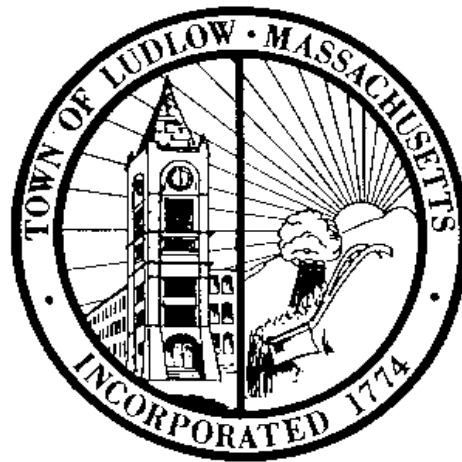


THE TOWN OF LUDLOW, MA

LOCAL NATURAL HAZARDS

MITIGATION PLAN

February 8, 2008



Adopted by the Ludlow Board of Selectmen on Tuesday, February 12, 2008

Prepared by:
The Ludlow Local Emergency Planning Committee

and

The Pioneer Valley Planning Commission

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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, hurricanes, wildfires, earthquakes, dam failure, etc. 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 Ludlow and the Pioneer Valley Planning Commission (PVPC), 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 Local Natural Hazards 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. FEMA requires that a community adopt a pre-disaster mitigation plan as a condition for mitigation funding. For example, the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), and the Pre-Disaster Mitigation Program are programs with this requirement.

Planning Process

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

- Reviewing and incorporating existing plans and other information (Appendix B lists documents consulted)
- Identifying the natural hazards that may impact the community.
- Conducting 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.
- Identifying and assessing 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;
 - Implementing recommendations in existing planning documents including Stormwater Management Plans, Master Plans, Open Space and Recreation Plans, and 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.
- Identifying deficiencies in the current strategies and establishing goals for updating, revising or adopting new strategies.
- Adopting and implementing the final Local Natural Hazards Mitigation Plan.

During the planning process, the Town’s Local Emergency Planning Committee identified Action Plan items and specific time frames. The actions were selected from a list of local strategies which were compiled by the regional LEPC during several brainstorming sessions (see Regional Natural Hazard Mitigation Plan Risk Assessment Matrix – Section 3: Risk Assessment) and others identified by the Town during their review of existing programs, policies, and regulations. From this list, specific Action Items were prioritized by the Town’s Local Emergency Planning Committee based on the following criteria:

- Select Action Items which have the ability to significantly mitigate the negative impact of natural hazards on people and property;
- Select Action items which the Town has the ability to implement given the financial and staff resources available;
- Select Action Items which will have the greatest influence on achieving Local Goals & Objectives;
- Select a diverse set of Action Items which will address different Natural Hazards that present a high or moderate risk to the region; and
- Select Action items which will address those mitigation measures identified as deficient or in need of attention to ensure that the Town is in the best possible position to address natural hazards which impact property and residents.

The action items selected were all considered to have a low to moderate cost to implement. In some cases grant funding would be sought for implementation given the limited resources available in the Town.

The local action items represent a multi-faceted approach to addressing natural hazards in the Town and will be undertaken as resources become available and will be integrated into ongoing planning activities. As part of the review and adoption process, the Committee approved the action items that were in keeping with the goals and criteria established by the Town and assigned appropriate bodies within the Town to implement them within a five-year framework.

Public Committee Meetings

The Town posted agendas for public notice in advance of all meetings. (Appendix B) In addition, a mailing was made to each committee member, prior to each meeting that contained information from the previous meeting, an agenda sheet, and information to be covered.

Public meetings of the planning committee were all held at the Ludlow Fire Station on the following dates:

November 16, 2006, 3:00-5:00 pm: Informational and organizational meeting with

Ludlow Emergency Planning Committee.

December 14, 2006, 3:00-5:00 pm: Working committee meeting

January 18, 2007, 3:00-4:30 pm: Working committee meeting

February 15, 2007, 3:00-4:30 pm: Working committee meeting

March 16, 2007, 3:00-4:30 pm: Working committee meeting

October 18, 2007, 3:00-4:30: Review of FEMA comments with Ludlow Emergency Planning Committee

November 15, 2007, 3:00-4:30: Review of changes to plan and discuss date for resubmitting to FEMA

The draft plan was posted for public comment on the web (PVPC's website with a link from the Town of Ludlow's website). PVPC publicized the availability of plans for public comment on the web through an article in the Sunday, September 23, 2007 issue of *The Republican*. (Appendix B)

Public Meetings with the Board of Selectmen

January 26, 2005: The Board of Selectmen agreed to begin the process of developing a Local Hazard Mitigation Plan.

February 12, 2008: The Board of Selectmen adopted the Local Hazard Mitigation Plan. Meeting held at Ludlow Town Offices.

Involvement of neighboring communities

Neighboring communities have been notified of the opportunity to comment on the draft Hazard Mitigation Plan through the article in the Sunday, September 23, 2007 issue of *The Republican*. In addition, PVPC is scheduled to meet with the Western Regional Homeland Security Advisory Council on November 20, 2007, to further promote regional review of plans. Members of the Local Emergency Planning Committee emphasized that they should review any comments before incorporation into the plan.

2 – LOCAL PROFILE¹

Community Setting

Ludlow is situated along the northeastern border of Springfield, in Hampden County, on the western edges of the uplands in central Massachusetts. The towns of Palmer and Belchertown form the eastern border, the westerly flowing Chicopee River forms the southern border with the town of Wilbraham, the town of Granby forms the northern border, and the town of Chicopee and city of Springfield both form the western border.

Settled in 1775, the town developed around the Ludlow Manufacturing Company which produced jute for twine for the U.S. Postal Service. The former mill and manufacturing company, marked by a traditional old clock tower, is situated along the banks of the Chicopee River. The waves of immigrants that moved from Scotland, Ireland, Poland, and Portugal to work in the mills contribute to Ludlow's current ethnic flavor. The Our Lady of Famita Festival is one of the Pioneer Valley's largest ethnic celebrations. The historic town center of Ludlow, with its First Church, established in 1774, and First Meeting house, offers a glimpse into Ludlow's past.

Ludlow is proximate to the employment centers of Chicopee and Springfield, and provides easy access to the Massachusetts Turnpike (Interstate 90) and Interstate 291. Route 21 (Center Street) is the main artery through town, running diagonally from the northeastern corner of town to the southwestern corner, where it provides access to I-90. I-90 runs through the entire southern edge of town.

The town is a part of the Chicopee River Watershed Basin. The Chicopee River, along the southern border of town, and the Springfield reservoir, located in the northeastern corner of town, are the town's two major bodies of water. The total land area of Ludlow is approximately 18,184 acres. The majority of its land is either undeveloped (56%) or residential (22%).

Located among the pleasant rolling hills, Ludlow has changed from a mill town to a desirable residential community. The numbers of its residents has steadily climbed during recent decades. Since 1990, its population has increased by 13% to 21,209. Ludlow has a population density of 781 people per square mile and is one of the more densely settled communities in its sub-region of the Pioneer Valley. Its residential neighborhoods of single- and two-family homes are growing. Interestingly, almost one quarter of the housing units are rentals.

While it is a residential community, Ludlow is more than a bedroom community. It has an established factory district, an outlet mall, and along with neighboring Chicopee, it is home to the Westover Industrial Park. Ludlow is also the site of the new Hampden County Jail. Recreational opportunities are provided at Memorial Park, Memorial Field, and a state pool which was the first indoor swimming pool in Western Massachusetts. There is a town beach at Haviland Pond.

¹ The majority of the information for this section was obtained from: Ludlow Open Space Plan; www.mass.info/ludlow.ma/description; and PVPC's Ludlow Community Profile.

Infrastructure

Ludlow's history and geography have been major factors in the development of the town's infrastructure. Key factors that have played a role in the development of town are the manufacturing industry along the Chicopee River, and the construction of the Springfield Reservoir, I-90, and the Westover Air Force Base. With a growing residential population, Ludlow's infrastructure has more recently developed within these core areas.

Roads and Highways

The major artery running through town is Route 21, or Central Street. It travels diagonally from the northwest corner of Ludlow to the southeast corner, where it provides access to I-90 at Interchange 7. The majority of Ludlow's road network is concentrated in the southwestern corner of town, allowing access to the interstate, Springfield, and Chicopee, as well as the industrial park on the Westover Air Force Base.

Other key thoroughfares include Fuller Street, West Street, Holyoke Street, Lyons Street, Cady Street, Chapin Street, East Street, and Miller Street.

Rail

There are no active rail lines running through Ludlow, although there is one federal line which is currently out of service. In addition, the CSX rail line runs just beyond the city limits. It is a well-used line, accommodating over thirty trains per day, both freight and passenger rail.

Public Transportation

Ludlow is served by the Pioneer Valley Transit Authority (PVTA), both with regular bus service and paratransit service. Bus service is somewhat limited throughout Ludlow, but provides commuting options to larger employment centers from a park-and-ride lot at Interchange 7 off of I-90. Paratransit, a door-to-door demand responsive van service, is provided in Ludlow by PVTA, through MV Transportation.

Public Drinking Water Supply

The Springfield Water and Sewer Commission provides water service to residents of Ludlow. The water originates at Borden Brook and Cobble Mountain Reservoirs in the towns of Blandford and Granville. It is filtered and disinfected at the West Parish Filters Treatment Plant in Westfield, and stored at a distribution reservoir on Provin Mountain, Agawam, which supplies Ludlow, as well as Springfield, Agawam, East Longmeadow, and Longmeadow. The Springfield Reservoir, located in the northeastern portion of Ludlow, is a reserve water supply.

Ludlow is also served by the Massachusetts Water Resources Authority (MWRA) through Wilbraham Water Department and South Hadley FD #1.

In addition, some residents in Ludlow rely on well water.

Sewer Service

Ludlow is served by public sewer, with wastewater treatment provided by Springfield Water and Sewer Commission. In addition, some residents rely on septic for sewage disposal.

Schools

Public schools serving Ludlow include Chapin Street Elementary, East Street Elementary, Veterans Park Elementary, Baird Middle School, Ludlow High School, as well as two pre-school programs - Early Childhood Partnership and the Integrated Preschool Program.

