan (EAP) was created for the dam in July 2001, and updated in 2006. The EAP notes that in the event of a dam failure, seven residential structures would be flooded, causing appreciable damage and possible loss of life. Additionally the plan notes that the streets in the inundation area may suffer major damage, causing them to be impassable during and after

[28] This number assumes that a school or other similar use is operating on the Northfield campus.

the floodwaters recede. Sections of Linden Avenue, Winchester Road, Pierson Road, Route 10, and Route 63 will be inundated by the flood wave according to the plan. The plan will again be updated by the Northfield Mount Hermon School by the end of July 2012. At that time it is recommended that the Northfield Mount Hermon School, East Northfield Water District, and the Town conduct an exercise to test the EAP. The Town should also make an effort to ensure that residents who may be affected by a failure of the Upper Reservoir Dam are entered into the Town's Reverse 911 system, which can alert them by telephone of the need to evacuate.

Dams Located in Other Towns that Impact Northfield
Northfield Mountain Pumped Storage Project located east of Northfield in Erving is owned and maintained by FirstLight Power Resources of Hartford, Connecticut. The Emergency Action Plan for this facility was produced by Northeast Utilities of Hartford, Connecticut and includes inundation maps for the Northfield Main Dam and the Northwest Dike of the Northfield Mountain Reservoir in Erving. Both the dam and the dike are classified as Significant Hazards by the MA DCR Office of Dam Safety. According to inundation maps for the Northwest Dike, floodplain areas in Northfield along Four Mile Brook and the Connecticut River would be impacted by a dike failure. Upon failure, a small area of residential development would be affected. Residents would have from 18 to 50 minutes to respond to potential flooding.

Of additional concern is the Moore Dam, owned by TransCanada and located on the Connecticut River in the towns of Littleton, New Hampshire, and Waterford, Vermont, approximately 152 miles upstream from Northfield. According to the Emergency Action Plan, flooding caused by a failure of the dam would reach Northfield within 23 hours. Under Probable Maximum Flood conditions, flood waters would inundate farmland and residences along Caldwell Road, W. Northfield Road, Great Meadow Road, Old Bernardston Road, Route 10, including the bridge over the Connecticut River, Pine Meadow Road, and Cross Road. The Schell Bridge, a historic resource in Northfield, could also be in danger of being damaged or destroyed if the Moore Dam were to fail.

Additional dams found upstream on the Connecticut River in neighboring states may pose a hazard to the Town of Northfield. Some publicly owned reservoirs and dams that are located upstream of Northfield include the Vernon Dam, Townshend Lake and North Springfield Lake in Vermont, and Surry Mountain Lake and Otter Brook Lake in New Hampshire[29].

Beaver Dams
According to the Committee, beaver dams have caused flooding in several areas of town, which has resulted in damage to roads and property. Locations identified by the Committee and shown on the Critical Facilities and Infrastructure Map on page 70, include Old Vernon Road, East Street at School Street, and the access road off of Route 10 near Old Bernardston Road.

EARTHQUAKES

General Description
An earthquake is a sudden, rapid shaking of the ground that is caused by the breaking and shifting of rock beneath the Earth's surface. Earthquakes can occur suddenly, without warning,

[29] New England River Basins Commission, The River's Reach. December 1976.

at any time of the year. New England experiences an average of 30 to 40 earthquakes each year although most are not noticed by people.[30] Ground shaking from earthquakes can rupture gas mains and disrupt other utility service, damage buildings, bridges and roads, and trigger other hazardous events such as avalanches, flash floods (dam failure) and fires. Un-reinforced masonry buildings, buildings with foundations that rest on filled land or unconsolidated, unstable soil, and mobile homes not tied to their foundations are at risk during an earthquake.[31]

Location and Extent

Tables 3-3 and 3-4 show historic occurrences of earthquakes in the Northeastern part of the United States. A NOAA data query for earthquake events in Franklin County between the years 1991 and 2010 turned up no events.

Table 3-3: Northeast Earthquakes with a Magnitude of 4.2 or more 1924 - 2007

Location	Date	Magnitude
Ossipee, NH	December 20, 1940	5.5
Ossipee, NH	December 24, 1940	5.5
Dover-Foxcroft, ME	December 28, 1947	4.5
Kingston, RI	June 10, 1951	4.6
Portland, ME	April 26, 1957	4.7
Middlebury, VT	April 10, 1962	4.2
Near NH Quebec Border, NH	June 15, 1973	4.8
West of Laconia, NH	Jan. 19, 1982	4.5
Plattsburg, NY	April 20, 2002	5.1
Bar Harbor, ME	October 3, 2006	4.2

Source: Northeast States Emergency Consortium Web site: www.nesec.org/hazards/earthquakes.cfm.

Table 3-4: Northeast States Record of Historic Earthquakes

State	Years of Record	Number Of Earthquakes
Connecticut	1668 - 2007	137
Maine	1766 - 2007	544
Massachusetts	1668 - 2007	355
New Hampshire	1638 - 2007	360
Rhode Island	1776 - 2007	38
Vermont	1843 - 2007	73
New York	1840 - 2007	755
Total Number of Earthquakes within the Northeast states between 1638 and 2007 = 2,403.		

Source: Northeast States Emergency Consortium Web site: www.nesec.org/hazards/earthquakes.cfm.

[30] Northeast States Emergency Consortium Web site: *www.nesec.org/hazards/earthquakes.cfm*
[31] Federal Emergency Management Agency Web site: *www.fema.gov/hazards/earthquakes/quake.shtm.*

According to the United States Geological Survey, a fault line runs north-south through the center of Northfield. The fault extends along the entire length of Franklin County, and was originally responsible for the creation of the Connecticut River.

Massachusetts introduced earthquake design requirements into their building code in 1975. However, these specifications apply only to new buildings or to extensively modified existing buildings. Buildings, bridges, water supply lines, electrical power lines and facilities built before 1975 may not have been designed to withstand the forces of an earthquake. Approximately 60% of housing in Northfield was built prior to 1970.[32] The seismic standards have also been upgraded with the 1997 revision of the State Building Code.

LANDSLIDES

General Description

Landslides are geological phenomena that include a wide range of ground movement, such as rock falls, failure of slopes and shallow debris flows. They can occur in coastal, mountain, and river edge environments.

Landslides occur when the stability of a slope changes from a stable to an unstable condition. A change in the stability of a slope can be caused by a number of factors, acting together or alone. Natural causes of landslides include:

- groundwater pressure acting to destabilize the slope
- loss or absence of vertical vegetative structure, soil nutrients, and soil structure (e.g. after a wildfire)
- erosion of the toe of a slope by rivers
- weakening of a slope through saturation by snowmelt or heavy rains
- earthquakes adding loads to barely-stable slopes
- earthquake-caused liquefaction destabilizing slopes
- volcanic eruptions

Landslides are created by human activities as well, including deforestation, cultivation and construction, which destabilize already fragile slopes

- vibrations from machinery or traffic
- blasting
- earthwork which alters the shape of a slope, or which imposes new loads on an existing slope
- in shallow soils, the removal of deep-rooted vegetation that binds colluvium to bedrock
- construction, agricultural or forestry activities (logging) which change the amount of water which infiltrates the soil.

[32] 2005-2009 American Community Survey.

Location and Extent

Typical locations for landslides in Franklin County include along steep riverbanks and where steeps slopes have been disturbed by human activity. Landslides and mudslides in Franklin County have been relatively limited in extent. However, damaging landslides have occurred recently. According to WWLP News Springfield, early in the morning on March 7 of 2011, torrential rains swept away a piece of cemetery into the backyards of homes and nearby streets in Greenfield, MA. The landslide sent silt, mud, and debris down from the Green River Cemetery into homes on nearby Meridian Street. Residents did not hear a thing. A passerby called 911 and alerted authorities. Residents of three homes were evacuated. This area of Greenfield has been in the news before due to other landslides. According to the Greenfield Recorder, state geologists estimated that about 1,500 to 3,000 cubic yards of mud and debris came down into the yards but that no graves were involved. Three inches of rain in Greenfield over a day and a half contributed to the disaster that caused thousands of dollars worth of damage.

The Connecticut River Valley is given a Moderate landslide incidence rating (1.5% to 15% of the area involved) while the remainder of the state is listed as Low landslide incidence (less than 1.5% of the area involved).[33] Erosion along the banks of the Connecticut River in Northfield has resulted in the loss of agricultural land. Bank stabilization work has been completed in recent years and continues as part of a multi-phase project. See the Flooding section for more information.

ICE JAMS

General Description

Ice jams (or ice dams) occur when water builds up behind a blockage of ice. Ice jams can occur in various ways, but in New England they predominantly form on rivers and streams and mainly threaten infrastructure.

When the upstream part of a river thaws first and the ice is carried downstream into the still-frozen part of the watercourse, ice can form an ice dam and flood low lying areas upstream of the jam. Also, once an ice dam breaks apart, the sudden surge of water that breaks through the dam can flood areas downstream of the jam. Ice jams and flooding usually occur in spring; however, they can happen as winter sets in when the downstream reach of a river freezes first. Where floods threaten, the blockage can be removed mechanically.

Location and Extent

Ice jams have occurred on the Connecticut River, though none have been reported in Northfield. Historical data from the U.S. Army Cold Regions Research and Engineering Laboratory[34] from 2008 show ice jam occurrences, located by river. Since recording began there have been no ice jams on the Connecticut River in Northfield, but there have been several in Montague, downstream from Northfield. The last ice jam recorded on the Connecticut River occurred in 1957.

[33] U.S. Department of the Interior, U.S. Geological Survey. National Landslide Hazards Mitigation Strategy: A Framework for Loss Reduction. 2000.
[34] www.crrel.usace.army.mil

Table 3-5: Past Ice Jams on the Connecticut River

Date	Type	Town	Description or other information
01/24/1957	unknown	Montague City	Maximum annual gage height of 23.78 feet. Discharge 36,000 cfs
03/01/1947	Break-Up	Springfield	Weather Bureau reports ice jam upstream from gage Connecticut River at Springfield on March 1 (stage 4.5 ft) and 2, 1947 (stage 4.2 ft). Gage datum 37.3 ft MSL, flood stage 20 ft.
03/10/1946	unknown	Montague City	Maximum annual gage height of 27.41. Discharge "about" 71,000 cfs
03/01/1946	Break-Up	Northampton	As reported by The Hartford Courant on 03/12/46, "The Connecticut River crested at the 18-foot level in Hartford about 7 p.m. Monday and by 8 p.m. had subsided to 17.5 feet as freeze-up gripped the whole Connecticut Valley and reduced the danger of a spring flood. Waters were receding at Northampton, Mass, despite an ice jam there.
12/21/1945	unknown	Holyoke	Stage 2.7 ft. Gage datum 97.47 ft, flood stage 9 ft. NWSFO/NERFC flood stage 19 ft.
03/13/1936	unknown	Northampton	Gigantic ice jam in the Connecticut River, with ice piled 18 to 20 feet high at spots. This put terrific pressure on the Boston and Maine railroad embankment bordering the river and at one point a bulge was noticeable.
03/13/1936	Break-Up	Holyoke	Nearly the entire flow of the swollen river was diverted across the inner part of the Hockanum Meadows, where it threatened to establish a new channel. This diverted stream returned to its normal channel near Mount Tom Junction when the huge ice barrier broke during the evening of March 15, floated downstream at a rate of more than 6 miles per hour, and passed over the Holyoke dam at a stage of 9.5 feet above the crest. The battering of the great ice blocks was thought to have removed 5-8 feet of the granite crest of the dam for over three-fourths of its 1,020-foot length. When the normal channel was rid of the ice jam, the main current of the swollen river reoccupied it. Most of the damage to agricultural land was done by local deep scour, strong river-bank corrosion, which was at some places accompanied by removal of many tons of material, and deposition elsewhere of appreciable thicknesses of rather coarse sediment. A tremendous amount of damage was done in thickly settled areas by the battering of large objects carried by the flood waters, by deposition of silt in and around buildings, and by the wetting of their interiors

Source: U.S. Army Cold Regions Research and Engineering Laboratory, 2008.

According to the committee, ice jams have occurred on the Connecticut River in Northfield in the past, before the Vermont Yankee Nuclear Power Plant upstream in Vernon, Vermont became operational in 1972. Water from the Connecticut River is used to cool the nuclear reactor. Despite the use of cooling towers to cool the water before being discharged back into the river, the water temperature in the Connecticut River has risen due to the operation of the power plant. The committee feels that the higher water temperature due to the plant's operation has prevented the formation of ice jams on the river. The plant's operating license was renewed in 2011 for another 20 years. If the plant closes in the future, it is possible that ice jams will become a more common occurrence on the Connecticut River.

MANMADE HAZARDS[35]

General Description

Most non-natural or manmade hazards fall into two general categories: intentional acts and accidental events, although these categories can overlap. Some of the hazards included in these two categories, as defined by MEMA, consist of intentional acts such as explosive devices, biological and radiological agents, arson and cyberterrorism and accidental events such as nuclear hazards, invasive species, infrastructure failure, industrial and transportation accidents. Accidental events can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials.

This plan does not address all manmade hazards that could affect Franklin County. A complete hazards vulnerability analysis was not within the scope of this update. For the purposes of the 2011 plan, non-natural hazards that are of an accidental nature were evaluated. They include industrial transportation accidents and industrial accidents in a fixed facility.

Hazardous Materials Definition

Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. Chemical manufacturers are one source of hazardous materials, but there are many others, including service stations, hospitals, and hazardous materials waste sites. Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants.

Hazardous Materials incidents have the potential to occur in every corner of the Commonwealth. A release may occur at a fixed facility or in transit. Communities with a large industrial base may be more inclined to experience a hazardous materials release due to the number of facilities that use such materials in their manufacturing process. Communities with several major roadways may be at a greater risk due to the number and frequency of trucks transporting hazardous materials.

Location and Extent

Industrial Accidents - Transportation

Franklin County transportation systems include road, rail, and air. Accessible and efficient freight transportation plays a vital function in the economy of the region. Most freight and goods being transported to and from Franklin County are by truck; however, a significant amount of freight that moves through the county is being hauled over the three main rail lines. Given that any freight shipped via air needs first to be trucked to an airport outside the region, air transportation is not being evaluated in this plan.

According to the Franklin County Hazardous Material Emergency Plan[36], approximately 13 to 15 trucks per hour traveling through the region contain hazardous materials (Table 3-6). Most of

[35] Content adapted from Commonwealth of Massachusetts State Hazard Mitigation Plan 2010

these trucks are on Interstate 91, however 1 to 0 trucks traveling on Routes 10 and 63 per hour through Northfield could potentially carry hazardous materials, including gasoline, fuel oil, kerosene, liquefied petroleum gas, and propane.

Table 3-6: Estimated Levels of Hazardous Material Transported on Franklin County Roadways

Roadway	Number of Tank or Van Trucks Carrying Hazardous Materials per hour
Interstate 91	10
Route 2	2
Other major roadways *(Routes 5/10, 63, 47, 116,202, 8A, 78, 122, 142, and 2A)*	1 or 0

Source: Franklin County Local Emergency Planning Committee, Franklin County Hazardous Material Emergency Plan and Maps, 2006. Based on a one-time survey conducted in 2003.

For rail transport, it was estimated that there are 100 to 130 train cars with hazardous materials passing through the region each day (Table 3-7). According to the HMEP Hazardous Materials Survey Results, the Connecticut River Main Line (Boston and Maine) railroad carries one train a day through Northfield, with an average train length of 30 cars. The survey identified Liquified Petrolium Gas as a hazardous material regularly carried on these trains. The New England Central Railroad carries one train in each direction per day, with an average train length of 60 cars. The hazardous materials regularly carried on these trains include:

- Liquified Petrolium Gas
- Anhydrous Ammonia
- Sulfuric acid
- Carbon dioxide
- Nuclear devices

Table 3-7: Estimated Level of Hazardous Material Transport on Franklin County Train Lines

Train Line	Trains per Day (General Merchandise)	Average Number of Cars per Train	Average Number of Cars per Train with Hazardous Waste
Main Freight Line, Pan Am Systems	10 to 24	50	4
Connecticut River Line, Pan Am Systems	2 to 3	30	2
East Deerfield Rail Yard, Pan Am Systems	10 to 15 trains passing through yard	n/a	2 to 5
New England Central	2	60	5

Source: Franklin County Local Emergency Planning Committee, Franklin County Hazardous Material Emergency Plan and Maps, 2006. Based on a one-time survey conducted in 2003.

According to the Committee, within the last few years the transport of ethanol by rail has become more common. According to the Northfield EMD, approximately three trains a week carry up to 60 cars of ethanol per train through Northfield. Ethanol is flammable and requires a special type of foam to extinguish. Specialized training for dealing with an ethanol accident is being planned for the County.

[36] Franklin County Local Emergency Planning Committee, Franklin County Hazardous Material Emergency Plan and Maps, 2006. Based on a one-time survey conducted in 2003.

Industrial Accidents – Fixed Facilities

An accidental hazardous material release can occur wherever hazardous materials are manufactured, stored, transported, or used. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas. Those facilities using, manufacturing, or storing toxic chemicals are required to report their locations and the quantities of the chemicals stored on-site to state and local governments. The Environmental Protection Agency's Toxics Release Inventory (TRI) contains information about more than 650 toxic chemicals that are being used, manufactured, treated, transported, or released into the environment. Northfield does not have any facilities listed on the Toxic Release Inventory. However Northfield's 2010 Comprehensive Emergency Management (CEM) Plan identifies the First Light Power facility on Millers Falls Road, and the Department of Public Works building on Caldwell Road as facilities containing hazardous materials (Table 3-8.1).

Table 3-8.1: Hazardous Facilities in Northfield

Hazardous Facility	Location	Description of Hazard
First Light Power	99 Millers Falls Road	Sulfuric Acid, Mineral dielection fluid
DPW Headquarters	49 Caldwell Road	Diesel Fuel

Source: 2010 Northfield Comprehensive Management Plan.

Under the Emergency Planning and Community Right-to-Know Act (EPCRA), facilities that use or store chemicals in quantities that equal or exceed established thresholds must report an annual inventory of these chemicals by March 1 of each year to the Massachusetts Emergency Management Agency (MEMA), the Franklin County Regional Emergency Planning Committee (REPC), and the Northfield Fire Department. Known as Tier II forms, the reports require basic facility identification information, employee contact information for both emergencies and non-emergencies, and information about chemicals stored or used at the facility. The information must be made available to the public. Current Tier II facilities in Northfield are identified on the Critical Facilities and Infrastructure Map, and in Table 3-8.2 below.

Table 3-8.2: Tier II Facilities in Northfield

Tier II Facility	Location
Northfield Mountain Substation	Route 63
The Lane Construction Corp	216 Mount Hermon Station Road
Verizon	79 Main Street
Northfield Wastewater Treatment Plant	104 Meadow Street
Northfield Mount Hermon School	206 Main Street
Water Treatment Plant	126 Louisiana Road

Source: Massachusetts Emergency Management Agency.

In addition to the above facilities, many farmers store agricultural chemicals on their properties. Given that much farmland is located in or near floodplains and their adjacent water bodies, the potential for an accidental hazardous materials spill to impact water quality is present. This plan does not include an in-depth evaluation of hazardous materials as they relate to farming. In many cases, farmers do use and store pesticides, herbicides and fertilizers on their property. And in most cases, farmers are utilizing best management practices in the use and storage of agricultural chemicals and have undergone any required training and licensing if they are

applying these chemicals to the land. Despite training and best management practices, an accidental release of hazardous materials can occur and potentially threaten human health and the environment. One approach that the Town could take to help prepare for a hazardous materials spill on a farm would be to become familiar with the types and quantities of chemicals stored on site at the larger farms. This would assist first responders in being adequately prepared to protect human health and prevent contamination of the environment in the event of a major spill or other accidental release of hazardous materials.

Hazardous facilities located outside of town boundaries can potentially impact the Town as well. The Vermont Yankee nuclear power plant is located on the Connecticut River in Vernon, Vermont, near the Vermont/Massachusetts border and approximately 6.5 miles from the Northfield Town Hall. In January 2010, the facility notified the Vermont Department of Health that samples taken in November 2009 from a ground water monitoring well on site contained tritium. This finding signals an unintended release of radioactive material into the environment. Testing has shown that contaminated groundwater has leaked into the Connecticut River, though tritium levels in the river have remained below the lower limit of detection.[37]

More recently, the 2011 tsunami and earthquake in Japan that damaged a nuclear power plant demonstrates the potential vulnerability of these facilities to natural disasters, and the geographic extent that could be impacted by an accident. The Nuclear Regulatory Commission recently extended the plant's operating license for 20 more years, which expires in March 2012. Town officials should continue to stay abreast of proper evacuation procedures in the event of an accident at the Vermont Yankee nuclear power plant.

Because Northfield falls within a ten mile radius of Vermont Yankee, the Town's emergency personnel have participated in regular trainings that evaluate shelters, evacuation procedures, traffic control, and what equipment and materials would be needed in the event of an accident at the plant. In addition the Town has a nuclear planning document that is updated regularly. These trainings help the Town to be better prepared for a nuclear event, and also serve as a basis for dealing with other manmade hazard emergencies.

The Town has two public drinking water supplies, either of which could become contaminated due to manmade or natural hazard events. The two water districts in Northfield provide drinking water to residents and businesses in Northfield Center and near the former Northfield Campus of NMH. Currently the two water districts are interconnected, allowing them to serve as a back-up supply to each other's customers in the event of an emergency. Both are gravity-fed, although the East Northfield Water Company does have an emergency generator for its treatment plant. The Town could consider exploring other potential back-up water supply options in case of failure of one or both existing supply systems. The Committee suggested the Pioneer Valley Regional School as a possible back-up source. The Town should investigate establishing formal agreements with surrounding towns or the Pioneer Valley Regional School for supplying back-up drinking water.

[37] Vermont Department of Health. http://healthvermont.gov/enviro/rad/vt_yankee.aspx

Vulnerability Assessment

Vulnerability Overview

This section presents exposure, damages, loss estimates, population impacts and data deficiencies for each of the hazards addressed in the Hazard Identification and Profile Section of the Plan. Additionally, an overall vulnerability assessment is provided for each hazard. This analysis is an in-depth look at each hazard in Northfield. Coupled with the All Hazards Vulnerability Assessment in the following section, these findings will support planning efforts based on a better understanding of the potential impacts associated with each hazard and provide a foundation for the mitigation strategies presented in Section 5.

Vulnerability Assessment Methodology

The Vulnerability Assessment is a series of tables that enabled FRCOG staff to determine the vulnerability of Northfield to flooding and to calculate the potential costs of flooding to the town.[38] Estimated losses for all other hazard event were also determined, based on damages from past recorded events. The potential implications for senior and low income populations in the event of a hazard are also assessed.

FLOODING

Hazard Summary

In this section, a vulnerability assessment was prepared to evaluate the potential impact that flooding could have on the portions of Northfield located within the 100-year floodplain. Flooding was chosen for this detailed evaluation because it is a natural hazard likely to impact the community and the location of the impact can be determined by mapping of areas inundated during severe flooding events. Flooding can be caused by severe storms, such as hurricanes, nor'easters, and microbursts, as well as ice jams and snow melt. To determine the vulnerability of the town, data was gathered and calculated for the value of residential, commercial, and industrial properties. The damage estimates presented are rough estimates and likely reflect a worst-case scenario. Computing more detailed damage assessments based on assessor's records is a labor-intensive task and beyond the scope of this project.

Data Collected and Used

National weather databases and Town of Northfield data were collected and analyzed. U.S. Census and American Community Survey data on population, household size, senior and low income populations was collected. 2005 MassGIS Land Use data was used to determine different land uses that fall within the floodplain. Massachusetts Department of Revenue assessment data, and Northfield assessor data, was collected to determine estimated dollar losses in the event of a flood. Data on historic property damage and loss, and injuries and deaths, was collected for

[38] These tables were developed to provide towns with a template for calculating and estimating potential losses and costs of flooding. They draw from and integrate the work of other Natural Hazard Mitigation Plans, specifically the Natural Hazard Mitigation Plan for Thurston County, Washington, September 2009, but the tables can be linked to the most recent demographic, land use, and infrastructure information (databases) and automatically calculate and estimate the cost of flooding to each town or region.

Northfield and Franklin County from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center website. This data was used to support an evaluation of exposure and potential impacts associated with this hazard. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on flooding and the Committee interviewed for additional information.

NOAA flood event data for 1993 through 2010 for Franklin County is shown in Table 3-9. The average annual property damage in Franklin County due to flooding for those years is $764,889, with no annual crop damage reported. Note that property and crop damages attributed to flooding from Tropical Storm Irene in August 2011 are not included in the table. At the writing of this plan, preliminary damage estimates for Franklin County totaled $22,816,077 in damages. These are very rough preliminary estimates of the total cost of the storm. More detailed numbers will become available as FEMA analyzes the particular damage in each town.

Table 3-9: Flood Events in Franklin County

Year	# of Flood Events	Annual Property Damage	Annual Crop Damage
2010	1	$150,000	$0
2009	0	$0	$0
2008	3	$38,000	$0
2007	1	$250,000	$0
2006	0	$0	$0
2005	5	$11,435,000	$0
2004	2	$10,000	$0
2003	1	$10,000	$0
2002	0	$0	$0
2001	1	$0	$0
2000	1	$0	$0
1999	0	$0	$0
1998	4	$75,000	$0
1997	0	$0	$0
1996	11	$1,800,000	$0
1995	3	$0	$0
1994	2	$0	$0
1993	5	$0	$0
# of Years	**Total Number of Floods**	**Average Annual Property Damage**	**Average Annual Crop Damage**
18	**40**	**$764,889**	**$0**

Source: NOAA National Climatic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms.

NOAA data notes that roads in Northfield flooded due to heavy rains in June 1996, however no damages were reported. As noted previously, the town spent approximately $45,000 - $50,000 to clean up damage from tropical storm Floyd in 1999.

Impact on the Community

Exposure and Loss Estimation

Flooding can cause a wide range of issues, from minor nuisance roadway flooding and basement flooding to major impacts such as roadway closures. Specific damages associated with flooding events include the following primary concerns:

- Blockages of roadways or bridges vital to travel and emergency response
- Breaching of dams
- Damaged or destroyed buildings and vehicles
- Uprooted trees causing power and utility outages
- Drowning, especially people trapped in cars
- Contamination of drinking water
- Dispersion of hazardous materials
- Interruption of communications and/or transportation systems
- Debris management issues including debris removal and identification of disposal sites

Property Damage

There are roughly 2,283 acres in the floodplain in Northfield, making up 10.4% of the total land area in Town. Table 3-10 displays the number of dwelling units and the estimated population living in the 100-year floodplain in Northfield. According to 2005 MassGIS Land Use data there are 14 dwelling units located in the floodplain. Using this number and Northfield's average household size according to the 2010 U.S. Census, it is estimated that 35 people, or 1.1% of Northfield's total population, resides in the floodplain.

Table 3-10: Number of Dwelling Units and Percent of Total Population Residing in Flood Hazard Area

Total Town Population	Average Per Household Population	Number of Dwelling Units in Flood Hazard Area	Estimated Population in Flood Hazard Area	% of Total Population That Reside in the Flood Hazard Area
3,032	2.47	14	35	1.1%

Source: 2010 U.S. Census; 2005 MassGIS Land Use data.

Table 3-11 shows the amount of commercial, industrial, and public/institutional land uses located in town and within the floodplain. Less than an acre of both commercial and industrial land uses are located within the floodplain, accounting for less than 1 percent of the total commercial or industrial land uses within Town. Approximately 3.6 acres of public/institutional land uses are located in the floodplain, comprising 2.4% of the public/institutional land uses in Town. Much of the floodplain consists of agricultural land or forest.

Table 3-11: Acres of Commercial, Industrial, and Public/Institutional Land Use Within the Flood Hazard Area

Land Use	Total Acres in Town	Acres in Flood Hazard Area	% of Total Acres in Flood Hazard Area
Commercial	43.4	0.2	0.5%
Industrial	17.7	0.1	0.8%
Public/Institutional	147.5	3.6	2.4%

Source: 2005 MassGIS Land Use data.

The average assessed values of the residential, commercial, and industrial land uses located within the floodplain are displayed in Table 3-12. The total average assessed value for these three land uses within the floodplain is $5,708,580. This is of concern because should a catastrophic flooding event befall Northfield, the assessed values of these structures and facilities would likely be significantly reduced, which in turn would impact the town's tax revenues.

Table 3-12: Average Assessed Value of Land Use in Flood Hazard Area

Land Use	Total Acres in Town	Total Assessed Value	Average Assessed Value Per Acre	Acres in Floodplain	Average Assessed Value in Floodplain
Residential	1156.6	$291,039,327	$251,644	20.2	$5,070,635
Commercial	43.4	$14,093,999	$325,046	0.2	$68,260
Industrial	17.7	$72,105,977	$4,069,186	0.1	$569,686

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010; 2005 MassGIS Land Use data.

Actual 2010 assessed building values were collected from the Northfield Assessors Office for the wastewater treatment plant, a significant structure located in the floodplain in Northfield (Table 3-13). The value of the building contents was estimated using the percentages listed in Table 3-20 for different classes of buildings and facilities. The value is presented as a percentage of the replacement value of the building (the assessed value of the structure) based on the class of structure. The percentages vary for certain classes because the replacement cost of the contents is different from institution to business to service. The wastewater treatment plant is considered a government general service, and is estimated to have a total building value of $80,200. Table 3-14 presents 1%, 5%, and 10% damage loss estimates for the Wastewater Treatment Plant in the event of a flood.

Table 3-13: Total Building Value in Flood Hazard Area

Structure	Building Structure Value in Floodplain	Building Contents Value in Floodplain	Total Building Value in Floodplain
Wastewater Treatment Plant	$40,100	$40,100	$80,200

Source: 2010 Northfield Assessors data.

Table 3-14: Potential Estimated Loss for Buildings in Flood Hazard Area

Structure	Total Building Value in Flood Hazard Area	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Wastewater Treatment Plant	$80,200	$802	$4,010	$8,020

Source: 2010 Northfield Assessors data.

Table 3-15: Occupancy Class and Estimated Contents Value of Buildings

Occupancy Class	Contents Value % (as a percentage of building replacement value)
Residential (including temporary lodging, dormitory, and nursing homes)	50%
Commercial (including retail, wholesale, professional, services, financial, entertainment & recreation)	100%
Commercial (including hospital and medical office/clinic)	150%
Commercial Parking	50%
Industrial (including heavy, light technology)	150%
Agriculture	100%
Religion/Non-Profit	100%
Government Emergency Response	150%
Government General Services	100%
Education Schools/Libraries	100%
Education Colleges/Universities	150%

Source: Natural Hazard Mitigation Plan for Thurston County, Washington, September 2009.

Table 3-16 identifies the assessed value of all residential, commercial, and industrial land uses within the floodplain in Northfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a major flooding event.

Table 3-16: Potential Estimated Loss in the Floodplain by Land Use Category

	Average Assessed Value in Floodplain	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	5,070,635	$50,706	$253,532	$507,063
Commercial	68,260	$683	$3,413	$6,826
Industrial	569,686	$5,697	$28,484	$56,969
Total	**$5,708,580**	**$57,086**	**$285,429**	**$570,858**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Repetitive Loss Properties

Repetitive loss properties are those for which two or more losses of at least $1000 each have been paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978. According to MEMA, there are no repetitive loss structures in Franklin County.

Population Impacts

The Town should be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-17 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the

table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-17: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

Flooding is common in New England, often causing significant impacts to the roads, structures, facilities, utilities, and populations. Existing and future mitigation efforts should continue to be developed and employed that will enable Northfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as and the low-lying areas that can be impacted by flooding related to ice jams or rapid snow melt.

Data Deficiencies

In assessing the risks to Northfield from flood hazards, the following data deficiencies were identified:

- Lack of available data on the number of vulnerable populations living in households in the floodplain.
- Lack of digital floodplain data to overlay on zoning to determine number of developable lots in the flood hazard area.

SEVERE WINTER STORMS

Hazard Summary

Severe snow and ice storms are common in Northfield, often impacting the Towns' roads, structures, facilities, utilities, and population. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events.

Severe winter storms cause significant concern because they happen often and can be quite severe; they cost residents money; they require snow and ice removal, which can limit access to facilities and can cause health problems; they can cause utility failure and flooding from ice jams; and they put stress on community resources.

Data Collected and Used

National weather databases and Town of Northfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the National Oceanic and Atmospheric Administration's (NOAA) National Climactic Data Center website. This data was used to support an evaluation of exposure and potential impacts associated with this hazard. Available historic data are presented in Table 3-18.

Impact on the Community

Exposure and Loss Estimation

Heavy snowfall coupled with low temperatures often results in increases in traffic accidents; disruptions in transportation, commerce, government, and education; utility outages due to falling trees, branches, and other objects; personal injuries associated with slippery surfaces and freezing temperatures; and numerous other problems. Specific damages associated with severe winter storm (snow) events include the following primary concerns:

- Injuries, including fatalities, associated with accidents; low temperatures; power loss; falling objects and accidents associated with frozen and slippery surfaces and snow accumulation
- Increases in the frequency and impact of traffic accidents, which result in personal injuries
- Ice-related damage to trees, building and infrastructure inventory, and utilities (power lines, bridges, substations, etc.)
- Roads damaged through freeze and thaw processes
- Stress on the local shelters and emergency response infrastructure
- Lost productivity that occurs when people cannot go to work, school, or stores due to inclement conditions

New England's climate offers no immunity to the potential damaging effects of severe winter storms. Some minimum damage is anticipated annually, with potential extensive damage occurring about once every 10 years.

Property Damage

As presented in Table 3-18, historic data for severe winter storm (heavy snow) events indicate that between 1993 and 2010, 111 heavy snow events were recorded in Franklin County. An average of 6.1 heavy snow and ice events occur each year, causing an average annual property damage county-wide of $4.5 million.

Table 3-18: Severe Heavy Snow/Ice Events in Franklin County

Year	# of Heavy Snow/Ice Events	Annual Property Damage	Annual Crop Damage
2010	3	$30,000	$0
2009	5	$0	$0
2008	12	$6,020,000	$0
2007	7	$10,000	$0
2006	0	$0	$0
2005	9	$625,000	$0

Year	# of Heavy Snow/Ice Events	Annual Property Damage	Annual Crop Damage
2004	3	$0	$0
2003	5	$50,000	$0
2002	7	$1,605,000	$0
2001	7	$11,000,000	$0
2000	7	$0	$0
1999	6	$0	$0
1998	3	$0	$0
1997	6	$10,030,000	$0
1996	10	$47,000,000	$0
1995	6	$0	$0
1994	8	$5,050,000	$0
1993	7	$0	$0
# of Years	**Total # of Events**	**Average Annual Property Damage**	**Average Annual Crop Damage**
18	**111**	**$4,523,333**	**$0**

Source: NOAA National Climactic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms.

The entire built environment of Northfield is vulnerable to a severe winter storm. Table 3-19 identifies the assessed value of all residential, commercial, and industrial land uses in Northfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a severe winter storm.

Table 3-19: Potential Estimated Loss by Land Use Category

	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	291,039,327	$2,910,393	$14,551,966	$29,103,933
Commercial	14,093,999	$140,940	$704,700	$1,409,400
Industrial	72,105,977	$721,060	$3,605,299	$7,210,598
Total	**$377,239,303**	**$3,772,393**	**$18,861,965**	**$37,723,930**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Population Impacts

As discussed above, some traffic accidents associated with storm events include injuries and in limited cases, deaths. However, the number of injuries and deaths reported for accidents is generally low.

The Town should be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-20 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the

table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-20: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

Severe winter storms are common in New England, often causing significant impacts to the roads, structures, facilities, utilities, and population of Northfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Northfield to be prepared for these events when they occur. The cascade effects of severe winter storms include utility losses, transportation accidents, and flooding. Losses associated with flooding are discussed earlier in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding related to ice jams or rapid snow melt.

Data Deficiencies

No data deficiencies were identified.

Hurricanes and Tropical Storms

Hazard Summary

Hurricanes and tropical storms are rare in Northfield but could cause severe impacts such as flooding, power outages, flying debris, damage to property and injury and loss of life. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events.

Hurricanes or tropical cyclones can spin off tornados and bring thunderstorms, high winds and, in coastal areas, storm surges in the sea, possibly resulting in beach erosion and loss or damage to property. Inland, hurricanes and tropical storms mainly bring heavy rains that can cause flooding.

Data Collected and Used

National weather databases and Town of Northfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the National Oceanic and Atmospheric Administration's (NOAA) National Climactic Data

Center website, and the Spatial Hazard Events and Losses Database (SHELDUS). This data was used to support an evaluation of exposure and potential impacts associated with this hazard. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on hurricanes and tropical storms hazard data and mitigation measures.

Impact on the Community

Exposure and Loss Estimation

High winds and heavy rain associated with hurricanes and tropical storms can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death. Other associated concerns are debris management issues including debris removal and identification of disposal sites. Table 3-20 shows hurricane and tropical storm events in Franklin County for the last 20 years, from 1990 to 2009.

Property Damage

Between 1990 and 2009, one hurricane and 16 tropical storms have been recorded in Franklin County (Table 3-21). Hurricane Bob in 1991 caused over 5.5 million dollars in property damage in the county, and over $500,000 in crop damage. At the writing of this plan, damage from Tropical Storm Irene in August 2011 was still being determined, though preliminary estimates totaled the public cost of the storm to be approximately $22,816,077 countywide. Overall, tropical storms and hurricanes have caused an average annual property damage of just over $300,000 over the last 20 years.

Table 3-21: Hurricane and Tropical Storm Events in Franklin County

Year	# of Hurricane/Tropical Storm Events	Annual Property Damage	Annual Crop Damage
2009	0	$0	$0
2008	0	$0	$0
2007	0	$0	$0
2006	5	$277,861	$0
2005	1	$33,889	$0
2004	1	$37,778	$0
2003	2	$127,381	$0
2002	0	$0	$0
2001	0	$0	$0
2000	0	$0	$0
1999	1	$7,692	$0
1998	2	$63,269	$0
1997	0	$0	$0
1996	0	$0	$0
1995	1	$0	$0
1994	1	$35,714	$0
1993	0	$0	$0
1992	0	$0	$0

Year	# of Hurricane/Tropical Storm Events	Annual Property Damage	Annual Crop Damage
1991	1	$5,555,556	$555,556
1990	2	$7,142	$0
# of Years	**Total # of Events**	**Average Annual Property Damage**	**Average Annual Crop Damage**
20	**17**	**$307,314**	**$27,778**

The entire built environment of Northfield is vulnerable to the high winds and/or flooding from a hurricane or tropical storm. Table 3-22 identifies the assessed value of all residential, commercial, and industrial land uses in Northfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of an extreme wind and rain storm.

Table 3-22: Potential Estimated Loss by Land Use Category

	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	291,039,327	$2,910,393	$14,551,966	$29,103,933
Commercial	14,093,999	$140,940	$704,700	$1,409,400
Industrial	72,105,977	$721,060	$3,605,299	$7,210,598
Total	**$377,239,303**	**$3,772,393**	**$18,861,965**	**$37,723,930**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Population Impacts

As discussed above, some traffic accidents associated with storm events include injuries and in limited cases, deaths. However, the number of injuries and deaths reported for accidents is generally low.

The Town should be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-23 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-23: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

Hurricanes and tropical storms occur sporadically in New England, and can impact property, crops, utilities and the population of Northfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Sunderland to be prepared for these events. The cascade effects of these severe storms include utility losses and transportation accidents and flooding. Losses associated with flood hazards are discussed earlier in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding.

Data Deficiencies

No data deficiencies were identified.

Tornados, Microbursts and Thunderstorms

Hazard Summary

Thunderstorms and microbursts are common in western Massachusetts and can cause significant damage from high winds and excessive rain. Tornados are less common but could cause severe impacts such as flooding, power outages, flying debris, damage to property and injury and loss of life. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events.

Thunderstorms and microbursts bring strong winds, rain and, at times, hail, potentially causing damage to property, crops and utilities and injuries or deaths to residents. Persistent rain can also cause flooding. Tornadoes can have devastating effects on infrastructure, property and human health. Striking at random, their conical winds leave trails of devastation, at times more than a mile wide, in their wake. Small tornadoes, known as "gustnados," have been known to strike in Franklin County, most recently in Sunderland in 2009. The gustnado does not appear in data compiled on tornadoes for this report, however, even gustnadoes can cause damage; the 2009 occurrence destroyed a barn and downed trees in Sunderland.

Data Collected and Used

National weather databases and Town of Northfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County

from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center website, and the Spatial Hazard Events and Losses Database (SHELDUS). This data was used to support an evaluation of exposure and potential impacts associated with this hazard. Available historic data are presented in the following tables. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on tornados, thunderstorms, and microbursts hazard data and mitigation measures.

Impact on the Community

Exposure and Loss Estimation

High winds, heavy rain, lightning and/or hail associated with tornados, thunderstorms and microbursts can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death.

Property Damage

As presented in Table 3-24, historic data for tornado events indicate that between 1991 and 2010, 4 tornados were recorded in Franklin County. Over 20 years, tornados have caused an average of $16,000 in property damages yearly.

Table 3-24: Tornado Events in Franklin County

Year	# of Tornado Events	Annual Property Damage	Annual Crop Damage
2010	0	$0	$0
2009	0	$0	$0
2008	0	$0	$0
2007	0	$0	$0
2006	1	$200,000	$0
2005	0	$0	$0
2004	0	$0	$0
2003	0	$0	$0
2002	0	$0	$0
2001	0	$0	$0
2000	0	$0	$0
1999	0	$0	$0
1998	0	$0	$0
1997	2	$100,000	$0
1996	0	$0	$0
1995	0	$0	$0
1994	0	$0	$0
1993	0	$0	$0
1992	1	$25,000	$0
1991	0	$0	$0
# of Years	**Total # of Events**	**Average Annual Property Damage**	**Average Annual Crop Damage**
20	**4**	**$16,250**	**$0**

Source: NOAA National Climatic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Severe thunderstorms, hail and lightning events brought about significant property wreckage in Franklin County in recent years. Thunderstorms, 115 of them in the last 19 years, caused an average annual property loss of more than $59,000 (Table 3-25). It is worth noting that the number of thunderstorms has increased in recent years; in the 1990s, there were an average of 3.8 storms per year, according to NOAA data. From 2000 to 2008, NOAA recorded an average of 9.6 storms per year, 2.5 times the previous decade. In 2007 and 2008, the most recent years with data available, 40 storms were recorded countywide for an average number of 20 storms for those two years.

Table 3-25: Thunderstorm Events in Franklin County

Year	# of Thunderstorm Events	Annual Property Damage	Annual Crop Damage
2008	21	$602,000	$0
2007	19	$0	$0
2006	9	$338,000	$0
2005	9	$85,000	$0
2004	4	$30,000	$0
2003	1	$10,000	$0
2002	6	$25,000	$0
2001	5	$0	$0
2000	3	$20,000	$0
1999	5	$0	$0
1998	8	$2,000	$0
1997	7	$10,000	$0
1996	5	$0	$0
1995	3	$0	$0
1994	4	$0	$0
1993	0	$0	$0
1992	2	$0	$0
1991	3	$0	$0
1990	1	$0	$0
# of Years	**Total # of Events**	**Average Annual Property Damage**	**Average Annual Crop Damage**
19	**115**	**$59,053**	**$0**

Source: NOAA National Climatic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Over the last fifteen years there have been eleven severe thunderstorm events recorded in Northfield, resulting in an average annual property damage of $4,067 (Table 3-26). High winds from these storms caused as much as $20,000 in damages in two separate instances.

Table 3-26: Severe Thunderstorm Events in Northfield

Year	# of Thunderstorm Events	Annual Property Damage	Annual Crop Damage
1996	2	$0	$0
1997	2	$10,000	$0
1998	1	$0	$0

Year	# of Thunderstorm Events	Annual Property Damage	Annual Crop Damage
1999	0	$0	$0
2000	0	$0	$0
2001	1	$0	$0
2002	1	$8,000	$0
2003	0	$0	$0
2004	0	$0	$0
2005	1	$20,000	$0
2006	1	$3,000	$0
2007	1	$0	$0
2008	0	$0	$0
2009	0	$0	$0
2010	1	$20,000	$0
# of Years	**Total # of Events**	**Average Annual Property Damage**	**Average Annual Crop Damage**
15	11	$4,067	$0

Source: NOAA National Climactic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms.

As Table 3-27 shows, 24 hail storms between 1993 and 2010 have caused an average of more than $560,000 in property damage per year in Franklin County. According to NOAA data, two hail events have occurred in Northfield in recent years, one in June 2005, and one in August 2008. Neither storm caused injuries or property damage, though the 2008 storm produced penny to nickel size hail.

Table 3-27: Hail Events in Franklin County

Year	# of Hail Events	Annual Property Damage	Annual Crop Damage
2009	0	$0	$0
2008	0	$0	$0
2007	0	$0	$0
2006	5	$1,928,000	$0
2005	1	$305,000	$0
2004	1	$340,000	$0
2003	2	$1,350,000	$0
2002	0	$0	$0
2001	0	$0	$0
2000	0	$0	$0
1999	1	$0	$0
1998	0	$0	$0
1997	0	$0	$0
1996	2	$0	$0
1995	5	$0	$0
1994	4	$5,050,000	$0
1993	3	$550,000	$0
# of Years	**Total # of Events**	**Average Annual Property Damage**	**Average Annual Crop Damage**
17	**24**	**$560,176**	**$0**

Source: NOAA National Climatic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Ten lightning events (Table 3-28) have caused an average of more than $8,000 in property damage per year over the last 15 years in Franklin County. In Northfield, one lightning event was recorded in recent years. In July 2008, a house on Hidden Pond Lane was struck by lightning, catching fire and causing approximately $10,000 in property damage.

Table 3-28: Lightning Events in Franklin County

Year	# of Lightning Events	Annual Property Damage	Annual Crop Damage
2008	1	$10,000	$0
2007	0	$0	$0
2006	0	$0	$0
2005	1	$50,000	$0
2004	1	$35,000	$0
2003	0	$0	$0
2002	1	$15,000	$0
2001	1	$20,000	$0
2000	0	$0	$0
1999	0	$0	$0
1998	0	$0	$0
1997	1	$3,000	$0
1996	0	$0	$0
1995	2	$0	$0
1994	2	$0	$0
# of Years	**Total # of Events**	**Average Annual Property Damage**	**Average Annual Crop Damage**
15	**10**	**$8,867**	**$0**

Source: NOAA National Climatic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

The entire built environment of Northfield is vulnerable to the high winds and/or flooding from a tornado, microburst, or thunderstorm, and associated storm events such as hail and lightning. Table 3-29 identifies the assessed value of all residential, commercial, and industrial land uses in Northfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of an extreme wind and rain storm.

Table 3-29: Potential Estimated Loss by Land Use Category

	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	291,039,327	$2,910,393	$14,551,966	$29,103,933
Commercial	14,093,999	$140,940	$704,700	$1,409,400
Industrial	72,105,977	$721,060	$3,605,299	$7,210,598
Total	**$377,239,303**	**$3,772,393**	**$18,861,965**	**$37,723,930**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Population Impacts

As discussed above, some traffic accidents associated with storm events include injuries and in limited cases, deaths. However, the number of injuries and deaths reported for accidents is generally low.

The Town should be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-30 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-30: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

Microbursts and thunderstorms are common in New England, and can impact property, crops, utilities and the population of Northfield. Tornados are less common, but can cause significant damage when they do occur. Existing and future mitigation efforts should continue to be developed and employed that will enable Northfield to be prepared for these events. The cascade effects of severe storms include utility losses and transportation accidents and flooding. Losses associated with the flood hazard are discussed earlier in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding.

Data Deficiencies

In assessing the risks to Northfield from tornados, microbursts and thunderstorms, the following data deficiencies were identified:

- Data on damages to crops is lacking.

Wildfires and Brushfires

Hazard Summary

According to data from Massachusetts Fire Incident Reporting System of the Massachusetts Department of Fire Services, the Northfield Fire Department responded to one wildfire between 2004 and 2009. Wildfires can damage woodlands, homes, utilities and buildings, and could cause injuries or deaths. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events.

Burn piles that blaze out of control, lightning strikes in forested land, campfires improperly managed, and arson can cause wildfires. Northfield is vulnerable to these conflagrations, especially in times of drought. Fire suppression can be expensive and dangerous for firefighters, and wildfires can threaten wildlife and human habitat and health.