Natural Resources

Ludlow is blessed with a wide variety of landscapes and natural resources, from steep slopes along the Holyoke Range to the low, flat lands along the Chicopee River. Development has followed topographical cues, with much of the density along the southern edge of town. But working farms and pastureland are scattered throughout the land and reflect Ludlow's history as an agricultural community.

Topography

Ludlow's topography is characteristic of the valley region, transitioning from the gradually rolling meadows on the southern part of town to the steep slopes bordering the Holyoke Range. The western portion of the town consists of dry and marshy lowlands, while the eastern part of town has an average elevation of 400 – 650 feet.

There are two major area of extreme relief in Ludlow, Minnechoag Mountain, in the Ludlow State Park and Facing Rock, in Facing Rock Wildlife Management Area (WMA). Facing Rock WMA contains three hills over 450 feet in elevation; High Hill, Facing Rock, and Jefferson Peak. Small brooks and streams flow through these areas producing gentle stream valleys and occasional wetland areas.

Its lowest point lies in the central portion of Town, at an elevation of 230 feet. This is the location of the historic Ludlow Center. The Springfield Reservoir, the largest body of water in Ludlow, lies at an elevation of 373 feet. The highest point, in Ludlow State Park, is about 720 feet, located west of Tower Rd.

The areas of dense residential development have loose soil, are less rocky and gently sloping which is conducive to development. These soils are found in the southwestern quadrant of the Town, an area of residential and commercial uses. The areas north of the Chicopee River and towards the Massachusetts Turnpike are extremely flat and dry, but are broken up occasionally by wetlands and large ponds along Minechoag Brook. Little open space exists in the southern part of town, with the exception of the Ludlow Country Club, straddling the Minechoag Brook.

The remainder of the land in Ludlow is undeveloped, agricultural lands, located in the eastern half of town. This area is dominated by steep slopes, upland hills, dense forest, and large glacial rocks. The eastern part of town is primarily open spaces, like woodlands, open meadow, and farmland, but is slowly being developed.

Water Resources

Wetlands and bodies of water comprise approximately 8,817 acres of Ludlow's 18,000 acres of total landmass. Water resources are essential to residents. Waterways in Ludlow have had a large influence on development and recreation. The first settlers in Ludlow harnessed the power of water to run the mill industry for almost 100 years. The Town of Ludlow owns a beach along the shore of Haviland Pond. This beach hosts many sports and activities throughout the year.

There are several protected water supply areas in town, however only one is open for public passive recreation. The Town has a Pond Management Committee comprised of fifteen (15) volunteers who are all trained in water testing procedures and equipped with test kits.

Watershed

The Chicopee River carves the southern border of Ludlow from Palmer through the southeastern corner of Town and continues west to Springfield and Wilbraham. The Chicopee River is 17 miles long and has numerous small tributaries which travel south through the town. Among these are Broad Brook, Higher Brook, Minechoag Brook, Harris Brook and St Brook. The Chicopee River Basin, with an area of 721 square miles, is the second largest in Massachusetts and makes up the largest tributary area to the Connecticut River. The average flow of the Chicopee River is 900 cubic feet per second, or about 581,644,800 gallons per day.

Water Bodies

The Springfield Reservoir is the largest body of water in Ludlow. This water resource is not currently being utilized for public drinking water, but as a reserve water supply. Ludlow residents are presently being serviced with water from Cobble Mountain in Westfield. A series of aqueducts connect the Reservoir to other sections of Town. Springfield Reservoir has several areas in which passive recreation is encouraged.

Nash Hill Reservoir located south of Nash Hill Road is connected by an aqueduct to Ludlow Center. This parcel, owned by the Massachusetts Departments of Conservation and Recreation is approximately 40 acres. Recreation is not encouraged on this land due to the level of resource protection.

Numerous small ponds are scattered throughout the Town of Ludlow. Alden Pond, Lyon Pond, and Second Pond are located in the central and northern areas of Town. Harris Pond, Murphy Pond, Gamache Pond, Pickerell Pond, Wood Pond, Haviland Pond, and Minnechoag Pond are located in the southern half of Town. Haviland Pond, Lyon Pond, and Minnechoag Pond, are the three largest ponds in town. They all have depths in excess of 200 feet, while the other ponds in Ludlow are shallower.

Major Rivers and Streams

The Chicopee River, forming the southern boundary of Ludlow, is a key water resource and component of the topography. In addition, several smaller tributary streams and brooks traverse the town, including Higher Brook, Harris Brook, Minnechoag Brook, Broad Brook, and Stony Brook.

Wetlands

Fairly extensive wetlands are located throughout the town. Two of the largest areas are located in Westover Wildlife Area and along Second Pond and Minnechoag Brook. These wetland areas are important ecological areas, particularly for species of special concern. Many of these wetland areas are marked as potential vernal pools sites.

Flood Hazard Areas

The Town of Ludlow has several FEMA Q3 Flood Hazard areas identified. The Chicopee River, which creates the entire southern border of Town, sees a year swell every spring. Another flood prone area is the Westover Wildlife Management Area, which consists of several large wetlands

and ponds. FEMA data indicates that Ludlow is a member community of the National Flood Insurance Program and has FIRM date of 5/19/1981.

Forests

Portions of Ludlow are heavily forested with a mixture of hemlock, pine, oak, maple, and birch trees. There are significant climax forests consisting of generally even aged stands, which are punctuated by streams and ponds. The diversity of forests, wetlands and plant communities provide many excellent wildlife habitats.

An increase in subdivision development has altered the vegetation in many newly developed areas in Ludlow. Many of these developments are almost completely clear cut, in attempts to keep construction costs down. Because of this loss of the Town's urban trees, the Town worked to adopt a shade tree bylaw.

Development

Development Patterns

Several factors have played, and will continue to play, an important role in the development of Ludlow. These include: the existing development pattern and availability of land for future development; the present road network; physical factors such as steep slopes, poor soil conditions, land set aside for conservation, the Chicopee River, its tributaries and floodplains; and the availability of utilities such as public water and sanitary sewers. These factors have an impact, both individually and cumulatively, on where and how development occurs.

Zoning and other land use regulations constitute a town's "blueprint" for its future. Land use patterns over time will continue to look more and more like the town's zoning map until the town is finally "built out"—that is, there is no more developable land left. Therefore, in looking forward over time, it is critical that the town focus not on the current use and physical build-out today, but on the potential future uses and build-out that are allowed under the town's zoning map and zoning bylaws. Zoning is the primary land use tool that the town may use to manage development and direct growth to suitable and desired areas while also protecting critical resources and ensuring that development is in keeping with the town's character.

Ludlow has nine base zoning districts and three overlay districts. The base districts define the allowed uses and dimensional requirements in all parts of the town, while the overlay districts provide for additional restrictions in certain areas. These districts are described below.

Residential Districts - RA-1, RA, and RB: Areas of town which are best suited for low-density residential development; land uses and activities in keeping with the Town's rural character, primarily but not limited to farm and forest uses.

Business Districts - BA and BB: These district permits many types of offices, commercial, and retail businesses by special permit or site plan approval. BA is considered light commercial use, and BB is considered heavy commercial use.

Agricultural District – A: This district is spread throughout the majority of the town, especially north of Route 21, and permits land uses and activities in keeping with the Town's rural character, primarily but not limited to farm and forest uses and single family homes.

Industrial Districts - IA, IB, and IC: Areas of town which are best suited for manufacturing and industrial uses, as well as any use permitted in the Business District.

Ludlow's Overlay Districts further regulate land use within the community. These include:

Agriculture Moderate Density District - AMD: This overlay district establishes the locations where some business uses are allowed by special permit within the Agricultural District.

Aircraft Flight District – AF: This overlay district establishes the locations affected by the Westover Air Force Base and establishes additional prohibited uses.

Water Supply Protection District - WSP: This overlay district sets forth standards, rules and permitting procedure for uses that are located within the town's drinking water source recharge areas.

The Zoning Bylaw establishes a Site Plan Approval procedure for most business, industrial, and commercial buildings within the Town. Site Plan Review allows the Planning Board the ability to review the development proposal to ensure that the basic safety and welfare of the people of Ludlow are protected.

Current Development Trends

Today, this small community is home to approximately 21,209 residents. The majority of Ludlow's 18,184 acres is undeveloped forest and water, totaling nearly 12,000 acres. Agricultural land totaling 925 acres and residential land totaling 3,878 acres account for the majority of the remaining Town area. Commercial and industrially used land consists of approximately 500 acres, with public/urban open land contributing an additional 640 acres.

Currently, development in Ludlow is not sufficiently encouraged by existing zoning to seek areas where the infrastructure and environmental conditions support such development. Rather, Ludlow's existing zoning permits development, primarily subdivisions, across the entire town with no incentives for guiding that development to more suitable areas. As the Town has recently hired a full-time planner, more careful consideration will be made for better guiding development to suitable areas.

Development in Hazard Areas

Most of the hazards identified in this plan are regional risks and, as such, all new development falls into the hazard area. The exceptions to this are flooding and inundation in the event of a dam failure.

- According to current aerial photography, overlaid with FEMA Q3 Flood Insurance Rate Maps (FIRMs), there are approximately 167 structures within or

near the flood plain in Ludlow. According to the Community Information System (CIS) of FEMA, there were 30 structures located within the Special Flood Hazard Area (SFHA) in Ludlow as of November 20, 2003, the most current records in the CIS for the Town of Ludlow.

- For the high hazard dams, inundation zones are mapped as part of the Emergency Action Plans required of dam owners by the Commonwealth of Massachusetts. To date, an analysis of development trends in these inundation zones has not been conducted.

There are no restrictions on development that are articulated in terms of mitigating the other hazards. However, provisions within the Subdivision Rules and Regulations do in effect set limits that serve to mitigate the impacts of severe winter storms, hurricanes, wildfire and brushfires, earthquakes, drought, and man-made hazards:

- Grade limits on streets serve to minimize accident potential and power loss from severe winter storms (see page 62 for more detailed information);
- There are “height” limits in the dimensional requirements and in the subsection pertaining to wireless communications that reduce the incidence of problems during hurricanes and other high wind events. Requirements to place electrical transmission lines underground also reduce hazards during high winds (see page 66).
- Provisions within the subdivision and site plan review process, which involve a fire control plan, including a supplemental water supply, and review of the plan by the Ludlow Fire Department, serve to mitigate wildfire and brushfire hazards (see page 70).
- Requirements in the Subdivision Standards to place electrical transmission lines and gas transmission lines underground provide some mitigation of impacts from earthquakes (see page 73).
- Impacts from drought are mitigated through a zoning overlay district that protects the town’s water supply, including surface and groundwater resources (see page 80).
- Impacts from man-made hazards are mitigated to some extent through the Water Supply Protection District, which contains strong restrictions on uses, as well as regulations for the use and storage of hazardous materials (see page 85).

3 – HAZARD IDENTIFICATION & ANALYSIS

Natural Hazard Identification

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 Ludlow.

Floods

The average annual precipitation for Ludlow and surrounding areas in western Massachusetts is 47 inches. There are three major types of storms that bring precipitation to Ludlow. 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. Precipitation from coastal storms, also known as nor'easters, that travel into New England from the south constitute the second major storm type. In the late summer or early fall, the most severe type of these coastal storms, hurricanes, may reach Massachusetts 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 can be 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. Furthermore, flooding can be influenced by larger, global climate events. Global warming and climate change have the potential to shift current rainfall and storm patterns. Increased precipitation is a realistic result of global warming, and could potentially increase the frequency and intensity of flooding in the region. Currently, floods occur and are one of the most frequent and costly natural hazards in the United States.

Flash flooding events typically occur within minutes or a few 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 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 Chicopee 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.

The Town of Ludlow has several FEMA Q3 Flood Hazard areas identified. The Chicopee River, which creates the entire southern border of Town, sees a year swell every spring. Another flood prone area is the Westover Wildlife Management Area, which consists of several large wetlands and ponds.

Severe Snowstorms/Ice Storms

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 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.

New England generally experiences at least one or two severe winter storms each year with varying degrees of severity. Research on climate change indicates that there is great potential for stronger, more frequent storms as the global temperature increases. Severe winter storms typically occur during January and February; however, they can occur from late September through late April.

Hurricanes/Severe Thunderstorms

Hurricanes are violent rainstorms with strong winds that can reach speeds of up to 200 miles per hour, and large amounts of precipitation. Hurricanes generally occur between June and November and can result in flooding and wind damage to structures and above-ground utilities. Global warming will increase the threat of hurricanes as oceans and atmosphere warms. Climate change research indicates that storms like hurricanes will become more intense and more frequent in the future. In Massachusetts, major hurricanes occurred in 1904, 1938, 1954, 1955, 1960 and 1976.

Tornadoes/Microbursts

Tornadoes 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. High wind speeds, hail, and debris generated by tornadoes can result in loss of life, downed trees and power lines, and damage to structures and other personal property (cars, etc.).

Of additional concern are microbursts, which often do tornado-like damage and can be mistaken for tornadoes. In contrast to the upward rush of air in a tornado, air blasts rapidly downward from thunderstorms to create microbursts.²

Furthermore, tornados are expected to become more frequent and more violent as the earth's atmosphere warms, due to predictions of climate change from global warming. In Western Massachusetts, the majority of sighted tornadoes have occurred in a swath from Southwick to New Salem, and Ludlow sits directly within this "tornado alley."

Wildland Fires/Brushfires

According to FEMA, there are three different classes of wildland fires: *surface fires*, *ground fires* and *crown fires*.³ 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 lightning. 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 Ludlow, 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. Global climate changes may also influence precipitation patterns, making the region more susceptible to drought and therefore, wildfires.

There were 238 brushfires reported in Ludlow between 1996 and 2006, with 18 reported cases in 2006 alone.

Earthquakes

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, at any time of the year. New England experiences an average of 30 to 40 earthquakes each year

² <http://www.fema.gov>.

³ FEMA, "Fact Sheet: Wildland Fires," September 1993.

although most are not noticed by people.⁴ 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.⁵

Table 3-1: New England Earthquakes with a Magnitude of 4.2 or More, 1924 – 2002

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

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

Table 3-2: Historic Earthquakes, New England States

State	Years of Record	Number of Earthquakes
Connecticut	1568 - 1989	137
Maine	1766 - 1989	391
Massachusetts	1627 - 1989	316
New Hampshire	1728 - 1989	270
Rhode Island	1766 - 1989	32
Vermont	1843 - 1989	69
New York	1737 - 1985	24
<i>Note: Total Number of Earthquakes within the New England states between 1568 and 1989 = 1,239.</i>		

⁴ Northeast States Emergency Consortium Web site: www.nesec.org/hazards/earthquakes.cfm.

⁵ Federal Emergency Management Agency Web site: www.fema.gov/hazards/earthquakes/quake.shtm.

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

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. The seismic standards have also been upgraded with the 1997 revision of the State Building Code.

Dam Failure

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 released. Most dam failures occur when floodwaters above overtop and erode the material components of the dam. Often dam breaches lead to catastrophic consequences as the water ultimately 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 (MA DCR) was 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. This means that individual dam owners are now responsible for conducting inspections. Notice for dam owners to comply with the inspection schedule did not go out until 2006. Extensions were provided to some dam owners, particularly to towns, so that they could include the costs of inspection within their next funding cycles.*

The state has three hazard classifications for dams:

- *High Hazard:* Dams located where failure or improper operations will likely cause loss of life and serious damage to homes, industrial or commercial facilities, important public utilities, main highways, or railroads.
- *Significant Hazard:* 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:* Dams located where failure or improper operation may cause minimal property damage to others. Loss of life is not expected.

* Alice Bilbo-Miles , legal advisor to the Massachusetts Office of Dam Safety.

The inspection schedule for dams is as follows:

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

The time intervals represent the maximum time allowed between inspections. 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 currently eleven (11) dams known to exist in Ludlow, two (2) of which are deemed by DCR to be non-jurisdictional (the storage capacity of the impoundment and height of dam are such that they need not be regulated). The Town also owns a dam in Chicopee, the Wade Lake Dam. The following table identifies dams within the town, state id, name of owner, purpose, condition, last inspected date, and hazard risk classification.

Table 3-3: Ludlow Dams, Classified by Hazard Risk

Dam name/ date built	ID	Owner	Purpose	Condition/last inspected	Hazard Risk
Ludlow Reservoir Dam/1877	MA00547	City of Springfield	Water supply	Fair 11/16/2005	High
Cherry Valley Dam/ 1877	MA00548	City of Springfield	Water supply	Fair 11/16/2005	High
Indian Orchard Dam†/1915	MA 00722	Consolidated Edison Energy Massachusetts, Inc.	Hydro	Good 8/31/2004	High
Red Bridge Dam† /1901	MA00732	Consolidated Edison Energy Massachusetts, Inc.	Hydro	Good 8/31/2004	High
Putts Bridge† /1918*	MA00724	Consolidated Edison Energy Massachusetts, Inc.	Hydro	Good 8/31/2004	High
Harris Pond Dam/ 1950	MA00549	Town of Ludlow	Recreation	Fair 11/22/2006	Significant
Collins Pond Dam/ 1984	MA83013	I-Maxmat Corp.	Hydro, Recreation, Flood Control	No. info. 4/7/2004	Significant
Alden Pond Dam/ 1950	MA00546	Camp Alden Association	Recreation	No. info. 10/28/81	Low
Gauthier Pond Dam	MA01919	Edward and Nancy Gauthier	No. info.	No. info.	Low
Ackerman Upper Pond Dam	MA01918	Raymond T. Haluch	No. info.	No. info.	Non Jurisdictional**
Nash Hill Reservoir Dam/1950	MA00550	Commonwealth of Massachusetts-DCR	Water supply	Satisfactory 5/11/88	Non Jurisdictional***

Source: Massachusetts Department of Conservation and Recreation (DCR), Office of Dam Safety, October 2007

† Licensed by the Federal Energy Regulatory Commission.

* Awaiting confirmation from Office of Dam Safety that information on this dam is correct. Request for confirmation submitted 11-16-07.

** Jurisdictional determinations made by DCR based on storage capacity of impoundment and height of dam.

*** Committee members noted that the basin area is now dry and water is stored in above-ground tanks.

Drought

Drought is a normal, recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region. In the most general sense, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector.⁷

In Massachusetts, six major droughts have occurred statewide since 1930⁶. They range in severity and length, from three to eight years. In many of these droughts, water-supply systems were found to be inadequate. Water was piped in to urban areas, and water-supply systems were modified to permit withdrawals at lower water levels.

Reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of the direct impacts of drought. Of course, these impacts can have far-reaching effects throughout the region and even the country.

When evaluating the region's risk for drought on a national level, utilizing a measure called the Palmer Drought Severity Index, Massachusetts is historically in the lowest percentile for severity and risk of drought.⁷ However, global warming and climate change may have an effect on drought risk in the region. With the projected temperature increases, some scientists think that the global hydrological cycle will also intensify. This would cause, among other effects, the potential for more severe, longer-lasting droughts.

Man-Made Hazards – Hazardous Materials

Hazardous materials are chemical substances, which if released or misused can pose a threat to the environment or health. These chemicals come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. 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 and businesses routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines.

The Toxics Release Inventory (TRI), a publicly available EPA database that contains information on specific toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities.⁸ According to TRI, Ludlow has three industries currently releasing hazardous materials within town limits, and two which are registered as doing so in the past.

⁶ US Geological Survey Water-Supply Paper 2375. "National Water Summary 1989 – Floods and Droughts: Massachusetts." Prepared by S. William Wandle, Jr., US Geological Survey.

⁷ National Drought Mitigation Center – <http://drought.unl.edu>

⁸ 2004 Toxic Releases Inventory (TRI) Data Files for Massachusetts. www.epa.gov/tri/

Table 3-4: Ludlow TRI

Industry	Address	Year Recorded
Elite Consumer Products	203 West Street	Current (2004)
Roma Marble Inc.	15 Westover Road	Current (2004)
Eaton Global Hose	Dana Way	Current (2004)
Catad Chemical Co.	Randall Road, Stony Brook Industrial Park	1987
Chemi-Graphic Inc.	340 State Street	1992

Source: 2004 TRI Data Files for Massachusetts.

There are also several hazardous materials sites in town that are listed in the U.S. Environmental Protection Agency's Tier 2 data base. These sites have been mapped and included in this hazard analysis.