Data Collected and Used

National weather databases and Town of Northfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the National Oceanic and Atmospheric Administration's (NOAA) National Climactic Data Center website. Data from this website shows no wildfires have occurred in or impacted Franklin County in the last 20 years. However, according to the Massachusetts Department of Fire Services' Fire Incident Reporting System, at least 398 brush fires occurred in Franklin County between 2004 and 2009, and one brushfire occurred in Northfield during the same period. Because many brush fires do not have a dollar loss or human injury, it is not mandated that these types of fires be reported, and it is likely that this figure under-represents the total number of brush fires during this time period. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on wildland fires and brushfires hazard data and mitigation measures.

Impact on the Community

Exposure and Loss Estimation

A major out-of-control wildfire can damage property, utilities and forested land; create smoke that can cause breathing problems; and injure or kill people. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

Property Damage

No property damage, injuries or deaths have been recorded for Northfield's one fire reported between 2004 and 2009.

Because Northfield is heavily wooded and has so many historic wooden structures, the entire built environment of the town is vulnerable to a wildfire. Table 3-31 identifies the building type and valuation of this inventory as well as the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a wildfire.

Table 3-31: Potential Estimated Loss by Land Use Category

	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	291,039,327	$2,910,393	$14,551,966	$29,103,933
Commercial	14,093,999	$140,940	$704,700	$1,409,400
Industrial	72,105,977	$721,060	$3,605,299	$7,210,598
Total	**$377,239,303**	**$3,772,393**	**$18,861,965**	**$37,723,930**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Population Impacts

The Town should be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-32 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-32: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

While wildfires have caused minimal damage, injury and loss of life to date in Northfield, their potential to destroy property and cause injury or death exists. Existing and future mitigation efforts should continue to be developed and employed that will enable Northfield to be prepared for these events when they occur. Wildfires can also cause utility disruption and air-quality problems. Particular areas of vulnerability include low-income and elderly populations.

Data Deficiencies

No data deficiencies were identified.

Dam Failure

Hazard Summary

Dams hold back water, and when a dam fails, the potential energy of the stored water behind the dam is instantly released as water rushes in torrent downstream, flooding an area engineers refer to as an "inundation area." The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events.

When a dam fails, huge quantities of water quickly flow downstream. Areas adjacent to a river or stream or on low ground are in danger of being inundated by a large volume of water that could destroy structures, utilities, roadways and bridges, and cause injuries or deaths. Many dams in Massachusetts were built in the 19th century without the benefit of modern engineering design and construction oversight. Dams can fail because of structural problems due to age and/or lack of proper maintenance. Dam failure can also be the result of structural damage caused by an earthquake or flooding brought on by severe storm events.

Data Collected and Used

Data from the National Oceanic and Atmospheric Administration's National Climactic Data Center website shows no dam failures have occurred in or impacted Franklin County in the last 20 years. According to the members of the Multi-Hazard Mitigation Team, no dam failures have impacted Northfield in the last 20 years.

Impact on the Community

Exposure and Loss Estimation

While dam failures are rare, their impacts can be devastating, including loss of property, disruption to infrastructure, and injury and death.

Property Damage

Historic data for dam failure events indicate that between 1993 and 2010, no events were recorded in Franklin County, causing no property damage or population impacts.

Structures that lie in the inundation area of the dams in Northfield are vulnerable to a dam failure. Table 3-33 identifies the building type and valuation for all residential, commercial, and industrial uses in Town, as well as the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a dam failure.

Table 3-33: Potential Estimated Loss by Land Use Category

	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	291,039,327	$2,910,393	$14,551,966	$29,103,933
Commercial	14,093,999	$140,940	$704,700	$1,409,400
Industrial	72,105,977	$721,060	$3,605,299	$7,210,598
Total	**$377,239,303**	**$3,772,393**	**$18,861,965**	**$37,723,930**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Population Impacts

The Town should be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-34 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-34: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

Dam failures, while rare, can destroy roads, structures, facilities, utilities, and impact the population of Northfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Northfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, buildings in the floodplain or inundation areas, and infrastructure such as roadways and utilities that can be damaged by such events.

Data Deficiencies

In assessing the risks of Northfield to dam failure, the following data deficiencies were identified:

- Lack of inundation mapping for significant and high hazard dams in Northfield.

Earthquakes

Hazard Summary

Earthquakes are rare in Franklin County, however temblors are unpredictable and can cause significant damage to roads, structures, facilities, utilities, and population. Existing and future

mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for earthquakes.

While rare in Franklin County, earthquakes have happened in New England. New England experiences an average of 30 to 40 earthquakes each year although most are not noticed by people.[39] Ground shaking from earthquakes can rupture gas mains and disrupt other utility service, damage buildings, bridges and roads, and trigger other hazardous events such as landslides, avalanches, flash floods (dam failure) and fires. Un-reinforced masonry buildings, buildings with foundations that rest on filled land or unconsolidated, unstable soil, and mobile homes not tied to their foundations are at risk during an earthquake.[40]

Data Collected and Used

The National Oceanic and Atmospheric Administration recorded no earthquakes for Franklin County in the last 20 years. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on earthquake hazard data and mitigation measures.

Impact on the Community

Exposure and Loss Estimation

A major earthquake could cause severe damage to Northfield buildings, including older structures that were built before a 1975 law requiring new buildings to withstand earthquakes. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

Property Damage

Historic data for earthquake events indicate that between 1991 and 2010, no earthquakes were recorded in Franklin County during this period, causing no damage to property.[41]

The entire built environment of Northfield is vulnerable to earthquakes. Table 3-35 identifies the assessed value of all residential, commercial, and industrial land uses in Northfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of an earthquake. Buildings constructed prior to 1975, when the state building code went into effect, are particularly vulnerable. According to the 2000 U.S. Census, 63% of the housing in Northfield was built before 1970.

Table 3-35: Potential Estimated Loss by Land Use Category

	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	291,039,327	$2,910,393	$14,551,966	$29,103,933
Commercial	14,093,999	$140,940	$704,700	$1,409,400
Industrial	72,105,977	$721,060	$3,605,299	$7,210,598
Total	**$377,239,303**	**$3,772,393**	**$18,861,965**	**$37,723,930**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

[39] Northeast States Emergency Consortium web site: www.nesec.org/hazards/earthquakes.cfm
[40] Federal Emergency Management Agency web site: www.fema.gov/hazards/earthquakes/quake.shtm.
[41] NOAA National Climactic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Population Impacts

The Town should be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-36 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-36: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

Earthquakes, while rare, could cause significant impacts and losses to the roads, structures, facilities, utilities, and population of Northfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Northfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, trailer homes and buildings erected before 1975, and infrastructure such as roadways and utilities that could be damaged by earthquakes.

Data Deficiencies

No data deficiencies were identified.

Landslides

Hazard Summary

Landslides rarely occur in Franklin County, but in March 2011, following a period of heavy rain and melting snow, a landslide occurred at the Green River Cemetery in Greenfield. Cars were trapped and properties were covered in mud, silt, and other debris. Emergency personnel evacuated nearby homes and the town used heavy equipment to clean up the mud. Landslides are most often caused by heavy rains destabilizing slopes but can have other causes, including clearing land for development, earthquakes, and vibrations from machinery or blasting.

Landslides can be dangerous because they are unexpected and fast. They can bury structures with little warning and rescue efforts can be threatened by new slides.

Data Collected and Used

National Oceanic and Atmospheric Administration's National Climactic Data Center website shows no landslide events in Franklin County for the last 20 years. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on landslide hazard data and mitigation measures.

Impact to the Community

Exposure and Loss Estimation

While landslides are rare, their impacts can be devastating, including loss of property, disruption to infrastructure, and injury and death. Continued development increases the chances that landslides will be a danger. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

Property Damage

Historic data for landslide events indicate that between 1993 and 2010, no landslide events were recorded in Franklin County.

Table 3-37 identifies the assessed value of all residential, commercial, and industrial uses in Town, as well as the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a massive landslide.

Table 3-37: Potential Estimated Loss by Land Use Category

	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	291,039,327	$2,910,393	$14,551,966	$29,103,933
Commercial	14,093,999	$140,940	$704,700	$1,409,400
Industrial	72,105,977	$721,060	$3,605,299	$7,210,598
Total	**$377,239,303**	**$3,772,393**	**$18,861,965**	**$37,723,930**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Population Impacts

The Town should be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-38 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-38: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

Landslides, while rare in Franklin County, can destroy roads, structures, facilities, utilities, and impact the population of Northfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Northfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, and buildings, roadways, and utilities near the foot of slopes, especially when slopes are destabilized. According to the members of the committee, no landslides have occurred in the last 20 years in Northfield.

Data Deficiencies

No data deficiencies were identified.

Ice Jams

Hazard Summary

Ice jams (or ice dams) occur when water builds up behind a blockage of ice. Ice jams can occur in various ways, but in New England they predominantly form on rivers and streams and mainly threaten infrastructure.

When the upstream part of a river thaws first and the ice is carried downstream into the still-frozen part of the watercourse, ice can form an ice dam and flood low lying areas upstream of the jam. Also, once an ice dam breaks apart, the sudden surge of water that breaks through the dam can flood areas downstream of the jam. The resulting flow of water when an ice jam is broken can cause flooding downstream, threatening infrastructure, structures, and roadways.

Data Collected and Used

The National Oceanic and Atmospheric Administration's National Climactic Data Center website shows no ice jam events or damage in Northfield over the last 20 years. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on ice jam hazard data and mitigation measures.

Impact to the Community

Exposure and Loss Estimation
Losses to ice jams include the rising waters along the river or stream that is being dammed, and the rush of water downstream when the dam either melts or is broken up by human intervention. Buildings, roadways and utilities are threatened by ice blockages.

Property Damage
Data on ice jams in Franklin County indicate that no property damage or injuries or deaths occurred as the result of ice jams in the last 20 years.

The structures and people most at risk from an ice jam are those within the floodplain. Table 3-39 identifies the assessed value of all residential, commercial, and industrial land uses within the floodplain in Northfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a major flooding event.

Table 3-39: Potential Estimated Loss in the Floodplain by Land Use Category

	Average Assessed Value in Floodplain	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	5,070,635	$50,706	$253,532	$507,063
Commercial	68,260	$683	$3,413	$6,826
Industrial	569,686	$5,697	$28,484	$56,969
Total	**$5,708,580**	**$57,086**	**$285,429**	**$570,858**

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Population Impacts
Residents living within the floodplain are most vulnerable to impacts from an ice jam. As noted in the Flooding section, above, there are 14 homes, and an estimated 36 people, located within the floodplain in Northfield.

The Town should also be aware that senior and low income segments of Northfield's population may be more vulnerable to hazard events due to a number of factors. Senior and low income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 3-40 displays the number of senior and low income residents in Northfield. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Table 3-40: Senior and Low Income Populations in Northfield Exposed to Natural Hazard Events

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	448	14.8%
Low Income (Persons with annual incomes less than $25,000)*	344	11.3%
Total	**792**	**26.1%**

* Low income population was calculated by multiplying 2005-2009 American Community Survey Households with Incomes of Less than $25,000 (139) by the 2010 U.S. Census Average Household Size (2.47).
Source: 2010 U.S. Census, 2005-2009 American Community Survey.

Overall Vulnerability Assessment

Ice jams occur throughout New England, often causing significant impacts and losses to roads, structures, facilities, utilities, and the population. Existing and future mitigation efforts should continue to be developed and employed that will enable Northfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways near rivers and streams and utilities, in floodplains and other low-lying areas.

Data Deficiencies

In assessing the risks of Northfield to the impacts of ice jams, the following data deficiencies were identified:

- Lack of available data on the number of vulnerable populations living in households in the floodplain.
- Lack of digital floodplain data to overlay on zoning to determine number of developable lots in the flood hazard area.
- According to the committee, water discharged from the Vermont Yankee nuclear power plant in Vernon, Vermont has raised the temperature of the Connecticut River, making ice jams a rare occurrence. If the plant closes in the future, there is potential for increased occurrences of ice jams along the Connecticut River due to colder water temperatures.

Manmade Hazards

Hazard Summary

Manmade hazards are being assessed at the local level for the first time in this plan update. A preliminary assessment was made only of those manmade hazards of an accidental nature, such as transportation accidents or fixed-facility accidents involving hazardous materials. The Committee evaluated the potential for these types of hazardous materials accidents as quite high – particularly transportation related, given the proximity of Routes 63, 47 and 116 to more densely populated areas of Town. No formal vulnerability assessment was done on manmade hazards, however the potential for accidents, the unknown impact of such accidents and the lack of well-analyzed data make this hazard a high priority on the Action Plan.

Data Deficiencies

Need to research available models and data requirements to adequately evaluate the potential impact of hazardous materials transportation and fixed-facility accidents on drinking water supplies and on public health.

Hazard Analysis Methodology

In updating Northfield's Multi-Hazard Mitigation Plan, the Franklin Regional Council of Governments developed the All Hazards Risk Assessment methodology for assessing the risk of natural hazards. The All Hazards Risk Assessment is an interactive table that the Northfield Multi-Hazard Mitigation Planning Committee completed with the FRCOG staff to evaluate all the natural hazards that can impact the town based on frequency of occurrence, severity of impacts, area of occurrence and preparedness. The completed table gives the town an overall understanding of the natural hazards, provides guidance on which hazards the Town may want to focus mitigation efforts on, reaffirms that Northfield's planning and preparedness is on track, and shows residents that town departments and agencies are organized in case of a natural disaster.

In rating the hazards, the committee considered the following issues for each category:

Issues considered when ranking frequency of occurrence:

1) Known risk
2) Historical data (previous occurrences)

Issues considered when ranking severity of impacts:

1) Building stock
2) Critical facilities
3) Transportation systems
4) Lifeline utility systems
5) Communications systems and networks
6) High potential loss facilities
7) Hazardous material facilities
8) Economic elements
9) Special consideration areas
10) Historic, cultural, and natural resource areas
11) Natural resources

Issues considered when ranking preparedness:

1) Status of current plans
2) Training status
3) Availability of backup systems
4) Community resources (equipment, personnel, etc.)

The following rating charts were used to determine the rating for each event.

Table 3-41: Frequency of Occurrence Rating Chart

Classification	#	Frequency of Occurrence
Very High	5	events that occur at least once each year (100% per year)
High	4	events that occur from once in 2 years to once in 4 years (25% to 50% per year)
Medium	3	events that occur from once in 5 years to once in 50 years (2% to 20% per year)
Low	2	events that occur from once in 50 years to once in 100 years (1% to 2% per year)
Very Low	1	events that occur less frequently than once in 100 years (less than 1% per year)

Table 3-42: Severity of Impacts Rating Chart

Classification	#	Severity of Multiple Impacts
Catastrophic	4	Multiple deaths and injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of facilities for 30 days or more.
Critical	3	Multiple injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 week.
Limited	2	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 day.
Minor	1	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of facilities.

Table 3-43: Severity of Impacts Definitions

Severity of Impact Category	Severity of Impact Category Definitions
Built	Building Stock includes residential, commercial, industrial, and institutional buildings.
Built	Hazardous Material Facilities include facilities housing industrial/hazardous materials, such as corrosives, explosives, flammable materials, radioactive materials, and toxins.
Built	Historic, Cultural, and Natural Resource Areas may include buildings, structures, objects, sites, national and local historic or significant districts, and historical archival storage facilities.
Infrastructure	Critical Facilities are essential to the health and welfare of the whole population and are especially important following hazard events. Since vulnerability is based on service losses as well as building structure integrity and content value, assess the effects on the service function interruption of critical facilities as well as their physical aspects. For purposes of this mitigation planning guidance, critical facilities may include emergency service facilities such as hospitals and other medical facilities, jails and juvenile detention centers, police and fire stations, emergency operations centers, public works facilities, evacuation shelters, schools, and other uses that house special needs populations.
Infrastructure	Transportation Systems include airways (including airports, heliports, etc.), roadways (including highways, bridges, tunnels, roadbeds, overpasses, transfer centers, etc.), railways and public transit (including trackage, tunnels, bridges, rail yards, depots, etc.), and waterways (including canals, locks, seaports, ferries, harbors, dry-docks, piers, etc.).
Infrastructure	Lifeline Utility Systems such as potable water, wastewater, oil, natural gas, electric power, substations, power lines, etc.
Infrastructure	Communications Systems and Networks such as telephones, emergency service radio systems, repeater sites and base stations, television and radio stations, etc.
Natural	Natural Resources include agricultural land, water supply lands, rivers.

Severity of Impact Category	Severity of Impact Category Definitions
Population	High Potential Loss Facilities include facilities that would have a high loss associated with them, such as nuclear power plants or dams.
Population	Economic Elements include major employers, financial centers, and other business or retail districts in the community that could significantly affect the local or regional economy if interrupted.
Population	Special Consideration Areas include areas of high density residential, commercial, institutional, and industrial development that, if damaged, could result in economic and functional losses and in high death tolls and injury rates.

Table 3-44: Area of Occurrence Rating Chart

Classification	#	Percentage of Town Impacted
Large	3	More than 50% of the town affected.
Medium	2	10 to 50% of the town affected.
Isolated	1	Less than 10% of the town affected.

Table 3-45: Preparedness Rating Chart

Classification	#
Poor	3
Fair	2
Good	1

To determine the final hazard index for each hazard, each category was assigned a weight. Frequency of Occurrence was given the most weight (45%), followed by Severity of Impacts (30%), Area of Occurrence (15%), and Preparedness (10%). Ratings were entered into a spreadsheet which calculated the weighted hazard index for each hazard. Hazards with higher index scores represent the events most in need of organization focus and resources for emergency planning and mitigation projects.

The results of the All Hazards Risk Assessment can be seen in Table 3-46. The hazards receiving a Weighted Hazard Index of greater than 5.0 are – in order of vulnerability – Earthquakes (6.0), Tornados (5.9), Dam Failure (5.7), Microbursts (5.3), and Severe Winter Storms (5.2). Hazards with a Weighted Hazard Index falling within the 4.1 to 5.0 range are identified as moderate risks to the community, while hazards with a Weighted Hazard Index of 4.0 or below are considered low risks to Northfield.

Earthquakes, tornados, and dam failure are all identified as having a very low frequency of occurrence in Northfield. However, if they were to occur, each could cause catastrophic damage to the town's built and natural environment, population, and infrastructure. The area of occurrence varies for each, ranging from more than 50% of the town affected for earthquakes, to less than 10% of the town affected for dam failure. The committee felt that the town was generally not well-prepared to deal with impacts from all three of these hazards.

Microbursts, severe winter storms, hurricanes and tropical storms, and flooding can occur more frequently in town. The committee felt that microbursts could cause critical damage across the board, while severe winter storms and hurricanes and tropical storms generally had limited impacts except to the town's population, which could be critically impacted by a storm. Flooding

was considered to cause limited impacts to the town. Winter storms and hurricanes and tropical storms impact a large area of town, while microbursts are more concentrated. Flooding could impact anywhere from 10% to 50% of the town.

Thunderstorms and wildfires and brushfires occur annually, however they generally have minimal to limited impacts on the town. Additionally the committee felt that the town is well prepared for these hazards. Landslides and ice jams occur very seldom. Landslides in particular could cause critical damage, though the area impacted would be small. The committee noted that ice jams could become more frequent on the Connecticut River if the Vermont Yankee nuclear power facility in Vernon Vermont, just upstream from Northfield, were to close. Currently water discharged from the plant into the river keeps the river temperature warmer than it otherwise would be. Cooler water temperatures could cause more ice jams to occur.

Overall the committee felt the town is well prepared for thunderstorms and wildfires and brushfires, fairly well prepared for flooding, ice jams, hurricanes and tropical storms, severe winter storms, and microbursts. The committee identified earthquakes, tornados, dam failure, and landslides as hazards the town is not well prepared for.

TABLE 3-46: All Hazards Vulnerability Assessment

EVENTS	FREQUENCY OF OCCURRENCE* (FOO)	FOO WEIGHTED VALUE	SEVERITY OF IMPACTS* (SOI)				SOI WEIGHTED VALUE	AREA OF OCCURRENCE*	AOO WEIGHTED VALUE	PREPAREDNESS	PREP. WEIGHTED VALUE	WEIGHTED HAZARD INDEX
ASSIGNED WEIGHTING FACTOR	45%		30%					15%		10%		
INDEX VALUE	1-5		Built 1-4*	Natural 1-4*	Population 1-4*	Infrastructure 1-4*		1-3		1-3		
NATURAL HAZARDS												
Earthquakes	1	0.5	4	4	4	4	4.8	3	0.5	3	0.3	**6.0**
Tornados	1	0.5	4	4	4	4	4.8	2	0.3	3	0.3	**5.9**
Dam Failure	1	0.5	4	4	4	4	4.8	1	0.2	3	0.3	**5.7**
Microbursts	3	1.4	3	3	3	3	3.6	1	0.2	2	0.2	**5.3**
Severe Winter Storms	4	1.8	2	2	3	2	2.7	3	0.5	2	0.2	**5.2**
Hurricanes and Tropical Storms	3	1.4	2	2	3	2	2.7	3	0.5	2	0.2	**4.7**
Landslides	1	0.5	3	3	3	3	3.6	1	0.2	3	0.3	**4.5**
Flooding	3	1.4	2	2	2	2	2.4	2	0.3	2	0.2	**4.3**
Thunderstorms	5	2.3	1	1	1	1	1.2	3	0.5	1	0.1	**4.0**
Wild Fires and Brush Fires	5	2.3	1	2	1	1	1.5	1	0.2	1	0.1	**4.0**
Ice Jams**	2	0.9	1	2	1	2	1.8	1	0.2	2	0.2	**3.1**

Note: This assessment does not include manmade hazards, given lack of data assessed for this plan. However, manmade hazards are included in the Action Plan.
* See rating charts
**At the 9/8/11 Committee meeting, Committee members discussed the possibility of ice jams becoming more of a hazard should Vermont Yankee close. Vermont Yankee's closure would mean cooler waters in the Connecticut River and possibly more ice jams.

Development Trends Analysis

In assessing development trends for the Town of Northfield - and the impact those trends might have on hazard mitigation - the committee was asked to evaluate the probability of development in town and areas most likely to be targeted for development. The committee was also asked about changes in industry, proposed housing and retail development, and any major highway or public transit improvements that might change accessibility to parts of town. Additionally, data such as number of building permits issued, change in population, current zoning bylaws and the acres of developable land were considered.

As of the 2010 U.S. Census, Northfield's population was 3,032, a 2.7% increase since 2000 when the population was 2,591. This is a slightly greater increase than experienced County-wide, which declined slightly in population by .2% during the same period. The population has increased over the last 30 years, with the greatest increase occurring in the 1980s (Table 3-47).

Table 3-47: Northfield Population, 1970 - 2010

1970	1980	1990	2000	2010
2,631	2,386	2,838	2,951	3,032

Source: U.S. Census.

The growth in population over the last thirty years has translated into new housing development in town. Between 1985 and 1999, the predominant land use changes in the Town of Northfield were the construction of single-family homes on lots at least ½ acre in size; and, the conversion of pasture and cropland to forest and residential use. Most (if not all) of the residential development has been in the form of approval-not-required lots fronting existing town roads. According to MassGIS computer mapping land use data, between 1985 and 1999, Northfield experienced:

- A loss of 554 acres of forest (-3%)
- A loss of 157 acres of cropland (-6%)
- A loss of 105 acres of pasture (-18%)
- An increase of 484 acres in large lot residential development (+62%)[42]

Between 1999 and 2011, building permits for 81 new single family homes were issued in Northfield (Table 3-48). The number of permits issued per year has fluctuated, but in general has declined since the mid-2000s. The economic recession of the last few years has slowed new housing construction nation-wide.

[42] 2006 Northfield Open Space and Recreation Plan.

Table 3-48: Building Permits Issued for New Single Family Homes in Northfield, 1999-2011

Year	New 1 Family Dwelling
1999	16
2000	10
2001	4
2002	2
2003	10
2004	9
2005	11
2006	6
2007	2
2008	5
2009	2
2010	2
2011	2
Total	**81**

Source: Northfield Building Inspector.

Due to differences in technology and methodology used to collect 2005 MassGIS land use data, changes in land use between 1999 and 2005 (the most recent data available) cannot be accurately compared. According to the 2005 MassGIS land use data, there were an estimated 1,157 acres of residential land use in town, making up approximately 5.3% of the total acreage in town. Ninety-nine percent of residential land use was categorized as low to very low density development (houses on lots greater than a ½ acre in size). According to the 2005 data, there are roughly 2,834 acres of agricultural land uses in town, 18 acres of industrial land use, and 43 acres of commercial land use. Urban public/institutional uses make up 147 acres.