Table 3-5: Tier 2 Hazardous Materials Sites in Ludlow, MA

Industry	Address
Bay State Gas Company	Ravenwood Drive (by I-90)
Verizon Communications	Winsor Street
Dyno Nobel, Inc.	462 Randall Road
Buckeye Pipeline	Scott Street
James Austin Company	203 West Street
Springfield Water and Sewer Commission	1149 Center Street (by reservoir)

In addition to the Buckeye Pipeline, listed above, other petroleum delivery infrastructure located within the town includes the Mobile Pipeline, which runs along West Street, and the Tank Farm located on Tank Farm Road. Both the Buckeye and Mobile pipelines run to the Tank Farm. The other facility of note is the Bay State LNG Plant located on Ravenwood Drive.

Another concern for the Town may be its landfills, and hazardous waste and brownfield sites. Ludlow's Open Space and Recreation Plan lists these sites as environmental challenges, and gives some detail on their clean-up status. However, if a hazard event impacted one of these sites, it could cause significantly disastrous effects because of their contaminants.

Finally, varying quantities of hazardous materials are manufactured, used, or stored at an estimated 4.5 million facilities in the United States--from major industrial plants to local dry cleaning establishments or gardening supply stores. These hazardous materials are transported regularly over our highways and by rail and if released can spread quickly to any community. Incidents can occur at any time without warning. Human error is the probable cause of most transportation incidents and associated consequences involving the release of hazardous materials.

Natural Hazard Analysis Methodology

In order to review the likelihood of a specific hazard occurring, identify the location of occurrence, and assess the impacts of the hazard event, a *Hazard Identification and Analysis Matrix* was prepared to organize the information that was gathered for this project. The matrix is organized into the following sections: Type of Hazard, Frequency of Occurrence, Severity of Impacts and Hazard Index. The Hazard Index was completed to rank the hazards according to the frequency of occurrence and the amount of potential damage likely to occur. The Hazard Index forms the basis for concentrating the future mitigation efforts outlined in this plan. A description of each of the matrix categories is provided below. The completed Matrix is shown on Table 3-9, *Hazard Identification and Analysis Worksheet for Ludlow*.

Type of Hazard

The natural hazards identified for Ludlow include floods, severe snowstorms/ice storms, hurricanes/severe thunderstorms, tornadoes/microbursts, wildfires/brushfires, dam failure, earthquakes, drought, and hazardous materials. Many of these hazards result in similar impacts to a community. For example, hurricanes, tornadoes and severe storms may cause wind-related damage. A more detailed description of each type of hazard is included in the earlier section of this chapter.

Frequency of Occurrence

The frequency or likelihood of occurrence for each natural hazard was classified according to the following scale:

Table 3-6: Frequency of Occurrence and Annual Probability of a Natural Hazard

Frequency of Occurrence	Annual Probability
<i>Very High</i>	70-100% probability in the next year
<i>High</i>	40-70% probability in the next year
<i>Moderate</i>	10-40% probability in the next year
<i>Low</i>	1-10% probability in the next year
<i>Very Low</i>	Less than 1% probability in the next year

Source: information adapted from Hyde County, North Carolina Multi-Hazard Mitigation Plan, Sept 2002.

Location of Occurrence

The classifications are based on the area of the Town of Ludlow that would potentially be affected by the hazard. The following scale was used:

Table 3-7: Location and Percentage of Town Impacted of Given Natural Hazard

Location of Occurrence	Percentage of Town Impacted
<i>Large</i>	More than 50% of the town affected
<i>Medium</i>	10 to 50% of the town affected
<i>Small</i>	Less than 10% of the town affected

Source: information adapted from Hyde County, North Carolina Multi-Hazard Mitigation Plan, Sept 2002.

Severity of Impacts

The severity of direct impacts an affected area could potentially suffer were classified according to the following scale:

Table 3-8: Severity and Magnitude of Multiple Impacts of Given Natural Hazard

Severity of Impacts	Magnitude of Multiple Impacts
<i>Catastrophic</i>	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.
<i>Critical</i>	Multiple injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 week.
<i>Limited</i>	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 day.
<i>Minor</i>	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of facilities.

Source: information adapted from Hyde County, North Carolina Multi-Hazard Mitigation Plan, Sept 2002.

Hazard Index

The hazard index ratings were determined after assessing the frequency, location and impact classifications for each hazard. The hazard index ratings are based on a scale of 1 (highest risk) through 5 (lowest risk). The ranking is qualitative and is based, in part, on local knowledge of past experiences with each type of hazard. The size and impacts of a natural hazard can be unpredictable however; many of the mitigation strategies currently in place and many of those

proposed for implementation can be applied to the expected natural hazards, regardless of their unpredictability.

The Hazard Ratings are labeled as follows:

- 1 – High Risk
- 2 – Medium-High Risk
- 3 – Medium Risk
- 4 – Medium Low Risk
- 5 – Low Risk

Table 3-9: Hazard Identification and Analysis Worksheet for Ludlow

Type of Hazard	Frequency of Occurrence	Location of Occurrence	Severity of Impacts	Hazard Risk Index Rating
Flooding (100-year)	Moderate	Small	Minor	4
Flooding	Very High	Small	Minor	3
Severe Snowstorms/ Ice Storms	Very High	Large	Minor	2 - 3
Hurricanes/ Severe Thunderstorms	Low	Large	Minor	2 - 3
Tornadoes/Microbursts	Very Low	Small	Catastrophic	2
Wildfire/Brushfire	Very High	Small	Minor	5
Earthquakes	Very Low	Large	Limited/Critical	4
Dam Failures	Very Low	Small – Medium (depends on dam)	Minor – Catastrophic (depends on dam)	3
Drought	Low	Large	Minor	5
Man-made Hazards/ Hazardous Materials	Low	Medium	Critical/Catastrophic	3

Source: information adapted from Town of Holden Beach North Carolina Community-Based Hazard Mitigation Plan, July 15, 2003 and the Massachusetts Emergency Management Agency (MEMA).

Vulnerability Assessment

The following is a list of natural and manmade disasters, and the areas affected by them, that have or could affect the Town of Ludlow. The Past and Potential Hazards/Critical Facilities Map (Appendix D) reflects the contents of this list.

In order to determine estimated losses due to natural and man made hazards in Ludlow, each hazard area was analyzed with results shown below. Human losses are not calculated during this exercise, but could be expected to occur depending on the type and severity of the hazard. Most of these figures exclude both the land value and contents of the structure. The value of all structures in the Town of Ludlow, including exempt structures such as schools and churches, is \$1,734,554,340 as of FY2006⁹. The median value of a home in Ludlow is \$193,000 as of FY2006⁹. The data below was calculated using (1) aerial photography, (2) FEMA's Community Information System (CIS), and (3) FEMA's Understanding Your Risks: Identifying Hazards and Estimating Losses, August 2001.

Past and Potential Hazards

Flooding (100-year base flood): Medium-Low Risk

In this section, a preliminary vulnerability assessment was prepared to evaluate the potential impact that flooding could have on the portions of Ludlow located within the 100-year floodplain. Flooding was chosen for this 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 dams and snow melt.

There are approximately 1,167 acres of land within the FEMA mapped 100-year floodplain and 278 acres of land within the 500-year floodplain within the Town of Ludlow. According to the Community Information System (CIS) of FEMA, there were 20 1-4 family structures and 14 "other" structures located within the Special Flood Hazard Area (SFHA) in Ludlow as of November 20, 2003, the most current records in the CIS for the Town of Ludlow. Utilizing the Town's median home value of \$193,000, a preliminary damage assessment was generated. For the estimated number of people living in the floodplain, an average household size of 2.4¹⁰ people was used.

A total of 34 structures are located within the SFHA in Ludlow, totaling approximately \$6,562,000 of damage, and 82 people impacted. The damage estimate is a rough estimate and likely reflects 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.

Flooding: Medium Risk

⁹ Figure courtesy of The Warren Group – Real Estate Information; accessed 1/12/2007.

¹⁰ Figure courtesy of 2000 U.S. Census and represents calculated estimate of the number of people living in a household divided by the total number of households in Hampden County.

In addition to the floodplains mapped by FEMA for the 100-year and 500-year flood, Ludlow often experiences minor flooding at isolated locations due to drainage problems, or problem culverts. Most of the flood hazard areas listed here were identified due to known past occurrence in the respective area. There are many areas with no record of previous flood incidents that could be affected in the future by heavy rain and runoff.

To determine the vulnerability of these minor flood areas, the property nearby with the highest likelihood of damage was identified using FEMA's Q3 Flood Maps. Overlaying these maps onto aerial photography (Pictometry), the structures were able to be identified and tallied. Then, utilizing the Town's median home value of \$193,000, a preliminary damage assessment was then generated. Again, the damage estimate is a rough estimate and likely reflects 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.

River Street Neighborhood

This neighborhood in the southwestern corner of Ludlow is located along the steep banks of the Chicopee River. Although the area does not experience flooding, the high velocity of stormwater during storm events is problematic. The current drainage system serves this neighborhood as well as portions of the Massachusetts Turnpike, and runs-off directly into the river without any filtration or infiltration. The undeveloped area between River Street and the river where the run-off flows is experiencing severe erosion and scouring. And the Chicopee River is experiencing significant sediment loading at this location, most likely exacerbating impacts downstream.

This area has been targeted for construction of a sophisticated system for drainage including a new filtration and detention facility. This facility which will filter the stormwater from the area, slow it down, and allow for some infiltration before eventually running-off into the river.

Electric Park

This neighborhood in Ludlow is low-lying and close to the Chicopee River and several small ponds. There are several spots in the neighborhood which tend to see small flood events during heavy rains. During the flooding in October 2005, this area experience significant flooding, including damage to two homes. There are approximately 25 residences, but no critical facilities, which could be potentially damaged in a flood incident. Estimating 100% damage to 100% of the structures in this area, predicted cost of repairing or replacing would be \$4,825,000. Cost for repairing or replacing any dams or bridges, power lines, telephone lines, and contents of structures are not included.

- This area is not within a FEMA mapped 100-year flood zone.
- Dam failure would cause a flood incident.
- Annual potential for flooding in floodplain from both spring runoff and heavy summer/fall rains.
- Potential for damage/repair to road surfaces.

This area has also been targeted for a stormwater construction project – there are plans to

upgrade the current storm drainage system and increase its capacity to transport stormwater, thereby decreasing the risks of flooding.

East Street

Near the intersection of Chapin Street, East Street can be compromised by small flood events during heavy rains. This is potentially because the spot is low-lying and close to Minechoag Pond. There are no critical facilities at this spot. However, two group homes are located nearby, including one on Harlan Street which would be cut off from traveling westbound in the case of a flood event.

- This area is not within a FEMA mapped 100-year flood zone.
- Annual potential for flooding in floodplain from both spring runoff and heavy summer/fall rains.
- Potential for damage/repair to road surfaces.

Ludlow Senior High School

The area behind Ludlow High is often subject to flooding. This area lies within the FEMA mapped 100-year floodplain, and is in close proximity to Higher Brook and several small ponds and wetlands. The high school is an important critical facility, and needs to be available as a shelter. Although the flooding impacts the school grounds, it has not yet prevented access and utilization of the building.

- Annual potential for flooding in floodplain from both spring runoff and heavy summer/fall rains.
- Potential for damage/repair to school grounds and building.

Miller Street/Lyon Street

Along Miller Street, just south of the intersection with Norwich Road, a small tributary stream causes some isolated flooding events. There are no structures here that could be affected by a flood incident. The road is a key evacuation route, but a flooding event would still allow for evacuation.

- Annual potential for flooding in floodplain from both spring runoff and heavy summer/fall rains.
- Potential for damage/repair to Miller Street road surface.

Randall Road

Along Randall Road, there are a few beaver dams impacting some small streams and wetlands near the road. This can lead to minor flood incidents on the road. There are no structures here that could be affected by a flood incident, but the beaver dams are close to a Tier II hazardous waste facility.

- Potential for flooding from heavy summer/fall rains.
- Potential to impact nearby Tier II hazardous waste facility.
- Potential for damage/repair to Randall Road.

Severe Snowstorms/Ice Storms: Medium-High Risk

Three types of winter events are heavy snow, ice storms, and extreme cold which cause concern. Occasionally heavy snow years will collapse buildings. Ice storms have disrupted power and communication services. Timberland has been severely damaged. Extreme cold affects the elderly.

The Northeast Snowfall Impact Scale (NESIS) developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (Kocin and Uccellini, 2004) characterizes and ranks high-impact Northeast snowstorms. These storms have large areas of 10 inch snowfall accumulations and greater. NESIS has five categories: Extreme, Crippling, Major, Significant, and Notable. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus NESIS gives an indication of a storm's societal impacts.

NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The aerial distribution of snowfall and population information are combined in an equation that calculates a NESIS score which varies from around one for smaller storms to over ten for extreme storms. The raw score is then converted into one of the five NESIS categories. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers.

Ludlow's recent history has not recorded any loss of life due to the extreme winter weather but Ludlow has been subject to 22 winter storms categorized as major to extreme according to the NESIS scale since 1960. Additional historically significant winter storms to affect Ludlow include the Great Snow of 1717 and the Blizzard of 1888. These random events are difficult to set a cost to repair or replace any of the structures or utilities affected.

- Area has been subject to extremely heavy snow falls, records of early 1900s and into the 1950s and 1960s indicate this.
- Moderate risk town wide due to snow, ice and extreme cold.
- Elderly are affected by extreme weather.

Center Street

Snow drifting can be a problem north of Lyon Street, by the Reservoir. DPW attends to this problem with plowing.

West Street

Snow drifting can be a problem just past Randall Road, near Brook Street. DPW attends to this problem with plowing.

Nash Hill

The steep roads in this area make for dangerous driving conditions during winter weather events. DPW is diligent about salting to reduce dangers.

Hurricanes/Severe Thunderstorms: Medium-High Risk

Ludlow's location in western Massachusetts reduces the risk of hurricanes, but it still experiences some severe thunderstorms. These types of storms produce a combination of wind and heavy rain hazards. The Town has experienced small blocks of downed timber and uprooting of trees onto structures. Hurricanes can and do create flooding. Estimated wind damage 5% of the structures with 10% damage \$8,672,772. Estimated flood damage 10% of the structures with 20% damage \$34,691,087. This results in a total damage estimate of approximately \$43,363,859. Cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included.

- Chicopee River corridor at risk.
- 1938 hurricane was a major event - wind damage and flooding statewide.
- Additional hurricanes (The Great Atlantic Hurricane-1944, Carol & Edna-1954, Donna-1960, Gloria- 1985, and Bob-1991), hurricane remnants (Floyd- 1999) and other storms with high winds (Groundhog Day Gale- 1976), affect Ludlow with some regularity.
- Power and phone lines - disruptions of services.
- Flooding/washing of evacuation routes.

Tornadoes/Microbursts: Medium-High Risk

Risk of tornadoes is considered to be high in western Massachusetts. Tornadoes rarely occur in this part of the country; therefore, assessing damages is difficult. Buildings have not been built to Zone 2, Design Wind Speed Codes. Estimated damages to 10% of structures with 20% damages \$34,691,087. Estimated cost does not include building contents, land values or damages to utilities.

- No past tornado incidents recorded in the Town of Ludlow.
- 34 incidents of tornado activity (F1 or less) occurred in the region between 1950 – 2005.
- Some history of minor microbursts along the I-90 (Mass Pike) corridor.

Wildfires/Brush Fires: Low Risk

Ludlow boasts a large amount of forested land, approximately 58 percent of the Town's total land area or about 10,649 acres is undeveloped (MassGIS, 1999), and is therefore at risk of fire. As development spreads further northeast, into these forested areas, the risk of brush fire or wildfire incidents causing major structural damage increases. However, current areas of fire risk are mostly due to lack of accessibility. As this land is subdivided, it promotes more access to these forested areas. Therefore it is difficult to predict an increase in risk. The entire town served by fire protection from Ludlow Fire

Department, including brush fire protection.

In Ludlow, a large wildfire could damage more than 58 percent of the town's land mass, including vital watershed lands, in a short period of time. However, Massachusetts receives more than 40 inches of rain per year and much of the landscape is fragmented, and together these two traits make wildfires uncommon in Massachusetts. Nevertheless, in drought conditions, a brushfire or wildfire would be a matter of concern.

There are no records of wildfires or burned acreage available for Ludlow, but the 2005 Massachusetts *Fire Incident Reporting System* recorded 24 "other" fires, a category that includes any fire that does not occur in a building. The fire department is committed to collecting data on and acreage statistics on wildfires in Ludlow. Total fire damages in Ludlow, for 2005, for all categories equaled \$191,000.

Based on the availability of data, there is a low frequency of wildfires in Ludlow.

Ludlow State Forest and Surroundings

This area is one of the largest forested areas within the Town, and where the majority of new development is being built. There are approximately 75¹¹ residential structures that could be affected by a wildfire incident. 100% damage to 100% of the structures, estimated cost of repairing or replacing to be \$14,475,000.

- Forested areas with high fuel content have more potential to burn.
- Limited access for reaching some areas if a wildfire occurs here.

Earthquakes: Medium-Low Risk

Moderate potential for serious damage in developed portions of town and along Chicopee River shoreline. Structures are mostly of wood frame construction estimated loss 20% of town assessed structural valuation \$346,910,868. Costs of repairing or replacing roads, bridges, power lines, telephone lines, or the contents of the structures are not included.

- No past incidents recorded in Ludlow.
- Refer to Tables 3-1 & 3-2 for historic earthquake data for New England.

Dam Failures: Medium Risk

There are several dams within Ludlow, some of which have large inundation zones, with the potential to impact hundreds of people and structures.

Of the 5 high hazard dams, the 3 dams owned by Consolidated Edison Energy Massachusetts are regulated by the Federal Energy Regulatory Commission, and 2 are owned by the City of Springfield. Available state inspection information from 2007 indicates that some of the inspections on these high hazard dams are not up to date (see page 16 of this plan). Being classified as high hazard, they must be inspected every two years. The last inspections on the five high hazard dams indicate that they are in good to fair condition (none were in poor or unsafe condition). It should be noted that in 2006 The City of Springfield Water Department worked with Ludlow's Fire Chief to review

¹¹ Determined through the use of aerial photography from MassGIS.

Emergency Action Plans for their two dams. Copies of the plans are on file with the Fire Department.

The two dams with hazard risk ratings of significant are owned by the Town of Ludlow and I-Maxmat Corporation respectively. The Town-owned dam was last inspected in 2006 and minor repair work is underway to ensure the continued safety of this dam. State records indicate that the I-Maxmat-owned dam was last inspected in 2004, a date that is still in keeping with the 5-year inspection timetable for dams with this risk rating. State records contain no information on the condition of this dam.

According to committee members, there has been only one dam that has failed in Ludlow, the Collin's Pond Dam on the Swift River. This dam breached during the huge floods of 1938 and 1955, washing out several warehouses along the riverfront. Assuming 100% damage to 100% of structures within the inundation zone of the dam, the estimated cost in today's dollars would be \$6,825,000. It is important to note:

- No critical facilities are located in this area.
- Area is within the 100-year floodplain.
- Dam has been re-built, in good condition.

Drought: Low Risk

Ludlow relies on two external water supplies for the majority of its drinking water. A large percentage of the town's population receives drinking water from the Springfield Water and Sewer Commission's primary supply, Cobble Mountain, which is located in Westfield, and a smaller percentage comes from South Hadley's water supplies. There are isolated sections of the community that have only private wells.

South Hadley's water supply system receives its drinking water from the Massachusetts Water Resources Authority, which manages drinking water supplies for the Metropolitan Boston area; any drought that impacted MWRA supplies would truly be a regional event, and Ludlow's residents would need balance their water demands against those of the rest of the Commonwealth. Springfield's water supply has two emergency reservoirs, the Ludlow Reservoir in Ludlow and the Littleville Reservoir in Westfield, that could serve as back-up supplies in a drought event.

Six major droughts have occurred statewide since 1930. They range in severity and length, from three to eight years. In many of these droughts, water-supply systems were found to be inadequate. Water was piped in to urban areas, and water-supply systems were modified to permit withdrawals at lower water levels.

In Ludlow, as in the rest of the state, drought occurs at a medium frequency, with a range of a 1% or a 10% chance of drought occurring in a single given year. However, due to Ludlow's smaller population and the water richness of Western Massachusetts, communities like Ludlow would not be as severely impacted as some communities in Eastern Massachusetts. However, Ludlow's lack of its own water supply could lessen its ability to handle the effects of a long-term drought.