Until 2005 the largest employer in Northfield was the Northfield Mount Hermon School (NMH), employing roughly 530-600 employees at its two campuses (Gill and Northfield).[43] In 2005, the school closed its Northfield campus to consolidate facilities onto its Gill campus. The Northfield campus was purchased in 2010 and will become the C.S. Lewis College, scheduled to open in 2013. It is unclear at this time whether the number of jobs at the college will be equivalent to the number employed at the Northfield campus of NMH. However it is likely that as the college ramps up operations, new employees of the college who are relocating from elsewhere will be attracted to live in town.

As discussed above, there are roughly 2,283 acres in the floodplain in Northfield. Approximately 20 acres of the floodplain is made up of residential land uses, including 14 dwelling units. Commercial, industrial, and public/institutional land uses make up roughly 4 acres of the floodplain. The remaining 2,259 acres are mostly cropland and forest. The largest portion of the floodplain in Northfield is located along the Connecticut River, where it becomes quite wide in some areas of town. The floodplain is narrower along the smaller brooks and tributaries flowing into the Connecticut River, with a few areas that become wider, such as the area between School Street and East Street along the Mill Brook, and along East Wait Brook. Additionally there is a

[43] 2003 Northfield Community Development Plan.

sizable floodplain located along Keyup Brook in the south east corner of town, in the area of the Great Swamp.

Much of the floodplain in Northfield is located within the Residential-Agricultural Zoning District, which has a minimum lot size of 50,000 square feet, unless served by municipal sewer, which would allow for a lot size of 35,000 square feet. The Northfield Zoning Bylaws include a Floodplain Overlay District that regulates develop within the 100-year floodplain. New construction is allowed in the floodplain as long as it complies with building code regulations relating to building within the floodplain, wetlands protection regulations, Title 5 septic system requirements, and can be certified by an engineer that it will not cause an increase in the flood levels during a 100-year flood.

[Insert Zoning Map]

[Insert Critical Facilities and Infrastructure Map]

4 –MITIGATION STRATEGY

One of the goals of the Multi-Hazard Mitigation Plan is to evaluate all of the town's existing policies and practices related to hazards and identify potential gaps in protection. This section reviews the general mitigation measures for each hazard already in place in Northfield, assesses any potential changes suggested for the existing measures, and evaluates whether the 2004 suggested changes were implemented, or if not, are still relevant and should be updated and carried forward to the 2011 plan. Any additional suggested changes are also included. Next, future mitigation strategies are presented to reduce the potential exposure and losses identified as concerns in the risk assessment based on the frequency, severity, and impact of each hazard and as summarized in Table 3-46: All Hazards Vulnerability Assessment. This section addresses both mitigation activities that are specific to particular hazards, and approaches that could apply to multiple hazards.

Current Mitigation Strategies

Flooding

The 2010 Critical Facilities and Infrastructure Map for the Town of Northfield shows the 100-year flood zone identified by FEMA flood maps. The 100-year flood zone is the area that will be covered by water as a result of a flood that has a 1% chance of occurring in any given year.

The major floods recorded in Northfield during the 20th century have been the result of rainfall alone or rainfall combined with snowmelt. One of the goals of this Multi-Hazards Mitigation Plan is to evaluate all of the Town's existing policies and practices related to natural and man-made hazards and identify potential gaps in protection.

Management Plans
The Comprehensive Emergency Management (CEM) Plan for Northfield lists the following generic mitigation measures for flood planning:

- Identify areas in the community that are flood prone and define methods to minimize the risk. Review National Flood Insurance Maps.
- Disseminate emergency public information and instructions concerning flood preparedness and safety.
- Community leaders should ensure that Northfield is enrolled in the National Flood Insurance Program.
- Strict adherence should be paid to land use and building codes, (e.g., Wetlands Protection Act), and new construction should not be built in flood prone areas.

- Ensure that flood control works[44] are in good operating condition at all times.
- Natural water storage areas[45] should be preserved.
- Maintain plans for managing all flood emergency response activities including addressing potentially hazardous dams.

The Comprehensive Emergency Management (CEM) Plan for Northfield lists the following generic preparedness and response measures for floods:

- Place emergency operations center (EOC) personnel on standby during stage of flood 'watch' and monitor NWS/New England River Forecast Center reports.
- Ensure that public warning systems are working properly and broadcast any information that is needed at this time.
- Review mutual aid agreements.
- Monitor levels of local bodies of water.
- Arrange for all evacuation and sheltering procedures to be ready for activation when needed.
- Carry out, or assist in carrying out needed flood-proofing measures such as sand bag placement, etc.
- Regulate operation of flood control works such as flood gates.
- Notify all emergency management related groups that will assist with flood response activities to be ready in case of flood 'warning.'
- Broadcast warning/notification of flood emergency.
- Coordinate traffic control and proceed with evacuation of affected populations as appropriate.
- Open and staff shelters and reception centers.
- Undertake, or continue to carry out flood proofing measures.
- Dispatch search and rescue teams and emergency medical teams.

Evacuation Options

The majority of land subject to the 100-year floodplain in Northfield is farmland or open space. Given that some of the Town's gravel roads are farm roads, it should be determined what impact this would have on residents relying on farm roads to evacuate during a flood.

While new residential development in the last three years has been minimal, earlier in the decade new residential development in Northfield occurred on agricultural land in the south of Town on and near River View Drive and in West Northfield, along and near West Northfield Road. These

[44] Refers to manmade levees, dikes and dams. This definition includes dams not specifically constructed for flood control.

[45] Refers to ponds, lakes, vernal ponds and other such bodies of water. Wetlands are not included in this definition.

two areas are either within or directly adjacent to the 100-year flood plain. The Town should consider restricting or otherwise discouraging future development in these areas.

The Northfield CEM plan lists two shelters for victims of flooding: Northfield Elementary School on Main Street; and Pioneer Valley Regional School on F. Summer Turner Road. According to the vulnerability assessment, there is an estimated residential population of 36 in the floodplain. In the 2004 Local Natural Hazards Mitigation Plan, the Town Hall was the only shelter identified for flood victims. However, the Town Hall has limited facilities, which make it less than ideal as a shelter. Concerns were also raised about the need to have shelters available on both sides of the Connecticut River, in the event that flooding cuts off the east and west sides of the Town from each other. Accordingly, since the previous plan, the Town has identified two alternate shelters to the Town Hall. Pioneer Valley Regional School's (PVRS) possession of a backup generator as well as its kitchen and shower facilities led to its identification as a new shelter. The school was built in 2002 and is in compliance with the current earthquake standards of the Massachusetts State Building Code. Northfield Elementary School has also been identified as a shelter, and a backup power generator and wiring has been installed there for this purpose. The elementary school has kitchen facilities and its middle section was built in 1990 and is also in compliance with the current earthquake standards of the Massachusetts State Building Code.

According to the Critical Facilities, Infrastructure, 2005 Land Use and Natural Hazards Map for the Town of Northfield, Main Street, where the Elementary School is located, is well out of the 100-year flood plain. A wide band of cropland separates the majority of commercial and residential areas from the 100- year floodplain of the river. However, there are several creeks and tributaries of the river that run through populated areas and have the potential to cause flooding in Town. In addition, Northfield has a number of bridges situated either in or near the 100-year flood plain, which could make evacuation efforts more difficult. Some of the roads that residents would most likely take to reach the safety of the shelters travel through flood-affected areas[46].

It is assumed that, in an evacuation situation, residents on the east side of the river will choose different routes than those on the west side. The 2010 Northfield CEM Plan identifies Routes 10, 63, and 142 as flood evacuation routes. In general, routes that take residents east or west to a higher elevation out of the path of floodwaters will be safer than following the roads that parallel the river. Emergency management personnel should assess existing floodplain and dam failure data to determine an appropriate evacuation plan.

Note should also be taken of the fact that the Town's wastewater treatment facility lies within or near the floodplain. There is potential for the release of hazardous materials and infectious waste from this facility during a flood.

Flood Control Structures

FEMA has identified no flood control structures within the Town of Northfield. Floods on the Connecticut River and portions of its major tributaries that are prone to backwater effects are

[46] The affected streets include: Old Vernon Road, Old Bernardston Road, Route 10 and Route 63.

controlled by eight flood control reservoirs located upstream in New Hampshire and Vermont, and one downstream in Turners Falls.

Land Use Regulations that Mitigate Impacts from Flooding

The Town of Northfield has adopted several land use regulations that serve to limit or regulate development in floodplains, to manage stormwater runoff, and to protect groundwater and wetland resources, the latter of which often provide important flood storage capacity. These regulations are detailed in Appendix 1 and their effectiveness evaluated in Table 4-1. The land use regulations related to flooding include:

Zoning Bylaws:

- Section 4.02 and 6.04: Floodplain Overlay District
- Section 4.03 and 6.05: Water Supply Protection District
- Section 10.01: Site Plan Review
- Section 9.02: Open Space Residential Use
- Section 11.01: Removal of Natural Materials
- Section 11.03: Curb Cut regulations
- Section 11.04: Erosion Control

Subdivision Rules and Regulations:

- Section 3-6: Definitive Plan – Contents
- Section 4-1: Performance Guarantee
- Section 5-11: Design Standards – Watercourses
- Section 5-14c: Design Standards – Protection of Natural Features
- Section 6-10: Required Improvements – Drainage

River and Stream Protection

The Town of Northfield follows the standards established by the Wetlands Protection Act.

Planning Efforts Related to Flood Mitigation

Northfield Open Space and Recreation Plan

The purpose of the 2005 Northfield Open Space and Recreation Plan is to provide an accurate and thorough basis for decision-making involving the current and future open space and recreation needs of the residents of Northfield. The plan represents consensus on the most important recreational, scenic, and natural resources, related needs in town and on the best solutions for addressing them. The actions of the plan include measures that could mitigate the impacts from flooding, including:

- Provide educational pamphlets to landowners whose land abuts tributaries to the CT River watershed to help residents learn how to minimize the amount of runoff produced by their land.
- Work with the Planning Board to explore new zoning bylaws, as is necessary, which protect surface waters in town.
- Work in collaboration with surrounding towns to support the Connecticut River Streambank Erosion Committee with letter writing activities.

Northfield Community Development Plan (CDP): Open Space and Resource Protection

The Open Space and Resource Protection Chapter of the 2003 Northfield CDP is a statement of the community values of Northfield and a directive for open space protection within the Town. As such, it indirectly addresses flooding potential and mitigation. The Plan first identifies and maps the Town's significant natural, historic, scenic and open space assets and then lays out a methodology for determining future development. In particular, the chapter maps floodplain areas and water resources in the Town, including surface waters such as rivers, streams, ponds, wetlands, wetland and river buffers and groundwater resources such as public water supplies, aquifers, recharge areas and watersheds.

Northfield's Community Development Plan includes a number of flood-affected areas to be designated as having Absolute Environmental or Open Space Constraints. Land which has environmental or open space constraints which make it potentially unsuitable for development includes:

- National Wetlands Inventory wetlands;
- 100-foot buffer area of wetlands;
- Rivers, ponds and other wetlands;
- Public water supplies and Zone I recharge areas;
- Areas with a slope over 25 percent; and,
- Permanently protected open space areas.

The preservation of open space and agricultural land are key elements of this plan. The Town recognizes the need to properly identify and protect its extensive wetlands and water resources. The establishment and expansion of methods to ensure these goals is a high priority. Since the majority of the agricultural land is in the 100-year floodplain, preservation of agricultural land should also protect flood-prone areas from development.

The Town considers it critical to preserve these areas in their natural state, which will provide flood storage capacity as well as other benefits not directly related to natural hazard mitigation. The recommendations of the chapter include the need to develop an Open Space and Recreation Plan, consider strengthening the Town's Water Supply Protection Overlay District regulations and establishing new overlay districts to protect natural, scenic, historic and open space resources.

Four Mile Brook Watershed Assessment and Management Plan

In 2005 the Franklin Regional Council of Governments (FRCOG) was awarded a 604(b) Water Quality Management Planning Grant from the Massachusetts Department of Environmental Protection (DEP) to conduct an assessment of the Four Mile Brook Watershed, including a fluvial geomorphic assessment for the watershed. The assessment resulted in the development of a Watershed Management Plan that includes recommendations for roadway improvement and stream restoration projects, Best Management Practices that will prevent nonpoint pollution in the watershed, and conceptual designs to manage flow and mitigate bank erosion at several high hazard areas of Four Mile Brook adjacent to Four Mile Brook Road. The Four Mile Brook Watershed Management Action Plan can be found in Appendix IV.

According to the assessment, the main issues found within the watershed, in order of priority, were:

- Road runoff and sedimentation at identified priority road crossing locations;
- Bank erosion at three High Hazard Areas in the downstream portion of the watershed where Four Mile Brook Road impinges on the brook;
- Unpaved road maintenance Best Management Practices;
- Impacted riparian buffer areas;
- Managing development in the watershed to reduce stormwater runoff;
- Illegal trash dumping; and
- Prevalence of Japanese Knotweed, an invasive, exotic plant.

Recommended actions relevant to mitigating damages due to flooding include:

- Implement stormwater Best Management Practices at six priority road crossing sites;
- Implement erosion control and bank stabilization designs at three high hazard areas;
- Implement unpaved road maintenance Best Management Practices in identified problem areas along the road;
- Provide information to landowners within the riparian buffer area of the importance of maintaining and restoring riparian buffers; organize a riparian buffer planting project with the Four Mile Brook Watershed Association;
- Organize workshops for the Conservation Commission, Highway Department, and Planning Board on stormwater management, including information on Low Impact Development (LID) techniques; send landowners in the watershed information on the issues in the watershed related to development and information on how to reduce the "environmental footprint" of existing or new development.

In 2010, the DEP awarded the Town a s.319 Nonpoint Source Pollution grant, which is currently funding the implementation of stormwater Best Management Practices at the six priority sites identified in the assessment.

National Flood Insurance Program

The Town of Northfield participates in the National Flood Insurance Program. As of September 2011, there were seven policies in effect in Northfield for a total of $2,060,000 worth of insurance. The Town is not a member of the Community Rating System, which entitles policyholders to a discount on flood insurance premiums. The CRS ranking is based on the steps the town has taken to control flood losses. See pages 121-124 for more information on NFIP and the Community Rating System.

Table 4-1
Existing Hazard Mitigation Measures for Floods

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Zoning Bylaws					
Floodplain Overlay District	• Encroachments in the floodways which would result in any increase in flood levels are prohibited. • All encroachments, including new construction, fill or substantial improvement to existing structures require professional engineer or architect certification. • Certification by a professional engineer or architect is required to show no decrease in flood storage capacity or increase in flood levels. • The Town follows the standards set by the Wetlands Protection Act.	Special Flood Hazard Areas (Zones A, AE, AH, AO and A1-30) to indicate the 100-year floodplain.	Effective for controlling new development within the 100-year floodplain.	Consider limiting new development within the 100-year floodplain.	
				Consider adding flood prevention and preserving the integrity of the floodplain as stated purposes of the Floodplain Overlay District.	
				Create and distribute an educational program brochure designed to raise awareness of risks associated with building in the floodplain.	
Water Supply Protection Overlay District	• Designed to preserve and maintain existing and potential groundwater and surface water resources within the Town.	All areas identified on the Northfield Water Supply Protection District Map.	Somewhat effective for mitigating the potential for localized flooding.	The Conservation Commission should review the Water Supply Overlay District regulations and make recommendations for changes.	

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Site Plan Review	• Plan must show existing and proposed drainage. • Changes in surface drainage should not affect neighboring properties.	Commercial and industrial structures of 10,000 or more square feet of enclosed space; lots of 10 or more acres; or as required by other Town By-laws.	Effective for directing development to the most suitable locations on the lot.	Consider requiring that site plans must show the 100-year floodplain on all plans submitted.	
Open Space Development	• Requires that a minimum of thirty-five percent (35%) of land tract to be developed be open space. • The open space may not include wetlands, water bodies, floodplains, or slopes greater than twenty-five (25) percent.	Allowed for parcels of ten acres or more located within the Town.	Somewhat effective for controlling flooding.	The Town should consider requiring that flooding prevention be more specifically addressed.	
Removal of Natural Materials	• Regulates the removal of soil, loam, sand & gravel through a permitting process. • Exempts routine farming operations and activities taking place under current building permits.	Entire Town.	Not effective for controlling localized flooding. This bylaw does not specifically address the potential for localized flooding that soil removal can cause.	Add reducing or eliminating the potential for localized flooding events as a purpose of the bylaw.	
				Require mitigation of potential impacts from flooding.	
Subdivision Rules and Regulations					
	• Requires that subdivision design reduce, to the extent	Areas of Town identified on the Zoning Map for	Somewhat effective for mitigating or preventing localized flooding of	Consider adding Flood Prevention and Mitigation to purpose	

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
	reasonably possible, flood damage. Includes several other provisions that mitigate the potential for flooding and its associated impacts.	Residential Development	roads and other infrastructure.	section of the Subdivision Rules and Regulations.	
Definitive Plan	• Requires a Definitive Plan for new subdivisions, including location of storm drainage systems, water courses, marshes, flood plains, and wetland resources areas.	Areas of Town identified on the Zoning Map for Residential Development	Somewhat effective for mitigating or preventing localized flooding of roads and other infrastructure. Somewhat effective for controlling impacts from stormwater runoff.	Definitive plan should identify impacts and include flooding mitigation measures.	
Performance Guarantee	• Performance guarantee ensures that subdividers cover the cost of construction and improvements for projects.	Areas of Town identified on the Zoning Map for Residential Development	Effective.		
Design Standard – Watercourse and Protection of Natural Features	• Displacement of streams or watercourses is forbidden without approval of the Northfield Conservation Commission and Massachusetts DEP. • Proposed subdivisions containing or adjacent to wetlands, floodplain or inland water are referred to the Wetlands Protection Act.	Areas of Town identified on the Zoning Map for Residential Development	Somewhat effective for mitigating or preventing localized flooding of roads and other infrastructure.	Consider updating subdivision regulations with respect to watercourses and protection of natural features to reference current Wetlands Protection Act and Rivers Protection Act.	
				Consider amending standards to address impacts of uncontrolled surface water runoff and	

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
				sedimentation of streams and surface water bodies by requiring temporary and permanent erosion control measures.	
				Consider requiring Impact Statements for construction beyond a certain number of lots.	
				Design standards should more clearly address stormwater runoff.	
Required Improvements - Drainage	• Requires drainage systems be installed within the subdivision to permit the unimpeded flow of all natural water courses, to insure adequate drainage of all streets, and to intercept storm water along streets at intervals reasonably related to the extent and grade of the area drained.	Areas of Town identified on the Zoning Map for Residential Development	Somewhat effective for mitigating or preventing localized flooding of roads and other infrastructure. Somewhat effective for controlling impacts from stormwater runoff.	To the extent feasible, new subdivisions should maintain the natural drainage systems of watercourses or streams.	
Other Protections					
Northfield Wetlands Bylaw	• N/A		The Town does not have any wetlands bylaws.	The Town should assess their wetlands assets and consider adopting a bylaw to manage them.	
Northfield Community	• Inventories natural features	Entire Town.	Effective in establishing priorities for	Consider zoning revisions suggested by	

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Development Plan	and environments in the Town, including many that contain floodplain areas such as wetlands, aquifer recharge areas, farms, rivers, streams, and brooks. • Encourages development to locate outside certain flood-prone areas.		environmentally sensitive development that will mitigate flooding impacts.	Community Development Plan: • Review the Town's Water Supply Protection Overlay District boundaries and regulations, and consider strengthening them to better protect Northfield's water supplies.	
				• Consider establishing new overlay zoning districts to help protect important natural, scenic, historic, and open space resources.	
Participation in the National Flood Insurance Program	• As of September 2011, there were 7 homeowners with flood insurance policies.	Areas identified by the FEMA maps.	Somewhat effective, provided that the Town remains enrolled in the National Flood Insurance Program.	The Town should evaluate whether to become a part of FEMA's Community Rating System.	
State Building Code	• The Town of Northfield has adopted the Massachusetts State Building Code.	Entire Town.	Effective.	None.	
Four Mile Brook Watershed Assessment and Management Plan	• Includes recommendations to prevent nonpoint pollution in the watershed, manage flow and mitigate bank erosion along high hazard areas of	Four Mile Brook Road.	Effective, provided that recommendations are acted upon.	N/A	The Town is in the process of implementing stormwater Best Management Practices

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
	Four Mile Brook adjacent to Four Mile Brook Road.				at six sites along the brook. The Town should continue to implement the recommendations from the plan.
Town of Northfield Conservation and Recreation Plan	• Inventories natural features and promotes natural resource preservation in the Town, including areas in the floodplain; such as wetlands, aquifer recharge areas, farms and open space, rivers, streams and brooks.	Entire Town.	Effective in identifying sensitive resource areas, including floodplains. Encourages open space and farmland preservation to provide flood storage capacity.	Complete Town of Northfield Open Space and Recreation Plan (in progress).	The Open Space and Recreation Plan was completed in 2005. It has since expired, and should be updated.
				Consider prioritizing floodplain areas for permanent protection as open space.	

Severe Winter Storms

Winter storms can be especially challenging for emergency management personnel because, although the storm has usually been forecast, there is no certain way to predict its length, size or severity. The Massachusetts Emergency Management Agency (MEMA) serves as the primary coordinating entity in the statewide management of all types of winter storms and monitors the National Weather Service (NWS) alerting systems during periods when winter storms are expected.[47]

Management Plans
The CEM Plan for Northfield lists the following generic mitigation measures for severe winter storms:

- Develop and disseminate emergency public information concerning winter storms, especially material that instructs individuals and families how to stock their homes, prepare their vehicles, and take care of themselves during a severe winter storm.
- As it is almost guaranteed that winter storms will occur annually in Massachusetts, local government bodies should give special consideration to budgeting fiscal resources with snow management in mind.
- Maintain plans for managing all winter storm emergency response activities.

To the extent that some of the damages from a winter storm can be caused by flooding, all of the flood protection mitigation measures described in Table 4-1 can also be considered as mitigation measures for severe snowstorms/ice storms.

The CEM Plan for Northfield lists the following generic preparedness and response measures for severe winter storms:

- Ensure that warning/notification and communications systems are in readiness.
- Ensure that appropriate equipment and supplies, (especially snow removal equipment), are in place and in good working order.
- Review mutual aid agreements.
- Designate suitable shelters throughout the community and make their locations known to the public.
- Implement public information procedures during storm 'warning' stage.
- Prepare for possible evacuation and sheltering of some populations impacted by the storm (especially the elderly and special needs).
- Broadcast storm warning/notification information and instructions.
- Conduct evacuation, reception and sheltering activities.

[47] Comprehensive Emergency Management Plan for the Town of Northfield, 2010.

- If appropriate, activate media center. Refer to Resource Manual for media center information.
- Dispatch search and rescue and emergency medical teams.
- Take measures to guard against further danger from power failure, downed trees and utility lines, ice, traffic problems, etc.
- Close roads and/or limit access to certain areas if appropriate.
- Provide assistance to homebound populations needing heat, food and other necessities.
- Provide rescue and sheltering for stranded/lost individuals.

Restrictions on Development

There are no restrictions on development that are directly related to severe winter storms. The Town of Northfield Subdivision Rules and Regulations set grade limits on streets (Section 5-4 Design Standards), which, although not specified as weather hazard mitigation, can serve to minimize accident potential from severe winter storms.

- (Section 5-4) Design Standards –Street Grade. A street grade of more than eight (8) percent shall not be permitted, except where unusual topographic conditions exist, and only after the Board has given its approval. The centerline grade for any street shall not be less than six-tenths of one percent.
- (Section 5-12) Design Standards – Utilities. All utilities shall be placed underground. Utility easements should generally follow lot lines, and shall not be less than twenty (20) feet in width.
- (Section 6-9) Required Improvements - Curbs. When street grade exceeds four (4) percent, and at catch basins and at street intersections, as well as at the Board's discretion, curbing of Type VA3 or VA4 granite is required in accordance with the Massachusetts Department of Public Works (MDPW).

Other Mitigation Measures

Severe snowstorms or ice storms can often result in a small or widespread loss of electrical service. Ideally, public water supply wells are equipped with standby power sources. The distribution system often functions by gravity; therefore, no auxiliary power is needed. The East Northfield water treatment plant is equipped with a standby power source.

State Building Code

For new or recently built structures, the primary protection against snow-related damage is construction according to the State Building Code, which addresses designing buildings to withstand snowloads.

Table 4-2
Existing Hazard Mitigation Measures for Severe Winter Storms

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Subdivision Rules and Regulations					
Design Standards for Roads	• Standards include street grade regulations (eight percent maximum).	Entire Town.	Effective.	None.	
Utilities (electric and telephone)	• The Town requires all utilities to be placed underground for new subdivisions.	Entire Town.	Effective for ensuring that utility service is uninterrupted by severe storms in new areas of residential development.	Encourage utility companies to underground existing utility lines in locations where repetitive outages occur.	
				Encourage utility companies to underground new utility lines.	
				Encourage regular tree maintenance to reduce number of limbs near overhead power lines.	
Curb Cut Regulations	• Increased surface drainage onto public ways is forbidden.	Entire Town.	Effective.	None.	
Other Protections					
State Building Code	• The Town of Northfield has adopted the Massachusetts State Building Code.	Entire Town.	Effective.	None.	

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Shelters	• Shelters for victims of natural hazards in Northfield have been identified.	Entire Town.	Effective.	Ensure that identified shelters have sufficient back-up utility service in the event of primary power failure.	Pioneer Valley Regional School and Northfield Elementary School both have back-up power supplies.
Public Water Supply	• Public water supply sources should have backup power in case of electrical failure.	Town Center.	Effective for ensuring that utility service is uninterrupted by severe storms.	Evaluate status of public water supply sources and determine which ones have backup power supplies.	
				Every effort should be made to provide backup power sources to public water supplies, particularly those in identified shelters.	

Hurricanes and Tropical Storms

Of all the natural disasters that could potentially impact Northfield, hurricanes provide the most lead warning time because of the relative ease in predicting the storm's track and potential landfall. MEMA assumes "standby status" when a hurricane's location is 35 degrees North Latitude (Cape Hatteras) and "alert status" when the storm reaches 40 degrees north Latitude (Long Island).[48] The flooding associated with hurricanes can be a major source of damage to buildings, infrastructure and a potential threat to human lives. Therefore, all of the flood protection mitigation measures described in Table 4-1 can also be considered hurricane mitigation measures. High winds that oftentimes accompany hurricanes can also damage buildings and infrastructure.

Management Plans
The CEM Plan for Northfield includes the following generic mitigation measures for hurricane planning and response:

- Develop and disseminate emergency public information and instructions concerning hurricane preparedness and safety.
- Community leaders should ensure that Northfield is enrolled in the National Flood Insurance Program.
- Develop and enforce local building codes to enhance structural resistance to high winds and flooding. Build new construction in areas that are not vulnerable to direct hurricane effects.
- Maintain plans for managing all hurricane emergency response activities.

The CEM Plan for Northfield includes the following generic preparedness and response measures for hurricanes:

- Ensure that warning/notification systems and equipment is ready for use at the 'hurricane warning' stage.
- Review mutual aid agreements.
- Designate suitable wind and flood resistant shelters in the community and make their locations known to the public.
- Prepare for coordination of evacuation from potentially impacted areas including alternate transportation systems and locations of special needs facilities.
- Activate warning/notification systems to inform public of protective measures to be taken, including evacuation where appropriate.
- Conduct evacuation of affected populations.
- Open and staff shelters and reception centers.
- Dispatch search and rescue and emergency medical teams.

[48] Ibid.

- Activate mutual aid activities.
- Take measures to guard against further danger from downed trees and utility lines, debris, etc.

Restrictions on Development

The only restrictions on development that are wind-related are the provisions in the zoning bylaw related to wireless communications facilities (Section 11.06, see detailed description in Appendix 1). In addition, new permanent mobile homes, which are susceptible to catastrophic damage during high wind events, are prohibited in Town. Grandfathered mobile homes are the only permanent mobile homes permitted within the Town of Northfield. Temporary mobile homes may be allowed with a Special Permit for a period up to 9 or 12 months, depending on the situation, as a residence on a lot where the primary structure is under construction.

State Building Code

For new or recently built structures, the primary protection against wind-related damage is construction according to the State Building Code, which addresses designing buildings to withstand high winds.

Table 4-3
Existing Hurricane and Tropical Storm Mitigation Measures (also applies to Tornados, Microbursts, and Thunderstorms)

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Zoning Bylaws					
Wireless communications facilities	• Requires a special permit from the Zoning Board of Appeals. • Wireless facilities should be set back from property lines at a distance of 150% of the height of the tower. • Facilities are not permitted within 500 feet of a residential lot line.	Entire Town.	Effective.	Add safety and prevention of wind-related damage as a stated purpose.	
Mobile homes	• Town of Northfield Zoning Bylaw prohibits mobile homes within the Town.	Entire Town.	Does not address potential damage to existing mobile homes.	Consider using Community Development Block Grant home rehabilitation funds to assist homeowners in retrofitting grandfathered mobile homes.	
Subdivision Rules and Regulations					
Utilities **(electric and telephone)**	• The Town requires all utilities to be placed underground in new subdivisions.	Entire Town.	Effective for ensuring that utility service is uninterrupted by severe storms in new areas of residential development.	Encourage utility companies to underground existing utility lines in locations where repetitive outages occur.	

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
				Encourage utility companies to underground new utility lines.	
				Encourage regular tree maintenance to reduce number of overhead limbs near overhead electrical lines.	
Other Protections					
State Building Code	• The Town of Northfield has adopted the Massachusetts State Building Code.	Entire Town.	Effective.	None.	
Shelters	• Shelters for victims of natural hazards in Northfield have been identified.	Entire Town.	Effective.	Ensure that identified shelters have sufficient back-up utility service in the event of primary power failure.	Pioneer Valley Regional School and Northfield Elementary School both have back-up power supplies.
Debris Management Plan	• A debris management plan could be developed.[49]	Entire Town.	Effective.	Consider participation in the creation of a Regional Debris Management Plan.	
Public Water	• Public water supply sources	Town Center.	Effective for ensuring that utility service is	Evaluate status of public water supply sources and	The East Northfield Water Company has an

[49] Natural disasters can precipitate a variety of debris, including trees, construction and demolition materials and personal property. After a natural disaster, potential threats to the health, safety and welfare of impacted citizens can be minimized through the implementation of a debris management plan. Such a plan can be critical to recovery efforts after a disaster, including facilitating the receipt of FEMA funds for debris clearance, removal and disposal. Additional information is available at *http://www.fema.gov/rrr/pa/dmgbroch.shtm.*

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Supply	should have backup power in case of electrical failure.		uninterrupted by severe storms.	determine which ones have backup power supplies.	emergency generator for its treatment plant.
				Every effort should be made to provide backup power sources to public water supplies, particularly those in identified shelters.	The Town should consider establishing formal agreements with surrounding towns for use of drinking water in the event of an emergency.

Tornados, Microbursts, and Thunderstorms

Worcester County and areas just to its west, including portions of Franklin County, have been dubbed the "tornado alley" of the state because the majority of significant tornados in Massachusetts's weather history have occurred in that region.[50] According to the *Institute for Business and Home Safety,* the wind speeds in most tornados are at or below design speeds that are used in current building codes.[51] Like earthquakes, the location and extent of potential damaging impacts of a tornado are completely unpredictable. Most damage from tornados comes from high winds that can fell trees and electrical wires, generate hurtling debris and, possibly, hail.

As listed on the Critical Facilities, Infrastructure, 2005 Land Use and Natural Hazards Map for Northfield, there is one historic example of a tornado in Northfield. The tornado was reported on July 3, 1972 and was ranked F1 (Moderate Tornado) on the Fujita Scale of Tornado Intensity. The tornado was approximately three miles long and touched down on the Connecticut River to the southeast of Caldwell Road in Northfield. It is unknown how much damage it caused. Since the 1950s, there have been close to twenty tornados that have touched down in Franklin County.

Management Plans
The CEM Plan for Northfield includes the following generic mitigation measures for tornado planning and response:

- Develop and disseminate emergency public information and instructions concerning tornado safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.
- Strict adherence should be paid to building code regulations for all new construction.
- Maintain plans for managing tornado response activities. Refer to the non-institutionalized, special needs and transportation resources listed in the *Resource Manual*.

The CEM Plan for Northfield includes the following generic preparedness and response measures for tornados:

- Designate appropriate shelter space in the community that could potentially withstand tornado impact.
- Periodically test and exercise tornado response plans.
- Put emergency management on standby at tornado 'watch' stage.
- At tornado 'warning' stage, broadcast public warning/notification safety instructions and status reports.

50 Northfield Comprehensive Emergency Management Plan, August 2002.
51 *www.ibhs.org.*

- Conduct evacuation, reception and sheltering services to victims.
- Dispatch search and rescue and emergency medical teams.
- Activate mutual aid agreements.
- Take measures to guard against further injury from such dangers as ruptured gas lines, downed trees and utility lines, debris, etc.
- Acquire needed emergency food, water fuel and medical supplies.
- Take measures relating to the identification and disposition of remains of the deceased.

Restrictions on Development
The only restrictions on development that are wind-related are the provisions in the zoning bylaw related to wireless communications facilities (Section 11.06, see detailed description in Appendix 1). In addition, new permanent mobile homes, which are susceptible to catastrophic damage during high wind events, are prohibited in Town. Grandfathered mobile homes are the only permanent mobile homes permitted within the Town of Northfield. Temporary mobile homes may be allowed with a Special Permit for a period up to 9 or 12 months, depending on the situation, as a residence on a lot where the primary structure is under construction.

State Building Code
For new or recently built structures, the primary protection against wind-related damage is construction according to the State Building Code, which addresses designing buildings to withstand high winds.

See Table 4-3, above, for current wind-related mitigation strategies applicable to Tornados, Microbursts, and Thunderstorms.

Wildfires and Brushfires

Franklin County has approximately 356,465 acres of forested land, which accounts for 77% of total land area. Forest fires are therefore a potentially significant issue. Northfield has 2,111 acres of state park in the Northfield State Forest. A large portion of the Town remains forested and is therefore at risk of fire. The last major fire in Northfield was in 1976 and affected about 25 acres.

Management Plans

The CEM Plan for Northfield includes the following generic mitigation measures for wildfire planning and response:

- Promote fire safety measures such as fire-safe landscaping and construction practices to the public and business communities.

The CEM Plan for Northfield includes the following generic preparedness and response measures for wildfires:

- Restrict outside burning etc. based on moisture levels, fuels supply conditions such as drought.
- Identify high vulnerability or problem areas.
- Utilize mutual aid, including the State Fire Mobilization Plan, as needed.

Burn Permits

Burn permits for the Town of Northfield are issued from the Shelburne Control Center of the Massachusetts State Police. Approximately 472 permits were issued in 2009**.** During this process, the applicant is read the State Law, which includes guidelines for when and where the burn may be conducted as well as fire safety tips provided by the control center. Specific burn permit guidelines are established by the state, such as the burning season and the time when a burn may begin on a given day. It may be beneficial for the state to change some of their regulations to prevent wildfires and brushfires. Currently, the burning season extends from January 15th to May 1st. If the burning season were to start in November or December and end in April, this would allow for a longer season during the months found to be, traditionally, the least dry in Massachusetts. Currently, residents may only burn between 10 a.m. and 4 p.m. If state guidelines were changed to allow for an earlier start time, this would allow for most of the burning to be conducted in the morning when winds are often calmest.

Subdivision Review

The Northfield Fire Department reviews subdivision plans to ensure that their trucks will have adequate access and that the water supply is adequate for firefighting purposes. As required by the Town of Northfield Zoning Bylaws, a cul-de-sac, "T," or "L" turn around sufficient for fire apparatus shall be provided no more than 100 feet from the dwelling served by the drive (Section 7.03 Access Regulations).

Public Education/Outreach
The Northfield Fire Department has an ongoing educational program in the schools to teach fire safety during Fire Prevention Week, which falls during the first week of October.

Restrictions on Development
There are currently no restrictions on development that are based on the need to mitigate the hazards of wildfires/brushfires.

Forestry Operations
The Massachusetts Forest Cutting Practices Act (Chapter 132 of the Massachusetts General Laws) regulates timber harvesting of more than 25 thousand board feet or 50 cords on private or public land. Landowners are required to submit a Forest Cutting Plan to the Department of Conservation and Recreation (DCR) and the town Conservation Commission prior to beginning harvesting. A DCR Service Forester assigned to the region reviews the plan and must approve it before cutting can begin. When the work is completed, the landowner must contact the Forester for a final inspection.

The Forest Cutting Practices Act is largely concerned with the protection of wetlands and waterways and the prevention of erosion from forestry operations. However the Massachusetts Slash Law (Chapter 48 Section 16), which applies to all cutting operations falling under the Forest Cutting Practices Act, regulates the disposal of slash in order to minimize the danger from fire. This includes requirements to keep all public roads and access roads clear of slash in order to maintain adequate access to the woodlot for emergency vehicles in the event of a fire.

Table 4-4
Existing Hazard Mitigation Measures for Wildfires and Brush Fires

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Burn Permits	• Residents are permitted to obtain burn permits over the phone. State police personnel provide information on safe burn practices.	Entire Town.	Effective.	Request that the State revise burn permit guidelines.	
Subdivision Review	• The fire department is involved in the review of subdivision plans.	Entire Town.	Effective.	None.	
Public Education/Outreach	• The fire department has an ongoing educational program in the schools.	Entire Town.	Effective.	Develop and distribute an educational pamphlet on fire safety and prevention.	
Forestry Operations	• Timber harvests of more than 25 thousand board feet or 50 cords require a Cutting Plan to be submitted to the Department of Conservation and Recreation, and to the Northfield Conservation Commission.	Entire Town.	Somewhat Effective. Provides the town with information on where large operations are taking place.	N/A	Set up a system with the Conservation Commission to provide a copy of all cutting plans to the Fire Department when they are submitted by landowners. Maintain contact with the Service Forester assigned to Northfield to ensure that active Cutting Plans are being enforced.

Earthquakes

Although there are five mapped seismological faults in Massachusetts, there is no discernable pattern of previous earthquakes along these faults (including one which runs along the eastern side of the Town of Northfield) nor is there a reliable way to predict future earthquakes along these faults or in any other areas of the state. Consequently, earthquakes are arguably the most difficult natural hazard to plan for. Most buildings and structures in the state were constructed without specific earthquake resistant design features.

Management Plans
The Northfield CEM Plan lists the following generic mitigation measures for earthquakes:

- Community leaders in cooperation with Emergency Management Personnel should obtain local geological information and identify and assess structures and land areas that are especially vulnerable to earthquake impact and define methods to minimize the risk.
- Strict adherence should be paid to land use and earthquake resistant building codes for all new construction.
- Periodic evaluation, repair, and/or improvement should be made to older public structures.
- Emergency earthquake public information and instructions should be developed and disseminated.
- Earthquake drills should be held in schools, businesses, special care facilities and other public gathering places.

The Northfield CEM Plan lists the following generic preparedness and response measures for earthquakes:

- Earthquake response plans should be maintained and ready for immediate use.
- All equipment, supplies and facilities that would be needed for management of an earthquake occurrence should be maintained for readiness.
- Emergency management personnel should receive periodic training in earthquake response.
- If the designated EOC is in a building that would probably not withstand earthquake impact, another building should be chosen for an earthquake EOC.
- Mass Care shelters for earthquake victims should be pre-designated in structures that would be most likely to withstand earthquake impact.
- It is assumed that all special needs facilities could be affected to some extent by earthquake effects therefore preparedness measures should be in place to address the needs of all facilities listed in the Resource Manual.

- Most likely the entire population of the community will be affected by a seismic event. Estimate the maximum peak population affected, considering peak tourism, special event populations, and work hours.
- EOC will be activated and response will immediately be engaged to address any and all earthquake effects.
- Emergency warning/notification information and instructions will be broadcast to the public.
- Search and rescue and emergency medical teams will be dispatched.
- Firefighters will address fires/explosions and HAZMAT incidents.
- Law enforcement personnel will coordinate evacuation and traffic control as well as protecting critical facilities and conducting surveillance against criminal activities.
- Reception centers will be opened and staffed.
- Animal control measures will be taken.
- Immediate life-threatening hazards will be addressed such as broken gas lines, or downed utility wires.
- Emergency food, water and fuel will be acquired.
- Activate mutual aid.
- Measures will be taken by the chief medical examiner relating to identification and disposition of remains of the deceased.

Evacuation Options
The Northfield CEM lists the Northfield Elementary School, the Pioneer Valley Regional School, and Greenfield Community College (located in Greenfield) as shelters.

State Building Code
State and local building inspectors are guided by regulations put forth in the Massachusetts State Building Code. The first edition of the Massachusetts State Building Code went into effect on January 1, 1975 and included specific earthquake resistant design standards. These seismic requirements for new construction have been revised and updated over the years and are part of the current, 8th Edition of the Massachusetts State Building Code. Given that most structures in Massachusetts were built before 1975, many buildings and structures do not have specific earthquake resistant design features. According to the 2000 U.S. Census, 63% of the housing in Northfield was built before 1970. In addition, built areas underlain by artificial fill, sandy or clay soils are particularly vulnerable to damage during an earthquake.

Restrictions on Development
There are no seismic-related restrictions on development.

Table 4-5
Existing Hazard Mitigation Measures for Earthquakes

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
State Building Code	• The Town of Northfield has adopted the 8th Edition of the State Building Code.	Entire Town but applies to new construction only.	Effective for new buildings only.	Evaluate older structures, particularly schools and shelters, to determine if they are earthquake resistant. If not, identify alternate structures as shelters for earthquake events.	
Debris Management Plan	• A debris management plan could be developed.	Entire Town.	Effective.	Consider participation in the creation of a Regional Debris Management Plan.	
Public Water Supply	• Public water supply sources should have backup power in case of electrical failure.	Town Center.	Effective for ensuring that utility service is uninterrupted by severe storms and earthquakes.	Evaluate status of public water supply sources and determine which ones have backup power supplies.	The East Northfield Water Company has an emergency generator for its treatment plant.
				Every effort should be made to provide backup power sources to public water supplies, particularly those in identified shelters.	The Town should consider establishing formal agreements with surrounding towns for use of drinking water in the event of an emergency.

Dam Failures

The only mitigation measures in place are the state regulations that control the construction and inspection of dams. The Northfield CEM Plan states that there are three categories of dam failure or overspill and that action should be taken according to hazard rating:

Type 1: Slowly developing condition

- Activate EOC;
- Activate all communication networks and establish 24-hour communications with command post;
- Release public information;
- Notify the following:
    - MEMA region headquarters
    - American Red Cross
    - downstream communities;
- Review plans for evacuation and sheltering
    - Evacuation
        - Routes
        - Notification
    - Sheltering
        - Availability and capacity
        - Food, supplies, and equipment
        - Shelter owners and managers
        - Other communities (if out-of-Town sheltering is required)
- Require 'stand by' status of designated emergency response forces.

Type 2: Rapidly developing condition

- Establish 24-hour communication from the damsite to EOC;
- Assemble, brief and assign specific responsibilities to emergency response forces;
- Release public information;
- Obtain and prepare required vehicles/equipment for movement; and,
- Prepare to issue warning.

Type 3: Practically instantaneous failure

- Issue warning;
- Commence immediate evacuation;
- Commit required resources to support evacuation;
- Activate shelters or coordinate activation of shelters located outside the community;
- Notify:
    - MEMA region headquarters
    - American Red Cross
- Initiate other measures as required to protect lives and property.

Management Plans

The Northfield CEM Plan contains the following generic mitigation measures for dam failure:

- Develop and conduct public education programs concerning dam hazards.
- Maintain up-to-date plans to deal with threat and actual occurrence of dam overspill or failure.
- Emergency management and other local government agencies should familiarize themselves with technical data and other information pertinent to the dams that impact Northfield. This should include determining the probable extent and seriousness of the effect to downstream areas.
- Dams should be inspected periodically and monitored regularly.
- Repairs should be attended to promptly.
- As much as is possible burdens on faulty dams should be lessened through stream re-channeling.
- Identify dam owners.
- Determine minimum notification time for downstream areas.

The Northfield CEM Plan contains the following generic preparedness and response measures for dam failure:

- Pre-place adequate warning/notification systems in areas potentially vulnerable to dam failure effects.
- Develop procedures for monitoring dam site conditions at first sign of any irregularity that could precipitate dam failure.
- Identify special needs populations, evacuation routes and shelters for dam failure response.
- Have sandbags, sand and other items to reinforce dam structure or flood proof flood prone areas.

- Disseminate warning/notification of imminent or occurring dam failure.
- Coordinate evacuation and sheltering of affected populations.
- Dispatch search and rescue teams.
- Coordinate evacuation and sheltering of affected populations.
- Activate mutual aid if needed.
- Acquire additional needed supplies not already in place, such as earthmoving machinery.
- Establish incident command post as close to affected area as safely possible.
- Provide security for evacuated public and private property.

The Northfield CEM lists one dam in the Northfield area: the Mt. Hermon School Upper Reservoir Dam, which could affect up to 850 people if the former Northfield Mt. Hermon School campus were impacted.[52]

Additional dams found upstream on the Connecticut River in neighboring states may pose a greater hazard to the Town of Northfield. Some publicly owned reservoirs and dams that are located upstream of Northfield include Townshend Lake and North Springfield Lake in Vermont, Surry Mountain Lake and Otter Brook Lake in New Hampshire,[53] and the Moore Dam and Vernon Dam on the Connecticut River. All are rated high hazard and have Emergency Action Plans in place, excepting Vernon Dam, which is rated low hazard. Vernon Dam is owned by TransCanada and there is no emergency action plan. The dam is regulated and inspected by FERC, since it is a power-generating facility.

Permits Required for New Dam Construction

Massachusetts State Law (M.G.L. Chapter 253 Section 45) regulates the construction of new dams. A permit must be obtained from the Department of Conservation and Recreation (DCR) before construction can begin. One of the permit requirements is that all local approvals or permits must be obtained.

Dam Inspections

The DCR requires that dams rated as Low Hazard Potential be inspected every ten (10) years, dams rated as Significant Hazard Potential be inspected every five (5) years, and dams rated as High Hazard Potential be inspected every two (2) years. Owners of dams are responsible for hiring a qualified engineer to inspect their dams and report the results to the DCR. Owners of High Hazard Potential dams and certain Significant Hazard Potential dams are also required to prepare, maintain, and update Emergency Action Plans. Potential problems may arise if the ownership of a dam is unknown or contested. Additionally, the cost of hiring an engineer to inspect a dam or to prepare an Emergency Action Plan may be prohibitive for some owners. At the writing of this plan legislation is pending that would set up a loan fund for dam owners to assist with the cost of dam

[52] This number assumes that a school or other similar use is operating on the Northfield campus.
[53] New England River Basins Commission, The River's Reach. December 1976.

inspections. The dam listed in Northfield by the DCR is privately owned and rated as a High Hazard Potential.

There are several programs available to owners of dams to assist with repair or removal of dams on their property. The Natural Resources Conservation Service (NRCS), a program of the U.S. Department of Agriculture, offers two funding opportunities for qualifying private landowners to cover part of the cost of establishing and maintaining conservation practices that enhance and improve wildlife habitat and restore natural ecosystems, including dam removal or repair. Additionally, the Massachusetts Department of Fish and Game (DFG) Riverways Program works with dam owners (both public and private) to remove failing or unnecessary dams on rivers with high habitat value and where there is community support. Riverways provides (1) technical assistance (2) technical services from pre-approved consulting firms and/or, (3) funding. Riverways works closely with Conservation Commissions, DEP and other permitting agencies to make sure dam removal projects are consistent with state and federal laws and regulations.[54]

Zoning

While no specific mention is made regarding the construction of new dams in the Floodplain Overlay District (Section 4.02), the language regarding encroachment and the erection of structures in existing bylaws would indicate that a Special Permit would be required from the Zoning Board of Appeals and an Order of Conditions would be required from the Conservation Commission. In addition, several state federal and local agencies would also be involved.[55]

Restrictions on Development

There are no Town restrictions on dam locations. The DCR issues permits for new dams and does have the authority to deny a permit if it is determined that the design and/or location of the dam is not acceptable.

[54] For more information on these programs and other available funding sources, see www.ma.nrcs.usda.gov and http://www.mass.gov/dfwele/der/riverways/resources/riverfactsheets.htm.

[55] Including potentially the DEP, The Environmental Protection Agency, and the Army Corps of Engineers.