Man-Made Hazards - Hazardous Materials: Medium Risk

Ludlow has several facilities in town that could produce damage from man-made chemical explosions, leaks or spills (see table below). Please refer to the Ludlow Natural Hazard map to see where these uses are distributed. Ludlow relies on the Holyoke’s Regional HazMat Team for responding to incidents involving hazardous materials. Vehicle transportation of chemicals and bio-hazardous materials along I-90 along the river, and some local industries are a concern. Several areas of hazardous materials storage increase the potential for future incidents.

There is no reliable indicator of the extent of a man-made event in Ludlow because it would depend on a variety of factors including chemical involved in spill, size of leak/spill, and weather conditions at the time of spill, among others.

There have been no previous occurrences in Ludlow and the probability of future spills is unknown.

Address	Organization
West Avenue	James Austin's Company
Tank Farm Rd	Ludlow Terminal - Buckeye Pipe Line Co., LP
Center Street	Northeast Utilities System Ludlow Substation
MassPike	AT&T CORP
West Avenue	Elite Consumer Products
Center St.	Ludlow Reservoir, Springfield Water & Sewer Commission
Winsor St	Verizon Ludlow Co (MA858506)
Winsor St	Verizon Ludlow Co (MA858506)

(Past and Potential Hazards/Critical Facilities Map in Appendix D)

4 – CRITICAL FACILITIES

A Critical Facility is defined as a building, structure, or location which:

- Is vital to the hazard response effort;
- Maintains an existing level of protection from hazards for the community; or
- Would create a secondary disaster if a hazard were to impact it.

Critical Facilities within Hazard Areas

Hazards identified in this plan are regional risks and, as such, all critical facilities fall into the hazard area. There are several critical facilities that fall within specific hazardous areas as shown in the table at the end of this section.

The Critical Facilities List for the Town of Ludlow has been identified utilizing a Critical Facilities List provided by the State Hazard Mitigation Officer. Ludlow's Hazard Mitigation Committee has broken up this list of facilities into four categories. The first category contains facilities needed for Emergency Response in the event of a disaster. The second category contains Non-Emergency Response Facilities that have been identified by the Committee as non-essential. These are not required in an emergency response event, but are considered essential for the everyday operation of Ludlow. The third category contains Facilities/Populations that the Committee wishes to protect in the event of a disaster. The fourth category contains Potential Resources, which can provide services or supplies in the event of a disaster. The Past and Potential Hazards/Critical Facilities Map (Appendix D) identifies these facilities.

The critical facilities and evacuation routes potentially affected by hazard areas are identified in Table 4-1, following this list.

Category 1 – Emergency Response Services

The Town has identified the Emergency Response Facilities and Services as the highest priority in regards to protection from natural and man-made hazards.

1. Emergency Operations Center

Ludlow Public Safety Complex – 612 Chapin Street

Department of Public Works Building – 198 Sportsmens Road

2. Fire Station

Ludlow Fire Department – 574 Center Street

3. Police Station

Ludlow Police Department – 612 Chapin Street

4. Highway Garage

Department of Public Works, Highway Division – 198 Sportsmens Road

5. Water Department

Massachusetts Water Resources Authority (MWRA)

6. Emergency Electrical Power Facility

Mass Municipal Wholesale Electric Company (MMWEC) – Moody Street

7. Emergency Shelters

*Ludlow High School – 500 Chapin Street

*Baird Middle School – 109 Sportsmen Road

Chapin Street School – 766 Chapin Street

East Street School – 508 East Street

Veterans Park Elementary School -486 Chapin Street

*Health South – 14 Chestnut Place

Ludlow Senior Center – 37 Chestnut Street

*have emergency generators

8. Dry Hydrants - Fire Ponds - Water Sources

See Past and Potential Hazards/Critical Facilities Map (Appendix D)

9. Transfer Station

Department of Public Works, Highway Division – 198 Sportsmens Road

10. Utilities

Mass Municipal Wholesale Electric Company – Westover Industrial Park

Bay State Gas LNG Plant – Ravenwood Drive

Buckeye Pipeline – Tank Farm Road

11. Communications

Cell Tower – 145 Carmelinas Circle

Cell Tower – 34 Carmelinas Circle

Cell Tower – 183 Ravenwood Drive

Cell Tower – 31 Ravenwood Drive

Cell Tower – 1 State Street

Cell Tower – 1709 Center Street

Cell Tower – 653 Moore Street

Cell Tower – West Street

Cell Tower – Miller Street

Public Safety Complex – 612 Chapin Street

Charter Communications Hub Site – Ludlow High School, 500 Chapin Street

12. Primary Evacuation Routes

Massachusetts Turnpike (I-90)

Route 21 (Central Street)

Chapin Street

East Street

Miller Street

Holyoke Street

West Street

Kendall Street

Church Street

Rood Street

13. Bridges Located on Evacuation Routes

Interstate 90 (Mass Pike) – over Chicopee River

Center Street – over Chicopee River

West Street – one over Chicopee River, one over Higher Brook

Holyoke Street – over Harris Pond

East Street – over Chicopee River

Red Bridge Road – over Chicopee River

Category 2 – Non Emergency Response Facilities

The town has identified these facilities as non-emergency facilities; however, they are considered essential for the everyday operation of Ludlow.

1. Water Supply

Nash Hill Reservoir

Aqueduct (on Past and Potential Hazards/Critical Facilities Map (Appendix D))

2. Problem Culverts

Randall Road – impacted by beavers

Category 3 – Facilities/Populations to Protect

The third category contains people and facilities that need to be protected in event of a disaster.

1. Hospitals

Health South – 14 Chest Place

2. Special Needs Population

Hampden County House of Correction – 623 Randall Road

Ethnic neighborhoods – throughout town, mostly in old town section

3. Elderly Housing/Assisted Living

State Street Housing for Elderly – 69 State Street

Chestnut Street Housing (disabled) – 39 Chestnut Street

Colonial Sunshine Manor (disabled) – 114 Wilson Street

Group home – 46 Bowles Avenue

Group home – 159 Ridgeview Circle

Assisted Living – 460 West Street, Keystone Commons

4. Recreation Areas

Ludlow Country Club – Tony Lema Drive & East Street

Westover Golf Course – South Street

Whitney Park – 167 Howard Street

Children’s Playground – across from 47 Sewall Street

West Street Park – Cady & West Street

Memorial Park – Chestnut Street & Sewall Street

5. Schools

Ludlow High School – 500 Chapin Street

Baird Middle School – 109 Sportsmen Road

Chapin Street Elementary School – 766 Chapin Street

East Street Elementary School – 508 East Street

Veterans Park Elementary School – 486 Chapin Street

Early Childhood Partnership and Integrated Preschool Program – 54 Winsor St

St. John the Baptist School – 181 Hubbard Street & Oak Street

6. Churches

Jehovah’s Witnesses – Fuller Street

St. Paul’s Methodist Church – Hobbard & Sewall Street

First Church – 859 Center Street

Our Lady of Fatima – 438 Winsor Street

St. Mary’s – 12 Cedar & East Street

Christ the King Church – 41 Warsaw Avenue

St. Peter & Paul Ukranian Catholic Church – 45 Newbury Street

St. John the Baptist Church – 181 Hubbard Street & Oak Street

Church of Latter Day Saints – 584 West Street

7. Historic Buildings/Sites

Ludlow Center Historic District – along Center, Church and Booth Streets

Ludlow Village Historic District – roughly bounded by Winsor, Sewall and State Sts. and the Chicopee R. and crossing the Chicopee Road above Red Bridge Road

8. Apartment Complexes

Fuller Street

9. Employment Centers

Westover Industrial Park

10. Camps

Camp White – off of Munsing Street

11. Mobile Home Parks

Intersection of West Street and Holyoke Street

Intersection of Parker Lane and Miller Street

Category 4 – Potential Resources

Contains facilities that provide potential resources for services or supplies.

1. Food/Water

Big Y Supermarket – 425 Center Street

2. Hospitals/Medical Supplies

CVS Pharmacy – 433 Central Street

Wing Memorial Medical Center – 39 Hubbard Street

Health South – 14 Chest Place

3. Heating Fuel

Ludlow Heating and Cooling – 1056 Center Street

Noonan Energy – 244 Hubbard Street

4. Gas

Interstate Mobile Service Station – 456 Center Street

5. Building Materials Suppliers

C&A Smith Lumber and Feed – 84 Hubbard Street

6. Heavy & Small Equipment Suppliers

Carmelita's

7. Gravel Pits

Ray Haluch Gravel Co. – 1014 Center Street

Daniel's Gravel Bank – 466 Miller Street

Chernier's Gravel Bank – 405 Munsing Street

Table 4-1: Critical Facilities and Evacuation Routes Potentially Affected by Hazard Areas

Hazard Type	Hazard Area	Critical Facilities Affected	Evacuation Routes Affected
Flooding (100-year Flood)	100-year floodplain along Chicopee River	At the intersection of Center St and State St: senior housing; power plant; Health South clinics; and a pre-school.	Bridge over Chicopee River to Wilbraham
	100-year floodplain along Higher Brook	Runs behind the Ludlow Public Safety Complex (EOC); and Ludlow High School	None.
Flooding	Electric Park	None.	Chapin Street
	East Street and Chapin Street	None.	East Street
	Ludlow Senior High School	School grounds	None
	Miller Street/Lyon Street	None.	Miller Street/ Lyon Street
	Randall Road	None.	Randall Road
Severe Snow/Ice Storms	Center Street	None.	Center Street
	West Street	None.	West Street
Wildfires/Brushfires	Ludlow State Forest and Surroundings	Ludlow State Forest	Miller Street; East Street
Dam Failures	Collin's Bridge Dam inundation zone	None.	Chapin Street.
Hazardous Materials	I-90	None.	I-90.

Past and Potential Hazards/Critical Facilities Map (Appendix D)

5 – CURRENT MITIGATION STRATEGIES

Flooding

The Floodplain Map for the Town of Ludlow shows the 100-year and 500-year flood zones 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 one percent chance of occurring in any given year. Likewise, the 500-year flood has a 0.2 percent chance of occurring in any given year. In Ludlow, there are four general floodplain areas – along the Chicopee River; around Springfield Reservoir; in the northwest corner of town within the Westover Wildlife Management Area; and in the low-lying areas in the geographical center of town.

One of the goals of this Natural Hazards Mitigation Plan is to evaluate all of the town’s existing policies and practices related to natural hazards and identify potential gaps in protection.