Table 4-6
Existing Hazard Mitigation Measures for Dam Failures

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
Permits required for new dam construction	• State law requires a permit for the construction of any dam.	Entire Town.	Effective. Ensures dams are adequately designed.	None.	
Dam Inspections	• DCR has an inspection schedule that is based on the hazard rating of the dam (low, significant, high hazard).	Entire Town.	Low. The DCR does not have adequate staff and resources to inspect dams according to the required schedule.	Adequate staff and resources should be given to DCR to ensure the inspection schedules are maintained.	Since 2004, new State regulations have gone into effect placing the responsibility of dam inspections on the owners of the dams, rather than the DCR. Owners of High Hazard Potential and certain Significant Hazard Potential dams are also responsible for preparing Emergency Action Plans.
				Map dams and inundation areas.	
				Identify sources of funding for dam safety inspections.	At the writing of this plan, state legislation is pending that would create a loan fund for owners of dams to assist with paying for inspections.
				Incorporate dam safety into development review process.	
				Emergency action plans	

Type of Existing Protection	Description	Area Covered	Effectiveness	2005 Potential Changes	Potential Changes Accomplished/ Still Relevant?
				should be prepared for all High Hazard Potential dams impacting the Town, including those located in Vermont and New Hampshire.	
Zoning	• Special Permit and/or Order of Conditions required for dams in floodplain district or wetlands.	Floodplain areas and those under the jurisdiction of the Conservation Commission.	Effective.	None.	
Evacuation Plans	• Comprehensive evacuation plans would ensure the safety of the citizens in the event of dam failure.	Inundation areas in Town.	Not Effective. The preparation of inundation mapping and evacuation plans is expensive for owners of dams.	Owners of High Hazard Potential dams should prepare inundation area mapping and up-to-date evacuation plans in cooperation with the Town.	Identify funding sources for developing inundation maps and evacuation plans.

Landslides

Regulating land use and development to avoid construction on steep slopes and ensuring that construction does not reduce slope stability is one way to mitigate the hazard potential of landslides. The following regulations contain strategies that help reduce the risk of landslides in Northfield.

Management Plans
The Northfield CEM Plan does not contain any generic mitigation measures for landslides.

Restrictions on Development
The Town of Northfield Zoning Bylaws contains several regulations that could mitigate the potential for a landslide occurrence. The following regulations are outlined in Table 4-7 below, and provided in detail in Appendix 1.

- Section 4.03: Water Supply Protection District
- Section 10.01: Site Plan Review
- Section 11.01: Removal of Natural Materials
- Section 11.04: Erosion Control Regulations

Northfield's Subdivision Rules and Regulations were adopted for the purpose of "protecting the safety, convenience and welfare of the inhabitants of the cities and towns in which it is put into effect by regulating the laying out and constructing of ways with subdivisions that provide access to lots therein, but which have not become public ways, and ensuring sanitary conditions in subdivisions, and in proper cases, parks and open areas." The powers of the planning board shall be exercised to secure safety in the case of fire, flood, panic and other emergencies. The Subdivision Rules and Regulations contain several provisions that mitigate the potential for landslides, listed here and detailed in Appendix 1:

- Section 3-6: Definitive Plan – Contents
- Section 5-11: Design Standards – Watercourses
- Section 5-14 c: Design Standards – Protection of Natural Features
- Section 6-10: Required Improvements – Drainage

Table 4-7
Existing Hazard Mitigation Measures for Landslides

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes
Zoning Bylaws				
Water Supply Protection District	• A Special Permit is required for the construction of any residential building or structure within one hundred feet of the center line of any stream. • A Special Permit is required for all grading or construction on slopes in excess of twenty-five (25) percent, and must prevent erosion, soil instability, uncontrolled surface water runoff, or other environmental degradation.	Areas of Town within the Water Supply Protection District.		
Site Plan Review	• Site plans must show present and proposed topography, existing and proposed surface water drainage and proposed landscaping features (vegetative and structural). • The plan shall minimize tree or vegetation removal and grade changes; building locations shall avoid hilltops, steep slopes and wetland areas to the extent possible; and any change in surface drainage will not result in erosion or sedimentation.	Commercial and industrial structures of 10,000 or more square feet of enclosed space; lots of 10 or more acres; or as required by other Town By-laws.		
Removal of Natural Materials	• The removal of loam, earth, sand, mineral aggregate, stone or rock from a parcel of land requires a special permit except where it is incidental to the construction of an approved building,	Entire Town.		

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes
	routine farming operations or construction of roads within an approved subdivision. • Special Permit requires that approved vegetative cover to be established according to plan; no excavation take place less than 100 feet from the boundary of a public way or any waterway; and, no finish grade slopes exceed a grade of 2:1. • No construction shall result in a change in the natural surface drainage onto abutting property.			
Subdivision Rules and Regulations				
	• Requires a Definitive Plan for new subdivisions, including location of storm drainage systems, water courses, and significant natural features. • Removal, filling, or dredging of any bank, flat, marsh, meadow or swamp bordering an inland waterway is required to give written notice of intent to the Northfield Conservation Commission and the DEP.	Areas of Town identified on the Zoning Map for Residential Development.		

Ice Jams

The most common hazard associated with ice jams is flooding upstream of the ice jam. Therefore strategies to mitigate flooding are also appropriate for mitigating the impacts of ice jams. See Table 4.1: Existing Flood Hazard Mitigation Measures and the preceding section for complete information.

Manmade Hazards

Timely, informative and accurate notification of a hazardous material emergency is critical for an effective emergency response and for the safety and protection of Northfield's citizens. With the transportation of hazardous materials via Routes 63, 10 as well as the railroad – and with the close proximity of these routes to homes and water bodies - the possibility exists of a catastrophic accident or spill. Strategies to plan for the evacuation of residents and for the cleanup of any chemical spill are key to hazard mitigation.

Management Plans
The following are generic preparedness and response measures for manmade hazards listed in the Northfield CEM Plan, specifically hazardous materials emergencies:

- The immediate notification of the community emergency coordinator and the State is required when a release of an extremely hazardous substance or hazardous chemical in an amount above the Reportable Quantity (RQ) occurs. Specific information is required by the notification such as chemical name, method of release, health effects, medical attention and protective actions.
- The Hazardous Materials Release Report Form must be used in the event of the release of a hazardous substance
- Both local and State response personnel, including the DEP must be notified immediately of a release. The local point of contact is the local fire department through the 911 dispatch Center.

Evacuation Options
Evacuation of an incident site could be required upon the recommendation of the on-scene commander. The routes of evacuation and staging areas for the evacuees will be determined by the Incident Commander. Once the incident site has been evacuated, law enforcement officials will support expanded evacuation if required. The necessity for additional evacuation will be determined by the Incident Commander.

Restrictions on Development
The purpose of the Water Supply Protection District is to promote the health, safety, and welfare of the community by preserving and maintaining the existing and potential groundwater and surface water supply resources for private and public water wells and reservoirs within the Town of Northfield. The By-Law's provisions are intended to protect these resources and their recharge areas from any use of land or structures which reduce the quality or quantity of those water supplies. Uses restricted in the district include the manufacture or disposal of toxic or hazardous materials, and the use, storage, or transport of toxic or hazardous materials except for household or agricultural uses. While the existence of this bylaw, in and of itself, would not prevent hazardous materials accidents, it could potentially minimize the possibility of such accidents occurring in an area containing a drinking water source.

Table 4-8
Existing Hazard Mitigation Measures for Manmade Hazards

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes
Zoning Bylaws				
Water Supply Protection District	• Prohibits the manufacture, disposal, use, storage, and transport of toxic or hazardous materials except for household or agricultural use.	Areas of Town within the Water Supply Protection District.	Effective in minimizing the risk of hazardous material accidents in areas containing a public drinking water source.	

Future Mitigation Strategies

Hazard Mitigation Goal Statements and Action Plan

As part of the multi-hazard mitigation planning process to be undertaken by the Committee, existing gaps in protection and possible deficiencies will be identified and discussed. The Committee will develop general goal statements and Action Items that, when implemented, will help to reduce risks and future damages from natural hazards. The goal statements, Action Items, town department(s) responsible for implementation, and the proposed timeframe for implementation for each category of natural hazard are described below. There are also several general Action Items that were developed.

Several of the Action Items have multiple benefits because, if implemented, these Action Items will mitigate or prevent damages from more than one type of natural hazards. For example, updating the Subdivision Regulations to require new utility lines be placed underground will prevent property damage and loss of service in the event of high winds (tornado or hurricane) or severe snow and ice storms.

Action items from the previous plan were carried over where they were still applicable and/or where the item had not yet been completed. Those action items that have been completed since the last plan are listed below in the **2005 Action Items Completed** section.

2005 Action Items Completed

Action Item: Evaluate the possibility of adding both Northfield Elementary School and Pioneer Valley Regional School as shelters in Northfield.

Responsible Department/Board: Emergency Management Director, Select Board

2012 Status Update: As of the 2010 Northfield Comprehensive Emergency Management Plan, the Northfield Elementary School and the Pioneer Valley Regional School are designated shelters in Northfield.

Action Item: Examine current notification systems including the feasibility of the Town obtaining Reverse 911. Develop a preliminary project proposal and cost estimate.

Responsible Department/Board: Police Department, Fire Department, Emergency Management Director

2012 Status Update: Northfield has acquired a reverse call system.

Action Item: Ensure that identified shelters have sufficient back-up utility service (water, wastewater and electric) in the event of primary power failure.

Responsible Department/Board: Emergency Management Director, Select Board

2012 Status Update: Both the Northfield Elementary School and the Pioneer Valley Regional School have back-up power supplies.

2012 Action Plan

Prioritization of Goals and Action Items

The Committee prioritized Mitigation Action Items by examining the results of the All Hazards Risk Assessment completed by the Committee (see Section 3, pages 58 through 62). The All Hazards Risk Assessment is an interactive table that the Committee completed with the FRCOG staff to evaluate all the hazards that can impact the town based on frequency of occurrence, severity of impacts, area of occurrence and preparedness. The completed table gives the town an overall understanding of the hazards, and provides guidance on which hazards the Town may want to focus mitigation efforts on. Those hazards receiving the highest Weighted Hazard Index number were assigned the highest priority. Hazards were rated as follows:

Table 4-10: Hazard Index Range

Weighted Hazard Index	Priority Level
> 5.0	High
4.1 – 5.0	Medium
≤ 4.0	Low

Table 4-11: Summary of All Hazards Vulnerability Assessment

Natural Hazard	Weighted Hazard Index	Priority Level
Earthquakes	**6.0**	**High**
Tornados	**5.9**	**High**
Dam Failure	**5.7**	**High**
Microbursts	**5.3**	**High**
Severe Winter Storms	**5.2**	**High**
Hurricanes & Tropical Storms	**4.7**	**Medium**
Landslides	**4.5**	**Medium**
Flooding	**4.3**	**Medium**
Thunderstorms	**4.0**	**Low**
Wildfire & Brushfires	**4.0**	**Low**
Ice Jams	**3.1**	**Low**

The 2004 Northfield Local Natural Hazards Mitigation Plan did not prioritize action items, so it is not possible to evaluate any change in priorities since the last plan. The 2012 action plan is prioritized, so in future updates to the plan, it will be possible to document any changes in priorities. The 2004 planning process did include a vulnerability assessment that rated hazards according to the risk to the Town from each hazard (the 2004 plan did not evaluate landslides or ice jams). In the 2004 analysis, severe snowstorms/ice storms and severe thunderstorms (microbursts) that can cause wind damage were rated as the highest risk to the town. Flooding, hurricanes, and tornados were rated as a moderate to high risk to the town, and dam failure, earthquakes, and wildfire/brushfire were ranked as a lesser risk to the Town. The methodology of the 2004 assessment differs greatly from the methodology used in the 2011 All Hazards Vulnerability Assessment, making it difficult to compare the two. The results of the 2011/2012 assessment are shown in Table 4-11, above.

Because the ranking of priorities was based on the results of the All Hazards Risk Assessment, factors such as local knowledge of the frequency of occurrence of hazard events, the severity of impacts to the population, infrastructure, and the built and natural environments, the location and extent of impacts of the hazard events, and the town's preparedness to respond to hazard events were included in the prioritization process. The Committee's process also considered the anticipated benefits from the implementation of each Action Item to the population, the town's infrastructure, and to the built and natural environment. For most of the Action Items, project costs are not specifically known but there was consideration of whether or not the town currently had the technical and administrative capability to carry out the mitigation measures.

Erosion and flooding along the Four Mile Brook is documented in the Four Mile Brook Watershed Management Plan, which outlines actions the Town could implement to address the problem. The Town is currently implementing stormwater Best Management Practices in six priority locations identified in the plan. Another recommended action from the plan is to implement designs to reduce flooding and erosion hazards at three high hazard areas along the brook through the creation of log jams. A 2008 assessment estimated a total project cost of $153,000 to implement the proposed designs. The project would provide several key benefits, including diverting the flow of the brook away from Four Mile Brook Road, which has been washed out by flooding from the brook and is being compromised in areas from erosion along the brook. The project would also result in habitat benefits in the watershed. A full Benefit Cost Analysis has not been completed for this project. This project is identified as an action item in the Flooding section of the 2012 Northfield Multi-Hazard Mitigation Prioritized Action Plan.

Even when the political will exists to implement the Action Items, the fact remains that Northfield is a rural town that relies heavily on a small number of paid staff, many of whom have multiple responsibilities, and a dedicated group of volunteers who serve on town boards and committees. However, some action items, when implemented by Town staff and volunteers, result in a large benefit to the community for a relatively small cost. For example, the creation and maintenance of a local Citizen Emergency Response Team (CERT) will require Town staff and volunteer time, but will potentially result in many

benefits to the community as volunteers provide assistance during emergencies and help with other preparedness and mitigation efforts. The action items considered to have a relatively small cost compared to the benefit realized from implementation are highlighted in light green in Table 4-12.

For larger construction projects, the town has limited funds to hire consultants and engineers to assist them with implementation. For these projects, the Town will seek assistance through the Franklin Regional Council of Governments (FRCOG) or other funding sources such as the Hazard Mitigation Grant Program. Limited technical assistance is available from the FRCOG. However, the availability of FRCOG staff can be constrained by the availability of grant funding.

The final 2012 Northfield Multi-Hazard Mitigation Prioritized Action Plan is shown in Table 4-12. Some Action Items were evaluated as being associated with several hazards and were labeled "Multiple Hazard". Multiple Hazard Action Items were assigned a high priority given their association with more than one hazard. Potential funding sources to assist the town with implementation of the Action Item were listed. Finally, each Action Item was given an estimated completion date and assigned a responsible department or board.

With respect to Manmade Hazards, the Committee evaluated the potential for fixed facility and transportation hazardous materials accidents as high – particularly transportation related accidents, given the proximity of Route 10, Route 63, and the railroad tracks to the Connecticut River and to more densely populated areas of Town. However, no formal vulnerability assessment was done for manmade hazards due to the lack of available data to use in an appropriate assessment model. The consensus of the Committee was that the potential for these types of manmade hazards to occur, the unknown impact of such accidents on the town's population, infrastructure, and the natural and built environment, and the lack of available and well-analyzed data make this hazard and the implementation of associated Action Items a high priority.

Table 4-12: 2012 Northfield Local Multi-Hazard Mitigation Prioritized Action Plan

Note: Action Items highlighted in light green are considered to have a relatively small cost compared to the benefit realized from implementation. Funding will be sought to implement other Action Items.

Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
HIGH PRIORITY (> 5.0 WEIGHTED HAZARD INDEX)					
MULTIPLE HAZARDS					
Goal: To provide adequate shelter, water, food and basic first aid to displaced residents in the event of a natural disaster.					
Identify shelters that are equipped with an auxiliary power supply or are earthquake resistant as well as outside of floodplain and inundation areas. Disseminate this information to appropriate Town departments.	Building Inspector, Emergency Management Director	P	Town, Volunteers	2012	Carried over from 2005 plan. The Northfield Elementary School and the Pioneer Valley Regional School have been identified as emergency shelters. Both are outside of the floodplain and have back-up generators on-site.
Implement a maintenance plan for town-owned back-up generators to ensure they are ready to be used during an emergency. Equip all critical municipal facilities with the proper electrical capability to plug into a back-up generator.	Building Inspector, Emergency Management Director	B, P, I	Town, Volunteers	This Action has been implemented and will continue over the next five years.	New Action Item. The generator at the Town Hall was recently replaced. The Fire Station has a generator, and the Police Station is in the process of obtaining one.
Inventory supplies at existing shelters and develop a needs list and storage requirements. Establish arrangements with local or neighboring vendors for supplying shelters with potable water, food and first aid supplies in the event of a natural disaster.	Emergency Management Director, Planning Board, Fire Department, Police Department	P	Town, Volunteers	2012	Carried over from 2005 plan. A shelter trailer with basic shelter supplies is housed at the Franklin County Sheriff's Office in Greenfield, and is available to Franklin County towns on a first come, first served basis in an emergency as a supplementary shelter supply source.
Create, maintain, and train a volunteer base for assisting town emergency management staff during and after emergencies. Encourage residents to join the Northfield Citizen Emergency Response Team (CERT), Franklin County CERT, or Franklin County Medical Reserve Corps (MRC).	Police Department, Fire Department, Emergency Management Director	B, N, P, I	Town, Volunteers, MEMA, Massachusetts Department of Public Health (DPH), FRCOG	This Action Item will be implemented and continued over the next five years.	New Action Item. A local CERT is currently in the process of being developed in Northfield. The Town has MOUs with the Pioneer Valley Regional School to supply staffing when the school is used as an emergency shelter, and for use of the kitchen facilities.
Identify back-up water supply sources in the event that distribution systems are damaged by a manmade or natural disaster. Develop agreements with surrounding towns to supply water if such a situation occurs.	Emergency Management Director, Select Board	P	Town	2013	Carried over from 2005 plan.
Goal: To provide adequate notification and information regarding evacuation procedures, etc., to residents in the event of a natural disaster.					
Collect, periodically update, and disseminate information on which local radio stations provide emergency information, what to include in a "home survival kit," how to prepare homes and other structures to withstand flooding and high winds, and the proper evacuation procedures to follow during a natural disaster.	Police Department, Fire Department, Emergency Management Director	P	Town	This Action has been implemented and will continue over the next five years.	Ongoing from 2005 plan. The Town sends out an annual mailing to all residents with information on what local radio stations provide emergency information.
Consider implementing a card system for emergencies to assist responders when performing door to door checks. Different colored cards placed in windows of homes would alert responders that the inhabitants are either ok, in need of assistance, or have vacated the premises.	Police Department, Fire Department, Emergency Management Director	P	Town	2012	New Action Item.

Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
MANMADE HAZARDS					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to manmade hazards.					
Research appropriate vulnerability assessment models for fixed facility and transportation hazardous materials accidents, collect relevant data, and populate model to further prioritize manmade hazard action items.	Emergency Management Director, Homeland Security Council, FRCOG	B, N, P, I	FEMA	2012	New Action Item.
Develop standard procedures to follow concerning evacuation and public notification in the event of a chemical spill in a fixed structure or in a transportation setting such as Route 10, Route 63, or the railroad.	Emergency Management Director	P	FEMA	2012	New Action Item.
Plan and participate in training and exercises for an ethanol spill or fire, given the amount of ethanol currently being transported by rail through the town.	Emergency Management Director, Police Department, Fire Department, Regional Emergency Planning Committee (REPC), FRCOG	B, N, P, I	MEMA, FRCOG	This Action will be implemented and continued over the next five years.	New Action Item. The REPC is working on writing an annex to its Hazardous Materials Emergency Plan specifically addressing the handling of ethanol. An exercise to test the new annex is planned for September 2012.
Continue to update the inventory of hazardous materials stored at businesses and town departments.	Emergency Management Director	N, P	Town	This Action will be implemented and continued over the next five years.	New Action Item.
EARTHQUAKES					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to earthquakes.					
The Town should review its municipal buildings and structures to determine if they are particularly vulnerable to earthquake damage and determine if any retrofitting measures could mitigate this vulnerability.	Building Inspector, Emergency Management Director, Select Board, Fire Department, Police Chief	B, N, P, I	Town	2013	Carried over from 2005 plan.
Consider participation in the creation of a Regional Debris Management Plan.	Emergency Management Director, Franklin County Regional Emergency Planning Committee (REPC), Homeland Security Council, FRCOG	B, N, P, I	Town, FEMA, Department of Homeland Security (DHS)	2013	New Action Item.
TORNADOS					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to high winds associated with tornados.					
Consider participation in the creation of a Regional Debris Management Plan.	Emergency Management Director, Franklin County Regional Emergency Planning Committee (REPC), Homeland Security Council, FRCOG	B, N, P, I	Town, FEMA, Department of Homeland Security (DHS)	2013	New Action Item.
DAM FAILURE					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to dam failure.					
Town officials should review dam records inspection reports kept by the Office of Dam Safety, to determine if any dams should be inspected or re-inspected.	Emergency Management Director, Select Board	B, N, P, I	Town	This Action has been implemented and will continue over the next five years.	Carried over from 2005 plan.

Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
Review the Emergency Action Plan (EAP) and inundation map for the Mount Hermon Upper Reservoir Dam. Conduct an exercise to test the updated EAP.	Emergency Management Director, Northfield Mount Hermon School, East Northfield Water Company, Select Board, Police Department, Fire Department, Highway Department, FRCOG	B, P, I	Town, Northfield Mount Hermon School, FRCOG	2013	New Action Item. The Northfield Mount Hermon School will update the EAP by July 2012.
Reach out to residents within dam inundation areas in town, and encourage them to sign up for the Reverse 911 service in order to be alerted by phone in the event of a dam failure.	Emergency Management Director, Select Board	P	Town	Start date of 2012, to be continued annually	New Action Item.
Seek technical assistance to map inundation areas of dams in town and upstream that would impact Northfield.	Emergency Management Director, Select Board	B, N, P, I	Town, Volunteers	2014	Modified from 2005 plan.
Incorporate Dam Safety into Subdivision Regulations by requiring applicants to consult the Dam and Inundation Areas map during their preparation of subdivision plans. The applicant should assess the risk to the potential development from dams and supply that information along with mitigation measures to the Town as part of the review process.	Emergency Management Director, Planning Board, Zoning Board of Appeals, Building Inspector	B, P, I	Town, Volunteers	2014	Carried over from 2005 plan. This Action is dependent on the existence and/or development of inundation mapping for dams in town or that would impact the town.
MICROBURSTS					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to high winds associated with microbursts.					
See Action Items for Tornados.					
SEVERE WINTER STORMS					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to severe winter storms.					
Encourage the electric utility to continue the ongoing program to trim tree branches hanging over power lines and structures.	Emergency Management Director, Select Board	B, P, I	Town	This action item has been implemented and will continue over the next five years.	New Action Item.
Consider participation in the creation of a Regional Debris Management Plan.	Emergency Management Director, Franklin County Regional Emergency Planning Committee (REPC), Homeland Security Council, FRCOG	B, N, P, I	Town, FEMA, Department of Homeland Security (DHS)	2013	New Action Item.
MEDIUM PRIORITY (4.1 – 5.0 WEIGHTED HAZARD INDEX)					
HURRICANES AND TROPICAL STORMS					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to high winds, lightning, and hail associated with severe thunderstorms.					
See Action Items for Tornados (Wind-related) and Flooding.					
LANDSLIDES					
Goal: To minimize the loss of life, damage to property, infrastructure and natural resources, and the disruption of governmental services and general business activities due to landslides.					

Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
The Town should continue to participate in the Connecticut River Streambank Erosion Committee.	Select Board, Conservation Commission	B, N, P, I	Town, Volunteers, Massachusetts Department of Environmental Protection (DEP)	This action has been implemented and will continue over the next five years.	New Action Item. Since 1996, bioengineering techniques have been used in a number of areas along the Connecticut River in Northfield to stabilize eroding banks.
FLOODING					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to flooding.					
Continue to implement the recommendations from the Four Mile Brook Watershed Management Plan. In particular, the proposed designs to reduce flooding and erosion hazards at three high hazard areas should be prioritized for implementation to mitigate future damage to the road and other property from flooding.	Select Board, Conservation Commission, Highway Department, Four Mile Brook Watershed Advisory Committee, FRCOG	B, N, P, I	Town, MEMA, DEP	This Action has been implemented and will continue over the next five years.	New Action Item. In 2010, the DEP awarded the Town a s.319 Nonpoint Source Pollution grant, which is currently funding the implementation of stormwater Best Management Practices at the six priority sites identified in the assessment.
Review and update the Flood Plain District Overlay Zoning Bylaw. Special consideration should be given to further restricting or eliminating new development within the 100-year floodplain and areas prone to localized flooding.	Planning Board, FRCOG	B, N, P, I	Town, Volunteers, FRCOG	2014	Carried over from 2005 plan. The FRCOG has developed a model floodplain overlay bylaw that can be consulted.
Using Assessors' data and other available information expand and update the Vulnerability Assessment for properties located within the 100-year floodplain. Particular consideration should be given to determining how many housing units within the floodplain are occupied by vulnerable populations.	Planning Board	B, P	Town, Volunteers	2014	Carried over from 2005 plan.
Review evacuation procedures for the flood prone areas in Town (identified on the 2012 Critical Facilities and Infrastructure Map) and update.	Police Department, Fire Department	P	Town	This Action has been implemented and will continue over the next five years.	Carried over from 2005 plan.
Coordinate with state and regional agencies to identify a location(s) for the temporary storage of contaminated/ hazardous flood debris.	Emergency Management Director, Planning Board, Franklin County Regional Emergency Planning Committee (REPC), FRCOG	N, P	Town, Volunteers, REPC	This Action has been implemented and will continue over the next five years.	Carried over from 2004 plan.
Support local and regional, watershed-wide open space protection efforts, particularly in floodplain areas.	Planning Board, Select Board	B, N, P, I	Town, Volunteers	This action has been implemented and will continue over the next 5 years.	Carried over from 2005 plan.
LOW PRIORITY (≤ 4.00 WEIGHTED HAZARD INDEX)					
THUNDERSTORMS					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to strong thunderstorms..					
See Action Items for Tornados (wind-related) and Flooding.					
WILDFIRES AND BRUSHFIRES					
Goal: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to wildfires and brushfires.					
Encourage forest stewardship practices that produce more stable, successional forested landscapes and which reduce the risk of fire hazards and improve emergency access (such as the removal of slash).	Conservation Commission, Planning Board, Fire Department	B, N, P, I	Town, Volunteers	This action has been implemented and will continue over the next 5 years.	Carried over from 2005 plan.

Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
Set up a system to provide a copy of all cutting plans to the Fire Department when submitted to the Conservation Commission from a landowner.	Select Board, Conservation Commission, Fire Department	B, N, P, I	Town, Volunteers	2012	New Action Item.
Maintain contact with the DCR Service Forester assigned to Northfield to ensure that active Cutting Plans are being monitored and enforced.	Fire Department	B, N, P, I	Town	This action will be implemented and continued over the next 5 years.	New Action Item.
Educate homeowners about general fire safety when issuing burn permits.	Fire Department	B, N, P, I	Town	This action has been implemented and will continue over the next 5 years.	Carried over from 2005 plan.
Seek funding to increase the staff of the Fire Department's inspection and safety unit. **[only if need to monitor town forest – ask Tom if he can find out if land management plan has information on this]**	Fire Department	B, N, P, I	Town	2015	Carried over from 2005 plan.
ICE JAMS					
Goal: To minimize the loss of life, damage to property, infrastructure and natural resources, and the disruption of governmental services and general business activities due to ice jams and associated flooding.					
See Action Items for Flooding.					

National Flood Insurance Program Compliance

The U.S. Congress established the National Flood Insurance Program (NFIP) in 1968, with the passage of the National Flood Insurance Act of 1968. "For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, seawalls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses, nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

"In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection."[56]

The State of Massachusetts, through its local communities,[57] complies with the NFIP in part by enforcing the Wetlands Protection Act (WPA), which helps restrict development in flood-prone areas, enforcing the State Building Code, which regulates building specifications and additional related zoning bylaws, such as a floodplain overlay district. At the local level, Northfield's compliance with the NFIP is enforced through the building inspector and building code, the Conservation Commission and wetland and floodplain regulations, and the zoning bylaws and subdivision regulations related to flooding. While the local building code cannot be more restrictive than the state building code, the local Conservation Commission can restrict development above and beyond the requirements in the WPA. The ability of the Conservation Commission to further regulate development in flood prone areas could be a crucial tool in flood mitigation. In additional, the ability of the Select Board to adopt further bylaws such as a floodplain overlay district could also mitigate flooding.

The Town of Northfield participates in the National Flood Insurance Program. The goals of the National Flood Insurance Program (NFIP) are to provide flood insurance to property owners, to encourage flood loss reduction activities by communities, and to save taxpayers' money. As of September 2011, there were six policies in effect in Northfield for a total of $1,850,000 worth of insurance. The town is not a member of the Community Rating System, which entitles policyholders to a discount on flood insurance premiums. The CRS ranking is based on the steps the town has taken to control flood losses.

[56] http://www.fema.gov/library/viewRecord.do?id=1404

[57] Massachusetts is a Home Rule state, the local communities have significant authority to implement state regulations and many towns adopt their own wetland and floodplain regulations that are more stringent than state.

NFIP Community Rating System (CRS)[58]

The town is not a member of the NFIP Community Rating System, which entitles policyholders to a discount on flood insurance premiums. The Community Rating System is a part of NFIP and provides incentives and tools to further these goals. The goals of the CRS are to recognize, encourage, and reward, by the use of flood insurance premium adjustments, community and state activities beyond the minimum required by the NFIP that:

- Reduce flood damage to insurable property,
- Strengthen and support the insurance aspects of the NFIP, and
- Encourage a comprehensive approach to floodplain management.

The Community Rating System reduces flood insurance premiums to reflect what a community does above and beyond the National Flood Insurance Program's (NFIP) minimum standards for floodplain regulation. The objective of the CRS is to reward communities for what they are doing, as well as to provide an incentive for new flood protection activities. It provides lower insurance premiums under the National Flood Insurance Program. The premium reduction is in the form of a CRS Class, similar to the classifications used for fire insurance. For example, a Class 1 provides a 45% premium reduction while a Class 10 provides no reduction. The CRS Class is based on the floodplain management activities a community implements. In many cases, these are activities already implemented by the community, the state, or a regional agency. The more activities implemented, the better the CRS class.

Benefits of participating in the Community Rating System:

- Money stays in the community instead of being spent on insurance premiums.
- Every time residents pay their insurance premiums, they are reminded that the community is working to protect them from flood losses, even during dry years.
- The activities credited by the CRS provide direct benefits to the community, including:
    - Enhanced public safety,
    - Reduction in damage to property and public infrastructure,
    - Avoidance of economic disruption and losses,
    - Reduction of human suffering, and
    - Protection of the environment.
- Local flood programs will be better organized and more formal.
- The community can evaluate the effectiveness of its flood program against a nationally recognized benchmark.
- Technical assistance in designing and implementing some activities is available at no charge.
- The community will have an added incentive to maintain its flood programs over the years.
- The public information activities will build a knowledgeable constituency interested in supporting and improving flood protection measures.

[58] http://training.fema.gov/EMIWeb/CRS/

Costs to the local government to participate in the Community Rating System:

- The community must designate a CRS Coordinator who prepares the application papers and works with FEMA and the Insurance Services Office (ISO) during the verification visit.
- Each year the community must recertify that it is continuing to implement its activities. It must provide copies of relevant materials (e.g., permit records).
- The community must maintaining elevation certificates, permit records, and old Flood Insurance Rate Maps forever.
- The community must maintain other records of its activities for five years, or until the next ISO verification visit, whichever comes sooner.

Community Rating System Process

One of the actions that Northfield can take to improve their CRS rating (and subsequently lower their premiums) is to develop a CRS plan. The CRS 10-step planning process provides additional points for activities that communities can take during their planning process that go above the minimum described below, thus possibly lowering insurance rates. At a minimum, an *approved* multi-hazard mitigation plan that addresses floods could qualify for CRS credit. Although communities are not required to participate in CRS in order to receive approval of a Local Natural Hazards Mitigation Plan, FEMA encourages jurisdictions to integrate the CRS planning steps into their multi-hazard mitigation plans.

Credit is provided for preparing, adopting, implementing, evaluating, and updating a comprehensive floodplain management plan or repetitive loss area analyses. The Community Rating System does not specify what must be in a plan, but it only credits plans that have been prepared and kept updated according to CRS standard planning process. Credit is also provided for implementing a habitat conservation plan.

Community Rating System Credit Points[59]

A total of up to 359 points are provided for three elements. Up to 294 points are provided for adopting and implementing a floodplain management plan (FMP) that was developed using the following standard planning process. There must be some credit for each of the 10 planning steps:

Step	Maximum Points
• Organize to prepare the plan	10
• Involve the public	85
• Coordinate with other agencies	25
• Assess the hazard	20
• Assess the problem	35
• Set goals	2
• Review possible activities	30
• Draft an action plan	70
• Adopt the plan	2

[59] FEMA Local Multi-Hazard Mitigation Planning Guidance, July 1, 2008.

Step	Maximum Points
• Implement, evaluate, and revise	15

Up to 50 additional points are provided for conducting repetitive loss area analyses (RLAA) and up to additional 15 points are provided for adopting and implementing a Habitat Conservation Plan (HCP).

More information is available at http://www.fema.gov/business/nfip/crs.shtm. A copy of the "Local Official's Guide to Saving Lives, Preventing Property Damage, and Reducing the Cost of Flood Insurance" is including in the Appendix of this plan or can be downloaded at http://www.fema.gov/library.

5 – PLAN ADOPTION & MAINTENANCE

Plan Adoption

The Franklin Regional Council of Governments (FRCOG) provided support to the Northfield Local Multi-Hazard Mitigation Planning Committee as they underwent the planning process. Town officials were invaluable resources to the FRCOG and provided background and policy information and municipal documents, which were crucial to facilitating completion of the plan.

When the preliminary draft of the Local Multi-Hazard Mitigation Plan was completed, copies were distributed to the Northfield Multi-Hazard Mitigation Planning Committee for comment and input. The Committee is comprised of representatives of many of the Town boards and departments who bear the responsibility for implementing the action items and recommendations of the completed plan.

Copies of the Final Draft Local Multi-Hazard Mitigation Plan for the Town of Northfield were distributed to the Town boards for their review and comment. A copy of the plan was also posted on the town website for public review. Once reviewed and approved by MEMA, the plan was sent to the Federal Emergency Management Agency (FEMA) for their approval. On _____, the Select Board voted to adopt the plan.

Plan Maintenance Process

The implementation of the Northfield Local Multi-Hazard Mitigation Plan will begin following its approval by MEMA and FEMA and formal adoption by the Northfield Select Board. Specific Town departments and boards will be responsible for ensuring the development of policies, bylaw revisions, and programs as described in Table 4-12: 2012 Northfield Local Multi-Hazard Mitigation Prioritized Action Plan. The Committee will oversee the implementation of the plan.

Monitoring, Evaluating, and Updating the Plan

Implementation Schedule

Annual Meetings

The Northfield Multi-Hazard Planning Committee will meet on an annual basis or as needed (i.e., following a natural disaster) to monitor the progress of implementation, evaluate the success or failure of implemented recommendations, and brainstorm for strategies to remove obstacles to implementation. Following these discussions, it is anticipated that the committee may decide to reassign the roles and responsibilities for implementing mitigation strategies to different Town departments and/or revise the goals and objectives contained in the plan. At a minimum, the committee will review and

update the plan every five years, beginning in the fall of 2016. Annual meetings of the committee will be organized by the Northfield municipal administrative staff and facilitated by the Emergency Management Director.

Bi-Annual Progress Report

The Emergency Management Director, with the assistance of municipal administrative staff, will prepare and distribute a biannual progress report in years two and four of the plan. The progress report will be distributed to all of the local implementation group members and other interested local stakeholders. The progress report will poll the members on any changes or revisions to the plan that may be needed, progress and accomplishments for implementation, and any new hazards or problem areas that have been identified. This information will be used to prepare a report or addendum, as needed, to the multi-hazard mitigation plan. The Emergency Management Director and the Northfield Multi-Hazard Planning Committee will have primary responsibility for tracking progress and updating the plan.

Five-Year Update Preparation

During the fourth year after initial plan adoption, the Emergency Management Director will convene the Committee to begin preparations for an update of the plan, which will be required by the end of year five in order to maintain approved plan status with FEMA. The team will use the information from the annual meetings and the biannual progress reports to identify the needs and priorities for the plan update.

The measure of success of the Northfield Local Multi-Hazard Mitigation Plan will be the number of identified mitigation strategies implemented. In order for the Town to become more disaster resilient and better equipped to respond to natural disasters, there must be a coordinated effort between elected officials, appointed bodies, Town employees, regional and state agencies involved in disaster mitigation, and the general public.

As is the case with many Franklin County towns, Northfield's government relies on few public servants filling many roles, upon citizen volunteers and upon limited budgets. The implementation of the recommendations of this plan could be a challenge to the Committee. As the Committee meets regularly to assess progress, it should strive to identify shortfalls in staffing and funding and other issues which may hinder Plan implementation. The Committee should seek technical assistance from the Franklin Regional Council of Governments to help alleviate some of the staffing shortfalls. The Committee could also seek assistance and funding from sources listed in Table 5-1.

Table 5-1: Potential Funding Sources for Hazard Mitigation Plan Implementation

Funding Source	Description	Estimated Annual Funding
Hazard Mitigation Grant Program	Provides post-disaster funds to communities to help implement long-term hazard mitigation strategies.	$15M (from three past Presidential disaster declarations)
Flood Mitigation Assistance Program	Provides pre-disaster funds. There are three types of grants: planning grants, project grants, and technical assistance grants. Requires a 25% non-Federal match and is based on the total number of NFIP policies in the State.	$500,000
Community Development Block Grant	Although this funding comes from HUD, it is made available to communities through the State Economic and Community Development Administration. The grants are used to expand affordable housing and economic opportunities, and to revitalize communities by improving community facilities and services.	$2M
SBA Small Business Administration	Post-disaster low interest, long-term loans given to homeowners, renters, businesses, or private non-profit organizations. Up to 20% of the loan amount can be used for hazard mitigation actions.	$500,000 (based on past disasters)
State Office for Mitigation Funding	This newly created State Office was authorized by a recent act of the State Legislature. This Office will make funds available to local communities for hazard mitigation planning through an increase in the State's gasoline tax.	$5M
Manufactured Homebuilders Association	The State is interested in forming an agreement with this association to develop an earthquake-resistant homes campaign.	In-kind services
National Association of Homebuilders	The State is pursuing a relationship with this association and is discussing how the association can assist the State in promoting construction of safe rooms.	In-kind services

Incorporating the Plan into Existing Planning Mechanisms

Upon approval of the Northfield Multi-Hazard Mitigation Plan by FEMA, the Committee will provide all interested parties and implementing departments with a copy of the plan, with emphasis on the 2012 Northfield Local Multi-Hazard Mitigation Prioritized **Action Plan**. The Committee should also consider initiating a discussion with each department on how the plan can be integrated into that department's ongoing work.

The Committee acknowledges the importance of the Action Plan as a stand-alone document which will be distributed to all those cited as a Responsible Department or Board including:

- Emergency Management Director
- Police Department
- Town Administrator
- Select Board
- Board of Health
- Planning Board
- Fire Department
- Building Inspector
- Agricultural Commission

- Council on Aging
- Historical Commission
- Northfield Elementary School
- Pioneer Valley Regional School
- Board of Assessors
- Conservation Commission
- Highway Department

The 2005 Northfield Local Natural Hazard Mitigation Plan was not incorporated into existing planning mechanisms to the fullest extent possible. Below, is a list of several possible planning mechanisms that could benefit from integration of elements of the 2012 Local Multi-Hazard Mitigation Plan, including:

- Incorporation of relevant hazard mitigation information into the update of the town's current Open Space and Recreation Plan (OSRP). There are opportunities to discuss findings of the hazard mitigation plan and incorporate them into the Environmental Inventory and Analysis section of the OSRP and to include appropriate action items from the hazard mitigation plan in the OSRP Action Plan.
- Any future updates of the *Connecticut River Scenic Farm Byway Corridor Management Plan* could incorporate relevant material from this plan into sections such as the Natural Resources section and any action plans.
- When the Final Draft Local Multi-Hazard Mitigation Plan for the Town of Northfield is distributed to the Town boards for their review, a letter asking each board to endorse any action item that lists that board as a responsible party would help to encourage completion of action items.
- Each of the town boards and departments responsible for implementing actions listed in the Action Plan could include discussions of the action items they are responsible for in one meeting annually and assess their progress and report back to the Committee.
- The Planning Board could review the town's current Subdivision Rules and Regulations and Zoning Bylaws and consider the recommended revisions listed in this plan. Model bylaws and other technical assistance are available from the FRCOG to help the Planning Board update the town's current bylaws, as appropriate.

Continued Public Involvement

The Town of Northfield is dedicated to continued public involvement in the hazard mitigation planning and review process. During all phases of plan maintenance, the public will have the opportunity to provide feedback. The 2012 Plan will be maintained and available for review on the Town website through 2016. Individuals will have an opportunity to submit comments for the Plan update at any time. All meetings of the Committee are open to the public. This will provide the public an opportunity to express their concerns, opinions, or ideas about any updates/changes that are proposed to the Plan.

6 – APPENDIX

Appendix I: Northfield Zoning and Subdivision Rules and Regulations

Floodplain Overlay District

Northfield's zoning bylaws (Section 4.02.01) establish a Floodplain District as an overlay to all other districts. The purpose of the Floodplain District is to "ensure public safety through reducing the threats to life or personal injury; eliminate new hazards to emergency response officials; prevent the occurrence of public emergencies resulting from water quality, contamination, and pollution due to flooding; avoid the loss of utility services which if damaged by flooding would disrupt or shut down the utility network and impact regions of the community beyond the site of flooding; minimize costs associated with the response and cleanup of flooding conditions; and reduce damage to public and private property resulting from flooding waters."

(Section 4.02.03) Flood Plain District Boundaries and Base Flood Elevation and Floodway Data. The district includes all special flood hazard areas designated on the Northfield Flood Insurance Rate Map (FIRM) issued by the Federal Emergency Management Agency (FEMA) for the administration of the National Flood Insurance Program (NFIP) dated September 30, 1980 as Zone A, AE, AH, AO, A1-30 and the FEMA Flood Boundary & Floodway Map dated 6-19-79, both maps which indicate the 100-year regulatory floodplain. The exact boundaries of the district may be defined by the 100-year base flood elevations shown on the Flood Insurance Rate Map and further defined by the Flood Insurance Study booklet dated March, 1980."

Specifically, the bylaw requires that:

- (Section 4.02.03 Section B Part 1) Base Flood Elevation and Floodway Data. In Zone A, A1-30, and AE, along watercourses that have not had a regulatory floodway designated, the best available Federal, State, local, or other floodway data shall be used to prohibit encroachments in floodways which would result in any increase in flood levels within the community during the occurrence of the base flood discharge.
- (Section 4.02.03 Section B Part 2) Base Flood Elevation and Floodway Data. Within unnumbered A Zones, applicants seeking to develop subdivisions or other developments greater than either fifty lots or five acres shall submit base flood elevation data as specified above.

Flood Plain Overlay District Regulations (Chapter 6) provide regulations for the district.

- (Section 6.04.01) Within Zone A, where the base flood elevation is not provided on the Flood Insurance Rate Map, the building permit applicant shall provide base flood elevation data and it shall be reviewed by the Building Commissioner for its reasonable utilization toward meeting the elevation or flood-proofing requirements, as appropriate, of the State Building Code.
- (Section 6.04.02) Applicant shall notify the following agencies of any proposed alteration or relocation of a riverine watercourse: adjacent communities, bordering States, National Flood Insurance Program state coordinator at the Massachusetts Office of Water Resources; NFIP Program Specialist at the Federal Emergency Management Agency (FEMA) Region 1.
- (Section 6.04.03) All development in the district, including structural and non-structural activities, whether permitted by right or by special permit must be in compliance with Chapter 131, Section 40 of the Mass. Gen. Laws (Wetlands Protection Act) and with the following:

    - Wetlands Protection Regulations, Department of Environmental Protection (DEP) (Currently 310 CMR 10.00);
    - Section of the Massachusetts State Building Code which addresses floodplain and coastal high hazard areas (currently 780 CMR 2102.0, "Flood Resistant Construction");
    - Inland Wetlands Restriction, DEP (currently CMR 6.00); and,
    - Minimum requirements for the subsurface disposal of sanitary sewage, DEP (currently 310 CMR 15, Title 5).

- (Section 6.04.04) Within Zones AH and AO on the Flood Insurance Rate Map, adequate drainage paths shall be provided around structures on slopes in order to guide floodwaters around and away from proposed structures.
- (Section 6.04.05) In Zones A1-30 and AE, along watercourses that have a regulatory floodway designated on the Northfield Flood Insurance Rate Map or Flood Boundary and Floodway Map, encroachments are prohibited in the Regulatory Floodway which would result in any increase in flood levels within the community during the occurrence of the base flood discharge.
- (Section 6.04.06) All subdivision proposals located in the Floodplain District will be reviewed by the Planning Board to assure that: such proposals minimize flood damage; all public utilities and facilities are located and constructed to minimize or eliminate flood damage; adequate drainage is provided to reduce exposure to flood hazards; and existing contour intervals of the site and elevations of existing structures are included on plan proposal.
- (Section 6.04.07) The following uses are encouraged, provided that they are permitted in the underlying district, to minimize flood damage and obstructions to flood flows:

    - Agricultural uses such as farming grazing, truck farming, play areas, etc.;
    - Forestry and nursery uses;

- Outdoor recreational uses, including fishing, boating play areas, etc.;
- Conservation of water, plants, wildlife;
- Wildlife management areas, foot, bicycle, and/or horse paths;
- Temporary non-residential structures used in connection with fishing, growing, harvesting, storage, or sale of crops raised on the premises; and,
- Buildings lawfully existing prior to the adoption of these provisions.

○ (Section 6.04.08) In the floodway, designated on the Flood Boundary and Floodway Map; the following provisions shall apply:

- All encroachments, including fill, new construction, substantial improvements to existing structures and other development are prohibited unless certification by a registered professional engineer or architect is provided by the applicant demonstrating that such encroachment shall not result in any increase in flood levels during the occurrence of the 100-year flood.
- Any encroachment meeting the above standard shall comply with the floodplain requirements of the State Building Code.

Water Supply Protection District

The Northfield Zoning Regulations establish a Water Supply Protection Overlay District (Section 4.03) whose stated purpose is to preserve and maintain existing and potential groundwater and surface water resources within the Town. The Water Supply Protection Overlay District Regulations (Section 6.05) contain measures that are applicable to the control of flooding:

- (Section 6.05.02 e) A Special Permit is required for the construction of any building or structure intended for residence within one hundred horizontal feet on each side of the center line of any stream.
- (Section 6.05.02 f) A Special Permit is required for all grading or construction on slopes in excess of twenty-five (25) percent, and only provided that provisions have been made to prevent erosion, soil instability, uncontrolled surface water runoff, or other environmental degradation.

Site Plan Review

Northfield Zoning Regulations (Article X. Special Requirements for Specified Uses, Section 10.01) require Site Plan Review by the Planning Board for all industrial and commercial uses involving structures with 10,000 square feet or more of enclosed floor area; a lot containing 10 acres or more; or as required by other sections of the bylaw. In addition, the Zoning Board of Appeals may require Site Plan Review for any commercial or industrial use requiring a special permit. Included in the Site Plan Review requirements are measures that are applicable to the control of flooding:

- (Section 10.01.01) Site Plan Contents. Site plans shall be prepared by a registered architect, professional engineer, or a registered landscape architect and shall show present and proposed topography, existing and proposed surface water drainage and proposed landscaping features (vegetative and structural).
- (Section 10.01.04) Basis for Decision. In approving or disapproving a site plan, the Planning Board shall, as a minimum, take into consideration:

    - Preservation of Landscape. The plan shall minimize tree or vegetation removal, grade changes and intrusion into vistas from nearby public ways;
    - Open Space. Building location on the site plan shall avoid farmland, hilltops, steep slopes and wetland areas to the extent possible;
    - Surface Water Drainage. Any change in surface drainage shall not adversely affect neighboring properties and will not result in erosion or sedimentation.

Open Space

(Section 9.02) Open Space Residential Use. This section calls for a minimum of thirty-five (35) percent of the area of the land tract to be open space. "The open space may not include wetlands, water bodies, floodplains, slopes greater than twenty-five (25) percent, roadways, or land prohibited by legally enforceable restrictions, easements or covenants, or other constraints dictated by the Northfield Protective By-Law, Title 5, the Inland Wetlands Protection Act, and any other relevant law."