*Management Plans*¹²

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

1. Identify areas in the community that are flood prone and define methods to minimize the risk. Review National Flood Insurance Maps.
2. Disseminate emergency public information and instructions concerning flood preparedness and safety.
3. Community leaders should ensure that Ludlow is enrolled in the National Flood Insurance Program.
4. 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.
5. Ensure that flood control works are in good operating condition at all times.
6. Natural water storage areas should be preserved.
7. Maintain plans for managing all flood emergency response activities including addressing potentially hazardous dams.

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

1. Place EOC personnel on standby during stage of flood ‘watch’ and monitor NWS/New England River Forecast Center reports.
2. Ensure that public warning systems are working properly and broadcast any information that is needed at this time.
3. Review mutual aid agreements.
4. Monitor levels of local bodies of water.

¹² Comprehensive Emergency Management Plan for the Town of Ludlow, 2006.

5. Arrange for all evacuation and sheltering procedures to be ready for activation when needed.
6. Carry out, or assist in carrying out needed flood-proofing measures such as sand bag placement, etc.
7. Regulate operation of flood control works such as floodgates.
8. Notify all Emergency Management related groups that will assist with flood response activities to be ready in case flood 'warning'.
9. Broadcast warning/notification of flood emergency.
10. Coordinate traffic control and proceed with evacuation of affected populations as appropriate.
11. Open and staff shelters and reception centers.
12. Undertake, or continue to carry out, flood proofing measures.
13. Dispatch search and rescue teams.
14. Dispatch emergency medical teams.

Evacuation Options

Much of the land subject to flooding in town is residential. According to the Ludlow CEM Plan, the primary risk is the Chicopee River and Broad Brook areas. It identifies five special needs facilities including: St. John the Baptist School, State Street and Chestnut Street Housing for Elderly, the Early Childhood Center, and the Boys and Girls Club. In the CEM Plan, local officials have stated that there are local shelters available for flooding victims, including people with special, non-institutional needs. In that case, the shelters are Ludlow High School and Baird Middle School. Approximately five hundred (500) people would be expected to be impacted by a 100-year flood, of which one hundred (100) may need transportation, and six (6) may need special assistance. The evacuation plan is to encourage residents to use their vehicles, and bring in two buses, one wheelchair van, and one ambulance, if necessary, and to drive out of the area via West Street, Center Street, Chapin Street, and Miller Street.

In addition, Ludlow has eight (8) bridges situated either in or near the 100-year floodplain, which could make evacuation efforts as a result of flood more difficult. Some of the roads that residents would most likely take to reach safety travel through flood-affected areas.

Flood Control Structures

Of the 11 dams within the town of Ludlow, only the Collins Pond Dam is listed by the state as serving a flood control purpose. There are also two dikes, the Alden Street Dike, constructed in 1940, and the Railroad Dike, constructed in 1901. Both of these dikes are located along the Chicopee River to mitigate the impacts of flooding. They are owned by Consolidated Edison Energy Massachusetts, Inc.

Land Use Regulations that Mitigate Impacts from Flooding¹³

The Town of Ludlow has several land use regulations that serve to 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 summarized below and their effectiveness evaluated in Table 5-1.

Zoning By-Laws

The Ludlow Zoning By-Laws addresses flood hazards and source water protection through the review of special permit proposals and the use of overlay districts.

Section VII: Land Use Review – Special Permits

7.0.4 Special Permit Criteria

The Special Permit Granting Authority may grant a Special Permit authorized by this bylaw if said Board finds, when applicable, that:

- k. The proposal ensures protection from flood hazards, considering such factors as the following: elevation of buildings; drainage; adequacy of sewage disposal; erosion and sedimentation control; equipment location; refuse disposal; storage of buoyant materials; extent of paving; affect of fill, roadways or other encroachments on flood runoff and flow;

Section V – Overlay District Regulations – Water Supply Protection District

5.3.1 Purpose of District

To promote the health, safety, and welfare of the community by protecting and preserving the surface and groundwater resources of the Town and the region from any use of land or buildings which may reduce the quality of its water resources.

5.3.3 District Delineation

- a. The Water Supply Protection District is herein established to include all lands within the Town of Ludlow lying within the watershed areas of the Springfield Reservoir and the Nash Hill Reservoir which now or may in the future provide public water supply.
- b. Where the bounds delineated are in doubt or in dispute, the burden of proof shall be upon the owner(s) of the land in question to show where they should properly be located.

5.3.4 Prohibited Uses

[Several uses listed, *i.e.*, industrial uses, disposal sites, storage sites, etc.]

5.3.5 Restricted Uses

[Several uses listed with restrictions, *i.e.*, excavation uses, disposal sites, storage sites, etc.]

¹³ All bulleted items and direct quotes in the Ludlow Local Natural Hazards Mitigation Plan are taken from the Town of Ludlow’s Land Use Ordinance – Zoning Bylaws and Subdivision Rules and Regulations. Other references to these documents contained herein are paraphrases of the same.

5.3.6 Drainage

For commercial and industrial uses, to the extent feasible, run-off from impervious surfaces shall be recharged on the site by being diverted toward areas covered with vegetation for surface infiltration. Such run-off shall not be discharged directly to rivers, streams, or other surface water bodies. Dry wells shall be preceded by oil, grease, and sediment traps to facilitate removal of contamination. All recharge areas shall be permanently maintained in full working order by the owner(s).

5.3.7 Special Permit Uses

a. Uses Allowed by Special Permit

The following uses may be allowed by Special Permit obtained from the Planning Board:

- 1) Commercial and industrial uses which are allowed in the Table of Uses;
- 2) Any enlargement, intensification, or alteration of an existing commercial or industrial use;
- 3) The rendering impervious of more than 20% of any single residential lot.

5.3.10 Requires Buffer Strip Along River and Stream Banks

The following requirements shall apply to all uses allowed by right or by Special Permit:

- a. A buffer strip extending one hundred (100) feet in width landward from the bank of all rivers and streams shall be required for all land within the Water Supply Protection District. If any lot existing at the time of adoption of this bylaw does not contain sufficient depth measured landward from the riverbank to provide a one hundred foot buffer strip, the buffer strip may be reduced to 50% of the available lot depth, measured landward from the river or stream bank.
- b. The buffer strip shall include trees and shall be kept in a natural condition.
- c. No buildings nor structures shall be erected, enlarged, altered or moved from within the buffer strip.
- d. On-site waste water disposal systems shall be located no less than 150 feet from the normal high water mark of a river or stream.

5.3.11 Non-conforming Use

Non-conforming uses which were lawfully existing, begun, or in receipt of a building or special permit prior to the first publication of notice of public hearing for this bylaw may be continued. Such non-conforming uses may be extended or altered, as specified in M.G.L. Ch. 40A, section 6, provided that there is a finding by the Planning Board that such change does not increase the danger of surface or groundwater pollution from such use.

Section 5.5 Stormwater Management Bylaw

A. Purpose, Authority and Administration

1. Purpose

- a. The purpose of this bylaw is to better manage land development in order to protect, maintain, and enhance the public health, safety, and general welfare of the citizens of Ludlow by establishing minimum requirements and procedures to control the adverse impacts associated with stormwater runoff.
- b. Regulation of illicit connections and discharges to the municipal storm drain system is necessary for the protection of the Town of Ludlow's water bodies and groundwater, and to safeguard the public health, safety, welfare and the environment.
- c. Limit the harmful impacts of soil erosion and sedimentation. Said impacts include, but are not limited to impairing water quality and flow in lakes, ponds, streams, rivers, wetlands and groundwater, contamination of drinking water supplies, alterations or destruction of aquatic and wildlife habitats, cause flooding, and overload and/or clog municipal storm drainage systems.
- d. This bylaw has the following objectives:
 - (1) Reduce the adverse water quality impacts of stormwater discharges to rivers, lakes, reservoirs and streams in order to attain federal water quality standards;
 - (2) Prevent the discharge of pollutants, including hazardous chemicals, into stormwater runoff;
 - (3) Minimize the volume and rate of stormwater which is discharged to rivers, streams reservoirs, lakes and combined sewers that flows from any site during and following development;
 - (4) Prevent erosion and sedimentation from land development, and reduce stream channel erosion caused by increased runoff;
 - (5) Provide for the recharge of groundwater aquifers and maintain the base flow of streams;
 - (6) Provide stormwater facilities that are attractive, maintain the natural integrity of the environment, and are designed to protect public safety;
 - (7) To prohibit connections and unauthorized discharges to the MS4;
 - (8) To require the removal of all such illicit connections;
 - (9) Maintain or reduce pre-development runoff characteristics after development to the extent feasible;
 - (10) Minimize damage to public and private property from flooding;
 - (11) Ensure that these management controls are properly maintained.

2. Authority and Administration

The Board of Public Works shall administer, implement and enforce this bylaw. Any powers granted to or duties imposed upon the Board of Public Works may be delegated in writing by the Board of Public Works to its employees or agents.

C. Applicability

1. This bylaw shall apply to flows entering the municipally owned storm drainage system

2. This bylaw shall apply to all activities that result in disturbance of one or more acres of land that drains to the municipal separate storm sewer system. Except as authorized by the Department of Public Works or its agent, hereafter known as “The Board”, in a Stormwater Management Permit or as otherwise provided in this bylaw, no person shall perform any activity that results in disturbance of an acre or more of land. Prior to the issuance of any Special Permit or Site Plan Approval or development permit for any proposed development listed below, a Stormwater Management Permit, or a waiver of the requirement for Stormwater Management Permit, must be approved by the Department of Public Works. No person shall, on or after the effective date of the bylaw, initiate any land clearing, land grading, earth moving or development activities without first complying with this bylaw. The following uses and activities shall require submittal of drainage reports, plans, construction drawings, specifications and asconstructed information in conformance with the requirements of this bylaw:

- a. Multi-family residential developments involving four or more housing units;
- b. Any new commercial, industrial, and institutional structures under the same ownership, with at least 5,000 square feet of gross floor area, and/or 10,000 square feet of impervious surface, or that requires 10 or more parking spaces.
- c. Redevelopment or additions to existing commercial, industrial, and institutional uses which result in an additional impervious surface area or gross floor area of greater than 5,000 square feet, or which results in an increase of 10 or more parking spaces.
- d. Subdivisions and construction activities of any kind disturbing greater than one acre.
- e. Development or redevelopment involving multiple separate activities in discontinuous locations or on different schedules if the activities are part of a larger common plan of development that all together disturbs one or more acres.