Removal of Natural Materials

Any disturbance of the land and existing topography has the potential to aggravate existing flooding problems or create new flooding potential. The Northfield Zoning Regulations (Article XI Section 11.01) regulates the removal of natural materials. "The removal of loam, earth, sand, mineral aggregate, stone or rock from a parcel of land hereafter shall require a special permit issued by the Zoning Board of Appeals in the manner described in Article VIII (Special Permit Guidelines) of this By-law, except where it is incidental to the construction of an approved building, routine farming operations or construction of roads within an approved subdivision. Any removal of such material for any use in excess of 50 cubic yards shall require a special permit." All such permits expire at the end of three (3) years, after which they may be renewed.

- (Section 11.01.01) Plan Required. Lays out the requirements for plans to undertake excavation of greater than two (2) acres of removal of natural materials, included in which are measures that are applicable to the control of flooding:

    - Present contour lines for the entire lot at five foot intervals;
    - Proposed contour lines for the lot at completion of excavation and proposed phasing of different areas for excavation and restoration;
    - All waterways, brooks, swamps and surface drainage patterns as existing and as to exist after excavation; and,
    - The height of the water table at its highest springtime elevation.

- (Section 11.01.02) Special Permit Conditions. As part of the conditions of the special permit for natural materials removal, the Zoning Board of Appeals has the following requirements:

    - Drainage to abutting properties shall not be changed due to the excavation of natural materials;
    - After topsoil is spread on the finished grade, approved vegetative cover shall be established according to plan;
    - No excavation shall take place less than 100 feet from the boundary of a public way or from any waterway; and,
    - No finish grade slopes shall exceed a grade of 2:1.

- (Section 11.03) Curb Cut. No curb cut shall be made or private drive connected to any town or county public way without the signed approval of the Superintendent of Streets. Existing road drainage shall not be altered and no additional surface drainage onto the public way shall be created.

- (Section 11.04) Erosion Control Regulations. On all construction sites, sufficient erosion control measures as necessary to prevent erosion of sand, soil or other sediment from moving onto abutting property shall be constructed or arranged. No construction shall result in a change in the natural surface drainage onto abutting property.

(Section 11.06) Telecommunications. "The purpose of this By-law is to establish appropriate siting criteria and standards for communications towers and facilities…in order to minimize adverse visual impacts and maintain the residential character of the town, and preserve scenic views to and from the towns' roadways and waterways." The chapter requires that such facilities should be set back from property lines at a distance at least equal to 150% of the height of the tower, all towers should be at least 500 feet away from any residential building, that the maximum height of such towers should be no more than 120 feet from natural ground level. The bylaw requires a special permit from the Planning Board before such a facility can be erected.

Temporary Mobile Homes

According to the Town of Northfield Zoning Bylaws, the owner of a residence under construction may apply for a Special Permit to locate and inhabit a camper or mobile home on a lot where construction is taking place, for a period of nine (9) months or less, with proper sanitary and water systems. The owner or occupier of a residence destroyed by fire or other natural holocaust can apply for a permit from the Building Inspector and a permit from the Board of Health to place a mobile home on the site of the residence for a period of twelve (12) months or less while the residence is being rebuilt.

Subdivision Rules and Regulations

Northfield's Subdivision Rules and Regulations were adopted for the purpose of "protecting the safety, convenience and welfare of the inhabitants of the cities and towns in which it is put into effect by regulating the laying out and constructing of ways with subdivisions that provide access to lots therein, but which have not become public ways, and ensuring sanitary conditions in subdivisions, and in proper cases, parks and open areas." The powers of the planning board shall be exercised to secure safety in the case of fire, flood, panic and other emergencies. The Subdivision Rules and Regulations contain several provisions that mitigate the potential for flooding, including,

- (Section 3-6) Definitive Plan – Contents. Requires the proponent, in part, to identify:
    - Existing and proposed lines of streets, ways, lots, easements, waterways and public or common areas within the subdivision;
    - Any storm drainage system, existing or proposed. Drainage calculations, prepared by the applicant's engineer, shall include design criteria, drainage area(s) and all information necessary to enable the Board to check the size of any proposed drain, culvert or bridge. The plan shall invert and rim elevations of all manholes and catchbasins within the subdivision at 100- foot intervals. Surface elevation and approximate depth of water shall be given for manholes, catch basins and at any point where a drainage structure discharges into a waterway.
    - Water courses, marshes, flood plains, wetland resource areas, rock outcroppings, trees of over 20 inches in diameter, and other significant natural and historical features.
    - Location of street paving, all utilities, gutters, storm drainage lines, all easements and fire hydrants (if any).

- (Section 4-1) Performance Guarantee – Method. Before approval of a Definitive Plan, the subdivider shall either file a performance bond, or deposit money or negotiable securities in an amount determined by the Board to be sufficient to cover the cost plus ten percent of all or any part of the improvements (including stormwater drainage) specified in Section 6 Required Improvements of the Town of Northfield Subdivision Regulations, or follow the following procedure. Refund of the Bond shall be contingent on the completion of improvements, including a stormwater drainage system within two (2) years of date of bond or deposit. If the Board determines that said improvements have been completed as required, and that all costs due the Town have been paid, and recording requirements have been met, it shall release the interest of the Town in the bond. Approval with a covenant may be chosen as an alternate to the bond or deposit. Such covenant would provide that no lot be built upon or sold until all required improvements are completed and approved.

- (Section 5-11) Design Standards – Watercourses. Streams and watercourses may not be displaced from their natural courses and/or into open or covered culverts without the approval of the Northfield Conservation Commission and the Massachusetts Department of Environmental Protection (DEP).

- (Section 5-14 c) Design Standards – Protection of Natural Features. Should a proposed subdivision be adjacent to or include within its boundaries a wetland, flood plain or inland water, the applicant is directed to the Wetlands Protection Act. Further, anyone planning to remove, fill or dredge any bank, flat, marsh, meadow or swamp bordering an inland waterway is required to give written notice of intent to the Northfield Conservation Commission and the Massachusetts Department of Environmental Protection (DEP).

- (Section 6-10) Required Improvements – Drainage.

    - Storm drains, culverts and related installations, including catch basins, paved gutters and manholes, shall be installed within the subdivision as necessary to permit the unimpeded flow of all natural water courses, to insure adequate drainage of all streets, and to intercept storm water along streets at intervals reasonably related to the extent and grade of the area drained. Such installations shall be designed using a twenty (20) year storm basis for storm sewers, and a fifty (50) year storm basis for culverts. No storm sewers shall be under twelve (12) inches in diameter.
    - Where there is property adjacent to the subdivision, within the same watershed, provisions shall be made for proper protection of all properties by providing adequate drainage.
    - Where a subdivision is traversed by a watercourse, drainage way or stream, the Board may require that there be provided an appropriate easement of adequate width to conform substantially to the lines of such water course, drainage way or stream at 100-year flood elevation.

Water Supply Protection District

The Northfield Zoning Regulations establish a Water Supply Protection Overlay District (Section 4.03) whose stated purpose is to preserve and maintain existing and potential groundwater and surface water resources within the Town. The Water Supply Protection Overlay District Regulations (Section 6.05) contain measures that are applicable to the control of landslides:

- (Section 6.05.02 e) A Special Permit is required for the construction of any building or structure intended for residence within one hundred horizontal feet on each side of the center line of any stream.
- (Section 6.05.02 f) A Special Permit is required for all grading or construction on slopes in excess of twenty-five (25) percent, and only provided that provisions have been made to prevent erosion, soil instability, uncontrolled surface water runoff, or other environmental degradation.

Site Plan Review

Northfield Zoning Regulations (Article X. Special Requirements for Specified Uses, Section 10.01) require Site Plan Review by the Planning Board for all industrial and commercial uses involving structures with 10,000 square feet or more of enclosed floor area; a lot containing 10 acres or more; or as required by other sections of the bylaw. In addition, the Zoning Board of Appeals may require Site Plan Review for any commercial or industrial use requiring a special permit. Included in the Site Plan Review requirements are measures that are applicable to the control of landslides:

- (Section 10.01.01) Site Plan Contents. Site plans shall be prepared by a registered architect, professional engineer, or a registered landscape architect and shall show present and proposed topography, existing and proposed surface water drainage and proposed landscaping features (vegetative and structural).
- (Section 10.01.04) Basis for Decision. In approving or disapproving a site plan, the Planning Board shall, as a minimum, take into consideration:

    - Preservation of Landscape. The plan shall minimize tree or vegetation removal, grade changes and intrusion into vistas from nearby public ways;
    - Open Space. Building location on the site plan shall avoid farmland, hilltops, steep slopes and wetland areas to the extent possible;
    - Surface Water Drainage. Any change in surface drainage shall not adversely affect neighboring properties and will not result in erosion or sedimentation.

Removal of Natural Materials

Any disturbance of the land and existing topography has the potential to create landslide conditions. The Northfield Zoning Regulations (Article XI Section 11.01) regulates the removal of natural materials. "The removal of loam, earth, sand, mineral aggregate, stone or rock from a parcel of land hereafter shall require a special permit issued by the Zoning Board of Appeals in the manner described in Article VIII (Special Permit Guidelines) of this By-law, except where it is incidental to the construction of an approved building, routine farming operations or construction of roads within an approved subdivision. Any removal of such material for any use in excess of 50 cubic yards shall require a special permit." All such permits expire at the end of three (3) years, after which they may be renewed.

- (Section 11.01.01) Plan Required. Lays out the requirements for plans to undertake excavation of greater than two (2) acres of removal of natural materials, included in which are measures that are applicable to the control of landslides:

    - Present contour lines for the entire lot at five foot intervals;
    - Proposed contour lines for the lot at completion of excavation and proposed phasing of different areas for excavation and restoration;
    - All waterways, brooks, swamps and surface drainage patterns as existing and as to exist after excavation; and,

- The height of the water table at its highest springtime elevation.

- (Section 11.01.02) Special Permit Conditions. As part of the conditions of the special permit for natural materials removal, the Zoning Board of Appeals has the following requirements:

    - Drainage to abutting properties shall not be changed due to the excavation of natural materials;
    - After topsoil is spread on the finished grade, approved vegetative cover shall be established according to plan;
    - No excavation shall take place less than 100 feet from the boundary of a public way or from any waterway; and,
    - No finish grade slopes shall exceed a grade of 2:1.

- (Section 11.04) Erosion Control Regulations. On all construction sites, sufficient erosion control measures as necessary to prevent erosion of sand, soil or other sediment from moving onto abutting property shall be constructed or arranged. No construction shall result in a change in the natural surface drainage onto abutting property.

Subdivision Rules and Regulations

Northfield's Subdivision Rules and Regulations were adopted for the purpose of "protecting the safety, convenience and welfare of the inhabitants of the cities and towns in which it is put into effect by regulating the laying out and constructing of ways with subdivisions that provide access to lots therein, but which have not become public ways, and ensuring sanitary conditions in subdivisions, and in proper cases, parks and open areas." The powers of the planning board shall be exercised to secure safety in the case of fire, flood, panic and other emergencies. The Subdivision Rules and Regulations contain several provisions that mitigate the potential for landslides, including,

- (Section 3-6) Definitive Plan – Contents. Requires the proponent, in part, to identify:

    - Existing and proposed lines of streets, ways, lots, easements, waterways and public or common areas within the subdivision;
    - Any storm drainage system, existing or proposed. Drainage calculations, prepared by the applicant's engineer, shall include design criteria, drainage area(s) and all information necessary to enable the Board to check the size of any proposed drain, culvert or bridge. The plan shall invert and rim elevations of all manholes and catchbasins within the subdivision at 100- foot intervals. Surface elevation and approximate depth of water shall be given for manholes, catch basins and at any point where a drainage structure discharges into a waterway.

  - Water courses, marshes, flood plains, wetland resource areas, rock outcroppings, trees of over 20 inches in diameter, and other significant natural and historical features.
  - Location of street paving, all utilities, gutters, storm drainage lines, all easements and fire hydrants (if any).

- (Section 5-11) Design Standards – Watercourses. Streams and watercourses may not be displaced from their natural courses and/or into open or covered culverts without the approval of the Northfield Conservation Commission and the Massachusetts Department of Environmental Protection (DEP).

- (Section 5-14 c) Design Standards – Protection of Natural Features. Should a proposed subdivision be adjacent to or include within its boundaries a wetland, flood plain or inland water, the applicant is directed to the Wetlands Protection Act. Further, anyone planning to remove, fill or dredge any bank, flat, marsh, meadow or swamp bordering an inland waterway is required to give written notice of intent to the Northfield Conservation Commission and the Massachusetts Department of Environmental Protection (DEP).

- (Section 6-10) Required Improvements – Drainage.

  - Storm drains, culverts and related installations, including catch basins, paved gutters and manholes, shall be installed within the subdivision as necessary to permit the unimpeded flow of all natural water courses, to insure adequate drainage of all streets, and to intercept storm water along streets at intervals reasonably related to the extent and grade of the area drained. Such installations shall be designed using a twenty (20) year storm basis for storm sewers, and a fifty (50) year storm basis for culverts. No storm sewers shall be under twelve (12) inches in diameter.
  - Where there is property adjacent to the subdivision, within the same watershed, provisions shall be made for proper protection of all properties by providing adequate drainage.
  - Where a subdivision is traversed by a watercourse, drainage way or stream, the Board may require that there be provided an appropriate easement of adequate width to conform substantially to the lines of such water course, drainage way or stream at 100-year flood elevation.

Appendix II: Northfield Select Board Approval Memorandum

Appendix III: Meeting Agendas, Sign In Sheets, Publicity, and Committee Correspondence

AGENDA

Town of Northfield
Multi-Hazard Mitigation Planning Committee
Initial Meeting
Northfield Town Hall
September 8, 2011
1-2:30 p.m.

1. Introductions – Tom Hutcheson
2. Purpose of a Multi-Hazard Mitigation Plan – Mary Praus, FRCOG
3. All Hazards Risk Assessment – Committee and Mary Praus
4. Outstanding Questions – Committee and Mary Praus
5. Next Steps – Mary Praus

MEMA Multi-Hazards Mitigation Project

Northfield Meeting

Attendance Sheet for Thursday, September 8, 2011

Name	Email Address/Phone	Affiliation
Bob MacEwen	bobatnfld@hotmail.com	Both
Leonard Crossman	police@townnfld.com	Police
Kathy Wright	kawright40@comcast.net	Selectboard
Steven J. Hutchins	admin@townnfld.com	Town Administrator
Alyssa Larose	alarose@frcog.org	FRCOG

AGENDA

Town of Northfield
Multi-Hazard Mitigation Planning Committee
Final Meeting
Northfield Town Hall
February 13, 2012
6 – 8 p.m.

1. Introductions – Tom Hutcheson

2. Review of the Committee Memo and collection of remaining information – Committee and Alyssa Larose, FRCOG

3. Review of Section 4: Current Mitigation Measures tables – Committee and Alyssa Larose, FRCOG

4. Review of Section 4: 2012 Action Plan – Committee and Alyssa Larose, FRCOG

5. Next Steps – Alyssa Larose

MEMA Multi-Hazards Mitigation Project

Northfield Meeting

Attendance Sheet for Thursday, February 16, 2012

Name	Email Address/Phone	Affiliation
Tom Hutcheson	admin@townofnfld.com / 413-498-2901 x15	Town of Northfield
Kathy Wright	kwright40@Comcast.net / 413-498-2101	BOS
Lee Crossman	police@townofnfld.com 413-498-5128	Police Dept.
Bob MacEwen	bob2atnfld@gmail.com 978-906-3136	BOH
Skip Dunnell	sdunnell@sandri.com	FIRE CHIEF
Alyssa Larose	alarose@frcog.org 413-774-1194 x120	FRCOG

Final Meeting Scheduled for Updating Northfield's Multi-Hazard Mitigation Plan

The Northfield Local Multi-Hazard Mitigation Planning Committee, in partnership with the Franklin Regional Council of Governments (FRCOG) Planning Department, is in the process of updating the Northfield hazard mitigation plan. Funding for the update has been provided through a grant from the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA). The next steps in the process are to hold a final meeting of the Committee to finalize the plan, provide a public comment period, and seek approval from the Federal Emergency Management Administration (FEMA).

Once the updated Plan is approved by FEMA and adopted by the Town, Northfield will be eligible for state and federal grant monies to fund pre- and post-disaster mitigation projects to reduce the impact of future natural and man-made disasters. These funds are co-administered on behalf of FEMA by MEMA and the Department of Conservation and Recreation (DCR). The Plan can also help communities obtain credit in the form of reduced flood insurance premiums for policy holders under the National Flood Insurance Program (NFIP) Community Rating System, or CRS.

The final meeting of the Committee will be held on Thursday, February 16, at 6 p.m. at the Northfield Town Hall, located at 69 Main Street, Northfield. All meetings of the Committee are open to the public; meeting notices and agendas can be found at the Town Hall, and on the town website at www.northfield.ma.us. The draft plan is expected to be ready for public review in late February and will be made available at the Town Hall and at the Northfield Public Library located at 115 Main Street, Northfield.

The update of the multi-hazard mitigation plan has included identifying hazards that may impact the community, such as floods, winter storms, and spills of hazardous substances; conducting a risk assessment to identify infrastructure at the highest risk for being damaged by hazards; inventorying and assessing current Town hazard mitigation policies, programs, and regulations; and identifying action steps to prevent damage to property and loss of life. The planning process has also provided opportunities for public comment and included the review and incorporation of existing relevant documentation.

For additional information, please contact Tom Hutcheson, Town Administrator, at 413-498-2901, ext. 15 or admin@townnfld.com, or Alyssa Larose, FRCOG Land Use Planner at (413) 774-1194 x120 or alarose@frcog.org.

2012 Northfield Multi-Hazard Mitigation Plan update
Committee Memo 1-17-2012

Section 2

Page 6: Is the majority of new residential development still occurring on agricultural land in the south of Town on and near River View Drive and in West Northfield, along and near West Northfield Road? If not, where is it occurring?

Page 7: Has the West Northfield Water District been established and has a water distribution system been established?

Section 3

List mitigation projects for any of the hazards in this section.

Page 13: List impacts from Tropical Storm Irene including location of any flooding, structures impacted and estimated costs to town. Email any flooding photos if available.

Page15: List impacts from the 2008 ice storm, and the 2011 October snow storm, such as power outages, shelters opened, costs to town.

Page 15: Provide list of any other notable winter storms that caused severe impacts to the Town including costs if available.

Page 18: Have there been any wildfires that have encompassed more than a few acres and/or cost the town a substantial amount of money in the last several years? If so, please list location, size and costs.

Page 22: Have there been any dam failures in town?

Page 22: Does the Committee still feel the Nelson Mills Pond Dam should be rated as a high hazard dam?

Page 22: Has an inspection been completed of this Dam since 1988? Is inundation mapping available?

Page 23: Are there any chronic issues with beaver dams? If so, what are the locations, size of impoundments and mitigation actions taken? Any costs to the town?

Page 26: Have there been any mudslides / landslides in town or any areas of significant erosion which may result in landslides?

Page 48: Has there been any property damage, injuries or death due to wildfire or brushfire since 2004?

Page 61-63: Review the results of the **All Hazards Vulnerability Assessment** that was completed at the last committee meeting on September 8, 2011.

Section 4

Page 67-68: Since the last hazard mitigation plan, has the Town further restricted new development on agricultural land in the south of Town on and near River View Drive and in West Northfield, along and near West Northfield Road, that is within or adjacent to the floodplain?

Page 93: Does the Town have a back-up water supply sources or agreements with other towns to supply water in the event the existing distribution system is damaged due to an earthquake or other event?

Page 93: Do the designated shelters in town have supplies of bottled water?

Page 71-105: Review the **Existing Mitigation Measures** tables for each hazard, and fill in whether changes suggested in the 2005 plan were accomplished, and if not, are still relevant. Make note of any additional changes that are needed that could be added to the Action Plan.

Page 109-113: Review the **Action Plan**. Make note of any actions that have been completed, and add any new actions that should be considered by the committee.

Appendix IV: Four Mile Brook Watershed Management Action Plan

Table 3-1 Four Mile Brook Watershed Management Action Plan

Watershed Issue	Recommended Actions	Priority for Implementation	Participants	Potential Funding Sources	Timeframe for Implementation
B.1. Road Runoff and Sedimentation at Priority Road Crossing Locations	1. Implement the recommended stormwater Best Management Practices (BMPs) at the six priority sites.	**High**	Town of Northfield Select Board, Northfield Highway Department, Conservation Commission and the Four Mile Brook Watershed Advisory Committee; affected landowners; Franklin Regional Council of Governments (FRCOG) staff.	Chapter 90 funds, s.319 grant program.	Within 2 years. Next s.319 funding cycle is Spring 2009. If awarded a grant, the funds would be available to the Town in early 2010.
B.2. High Hazard Areas	1. Implement the recommended designs at the High Hazard Areas.	**High**	Town of Northfield Select Board, Northfield Highway Department, Conservation Commission and the Four Mile Brook Watershed Advisory Committee; affected landowners; MA DEP; FRCOG staff.	s.319 grant program; other funding sources to be explored.	Within 2 – 4 years. Next s.319 funding cycle is Spring 2009 and annually each Spring thereafter. If awarded a grant, the funds would be available to the Town in early 2010.
B.3. Unpaved Road Maintenance Best Management Practices	1. Implement the recommended BMPs for the identified problem areas along Four Mile Brook Road.	**High**	Town of Northfield Select Board, Northfield Highway Department, Conservation Commission and the Four Mile Brook Watershed Advisory Committee; affected landowners; FRCOG staff.	Chapter 90 funds, s.319 grant program.	Within 2 years. Next s.319 funding cycle is Spring 2009. If awarded a grant, the funds would be available to the Town in early 2010.
	2. Provide training on the use of the Massachusetts Unpaved Roads BMP Manual.	**High**	Massachusetts Tri-County Highway Superintendents Association; FRCOG staff; Town of Northfield Highway Department Staff; Northfield Conservation Commission	If necessary, funding sources will be investigated.	Within 1 – 2 years.
B.4. Impacted Riparian Buffers	1. Organize a workshop to provide information, including BMPs and sources of funding and technical assistance, to riparian landowners on the importance of maintaining or restoring vegetated riparian buffers. See Appendix E for sources of available information. 2. Prepare a brief riparian buffer fact sheet that includes information on the importance of maintaining or restoring native vegetated riparian buffers, including sources of information for BMPs and sources of funding and technical assistance. Send this fact sheet to landowners in the watershed.	**Medium**	FRCOG staff; Natural Resources Conservation Service (NRCS), Franklin Conservation District (FCD); Northfield Conservation Commission; affected landowners; watershed residents, stakeholders and volunteers.	s.319 grant program; Riverways Small Watershed Grants; other state and private grant programs to be investigated. In-kind services.	Within the next 5 years.

Table 3-1 Four Mile Brook Watershed Management Action Plan

Watershed Issue	Recommended Actions	Priority for Implementation	Participants	Potential Funding Sources	Timeframe for Implementation
	Fact sheet could be mailed with their tax bill. See Appendix E for sources of available information. 3. Organize a riparian buffer planting project like the one implemented by the Four Mile Brook Watershed Association. Focus efforts on Reach 2, where the banks are sparsely vegetated and the buffer is narrow.				
B.5. Managing Development to Reduce Stormwater Runoff	1. Organize a workshop series for the Northfield Conservation Commission, Highway Department and Planning Board to discuss the various sources of stormwater runoff, the impacts of stormwater runoff on water quality and the resources available to local boards to help them regulate land use activities that generate stormwater runoff. Workshop topics should include: a. An introduction to the revised the *Stormwater Management Standards* and *Massachusetts Stormwater Handbook* (February 2008).[8] b. An introduction and training to use the on-line *Clean Water Toolkit – Massachusetts Nonpoint Source Pollution Management Manual*.[9] If town boards do not have easy access to high speed internet, CD-ROM copies of the Toolkit can be distributed. c. An introduction to Low Impact Development (LID) and the LID Toolkit, which is available on CD-ROM and via the Internet.[10] 2. Develop a Fact Sheet for current and future landowners in the watershed that describes the watershed issues/concerns with respect to development and lists sources of information and tips for reducing the "environmental footprint" of new and existing development. This fact sheet can be mailed with the tax bill. Examples of available LID Fact Sheets are included in Appendix F.	**Medium**	Northfield Conservation Commission and Planning Board; FRCOG staff; MA DEP; MA Executive Office of Energy and Environmental Affairs.	s.319 grant program; other funding sources to be investigated.	Within the next 2 – 4 years.

[8] http://www.mass.gov/dep/water/laws/policies.htm#storm
[9] http://projects.geosyntec.com/NPSManual/
[10] http://mapc.org/LID.html