D. Exemptions

1. To prevent the adverse impacts of stormwater runoff, the Department of Public Works has developed a set of performance standards that must be met at new development sites. These standards apply to construction activities as described under Section C.2. The following activities may be exempt from these stormwater performance standards:

- a. Any agricultural activity which is consistent with an approved soil conservation plan prepared or approved by the Natural Resource Conservation Service;
- b. Any logging which is consistent with a timber management plan approved under the Forest Cutting Practices Act by Massachusetts Department of Environmental Management;
- c. Additions or modifications to existing single family structures;
- d. Developments that do not disturb more than one acre of land, provided that they are not part of a larger common development plan; and
- e. Repairs to any stormwater treatment system deemed necessary by the Ludlow Planning Board or Department of Public Works.
- f. Any emergency activity that is immediately necessary for the protection of life, property or the environment, as determined by the Ludlow Planning Board or Department of Public Works.

E. Stormwater Design Manual

1. A stormwater design manual, Stormwater Management, Volume Two: Stormwater Technical Handbook (March, 1997, Mass. Department of Environmental Protection, as updated or amended) is hereby incorporated by reference as part of this bylaw, and shall furnish additional policy, criteria and information including specifications and standards, for the proper implementation of the requirements of this bylaw.
2. This manual includes a list of acceptable stormwater treatment practices, including the specific design criteria for each stormwater practice. The manual may be updated and expanded from time to time, based on improvements in engineering, science, monitoring and local maintenance experience, at the discretion of the Massachusetts Department of Environmental Protection or supplemented by the Ludlow Planning Board. Storm water treatment practices that are designed and constructed in accordance with these design and sizing criteria will be presumed to meet the minimum water quality performance standards.

F. Stormwater Management Permit Procedures and Requirements

No land owner or land operator shall receive any of the building, grading, or other land development permits required for land disturbance activities, and no land owner shall commence land disturbance activities, without approval of a Stormwater Management Permit from the Department of Public Works and meeting the requirements of this bylaw.

1. Application Requirements

A. Application for approval of a Stormwater Management Permit shall include the following:

1. A stormwater management plan or an application for waiver shall be submitted to the Department of Public Works for review and approval for any proposed development specified in Section C.2. Two copies of the application and stormwater management plan shall be submitted, and clearly labeled. The plan shall contain supporting computations, drawings, and sufficient information describing the manner, location, and type of measures in which stormwater runoff will be managed from the entire development. The plan shall serve as the basis for all subsequent construction.
2. An erosion and sediment control plan, which shall contain sufficient information to describe the nature and purpose of the proposed development.
3. An ongoing maintenance agreement.
4. A non-refundable permit review fee. See separate fee schedule.

The applicant may request, and the Department of Public Works may grant, a waiver from any information requirements or fee it judges to be unnecessary to the review of a particular plan.

5. Inspections

No plan will be approved without adequate provision for inspection of the property before development activity commences. The applicant shall arrange with the Department of Public Works or other agents designated by the Department of Public Works for scheduling the following inspections:

- a. Initial inspection – prior to approval of any plan;
- b. Erosion Control inspections – after site clearing, rough grading and final grading to ensure erosion control practices are in accord with the plan.
- c. Bury inspection – prior to backfilling of any underground drainage or stormwater conveyance structures;
- d. Final inspection – when all work including construction of stormwater managements facilities and landscaping have been completed. The Department of Public Works or other agents shall inspect the work and either approve it or notify the Department of Public Works and applicant in writing in what respects there has been a failure to comply with the requirements of the approved plan. The applicant shall promptly correct any portion of the work which does not comply or the applicant will be subject to the bonding provisions of Section K or the penalty provisions of Section L. The Town may conduct additional inspections as needed to ensure effective control of erosion and sedimentation during all phases of construction.

8. Stormwater Management & Erosion Control Plan

A. Plan Requirements

The application for a Stormwater Management Permit shall consist of submittal of a Stormwater Management and Erosion Control Plan, prepared

by a Professional Engineer licensed by the Commonwealth of Massachusetts, which meets the design requirements provided by this bylaw. The plan shall include sufficient information to evaluate the environmental characteristics of the affected areas, the potential impacts of the proposed development on water resources; and the effectiveness and acceptability of measures proposed for managing stormwater runoff. The plan must be designed to meet the Massachusetts Stormwater Management Standards as set forth in this bylaw and the DEP Stormwater Management Handbook Volumes I and II. The applicant shall certify on the drawings that all clearing, grading, drainage, construction, and development shall be conducted in strict accordance with the plan. The minimum information submitted for support of a stormwater management plan shall be as follows:

1. A locus map;
2. The existing zoning and land use at the site;
3. The proposed land use;
4. The location(s) of existing and proposed easements;
5. The location of existing and proposed utilities;
6. The site's existing and proposed topography with contours at two foot intervals;
7. The existing site hydrology;
8. A description and delineation of existing stormwater conveyances, impoundments, and wetlands on or adjacent to the site or into which stormwater flows;
9. A delineation of 100-year flood plains, if applicable;
10. Estimated seasonal high groundwater elevation (November to April) in areas to be used for stormwater retention, detention, or infiltration;
11. The existing and proposed vegetation and ground surfaces with runoff coefficient for each;
12. A drainage area map showing pre and post construction watershed boundaries, drainage area and stormwater flow paths;
13. A description and drawings of all components of the proposed drainage system including:
 - (a) locations, cross sections, and profiles of all brooks, streams, drainage swales and their method of stabilization;
 - (b) all measures for the detention, retention or infiltration of water;
 - (c) all measures for the protection of water quality;
 - (d) the structural details for all components of the proposed drainage systems and stormwater management facilities;

- (e) notes on drawings specifying materials to be used, construction specifications, and typical;
- (f) Typical hydrology with supporting calculations;
- (g) Proposed improvements including location of buildings or other structures, impervious surfaces, and drainage facilities, if applicable;
- (h) A description of construction and waste materials expected to be stored on-site, and a description of controls to reduce pollutants from these materials including storage practices to minimize exposure of the materials to stormwater, and spill prevention and response;
- (i) Timing, schedules, and sequence of development including clearing, stripping, rough grading, construction, final grading, and vegetative stabilization; and
- (j) A maintenance schedule for the period of construction.

B. Specific Design Criteria

Additional policy, criteria, and information including specifications and design standards may be found in the Stormwater Design Manual.

1. Infiltration systems

- (a) Infiltration systems shall be equipped with clean stone and or filter fabric adjacent to the soil or other sediment removal mechanisms;
- (b) Infiltration systems greater than three feet deep shall be located at least 10 feet from basement walls;
- (c) Due to the potential for groundwater contamination from dry wells, they shall not be an acceptable method for management runoff containing pollutants;
- (d) Infiltration systems designed to handle runoff from commercial or industrial impervious parking areas shall be a minimum of 100 feet from any drinking water supply well;
- (e) Infiltration systems shall not be used as sediment control basins during construction unless specific plans are included to restore or improve the basin surface;
- (f) Infiltration basins shall be constructed with a three foot minimum separation between the bottom of the structure and the seasonal high groundwater elevation, as determined by a certified soil evaluator; and
- (g) Provisions shall be made for safe overflow passage, in the event of a storm which exceeds the capacity of an infiltration system.

2. Retention and detention ponds shall be designed and constructed in accordance with the criteria of the Stormwater Management, Volume Two: Stormwater Technical Handbook (March, 1997, Mass. Department of Environmental Protection, as updated or amended).

3. The applicant shall give consideration in any plan to incorporating the use of natural topography and land cover such as natural swales, and depressions as they exist prior to development to the degree that they can accommodate the additional flow of water.
4. The Department of Public Works shall give preference to the use of swales in place of the traditional use of curbs and gutters based on a case by case review of stormwater management plans.
5. The applicant shall consider public safety in the design of any stormwater facilities. The banks of detention, retention, and infiltration basins shall be sloped at a gentle grade into the water as a safeguard against personal injury, to encourage the growth of vegetation and to allow the alternate flooding and exposure of areas along the shore. Basins shall have a 4:1 slope to a depth of two feet below the control elevation. Side slopes must be stabilized and planted with vegetation to prevent erosion and provide pollutant removal. The banks of detention and retention areas shall be designed with sinuous rather than straight shorelines so that the length of the shoreline is maximized, thus offering more space for the growth of vegetation. All detention and retention basins must be fenced in.
6. Where a stormwater management plan involves direction of some or all runoff off of the site, it shall be the responsibility of the applicant to obtain from adjacent property owners any easements or other necessary property interests concerning flowage of water. Approval of a stormwater management plan does not create or affect any such rights.
7. All applicants for projects which involve the storage or use of hazardous chemicals shall incorporate handling and storage “best management practices” that prevent such chemicals from contaminating runoff discharged from a site into infiltration systems, receiving water bodies or storm drains, and shall include a list of such chemicals in the application.
8. Runoff from parking lots shall be treated by oil and water separators or other controls to remove oil and sediment;
9. The basis design criteria methodologies, and construction specifications, subject to the approval the Planning Board and Town Engineer, shall be those generally found in the most current edition of the Stormwater Management, Volume Two: Stormwater Technical Handbook (March, 1997, Mass. Department of Environmental Protection, as updated or amended) and in MA DEP’s Erosion Control and Sediment Guidelines for Urban and Suburban Areas (March 1997, as updated or amended).

C. Design Requirements for Erosion and Sediment Control Plan

1. The design requirements of the Erosion and Sediment Control Plan are:
 - a. Minimize total area of disturbance
 - b. Sequence activities to minimize simultaneous areas of disturbance

- c. Minimize peak rate of runoff in accordance with the MA DEP Stormwater Policy
- d. Minimize soil erosion and control sedimentation during construction. Prevention of erosion is preferred over sedimentation control
- e. Divert uncontaminated water around disturbed areas
- f. Maximize groundwater recharge
- g. Install and maintain all erosion and sediment control measures in accordance with the manufacturer's specifications and good engineering practices.
- h. Prevent off-site transport of sediment from the time of initial site disturbance forward
- i. Protect and manage on and off-site material storage areas (overburden and stockpiles of dirt, materials, borrow areas, or other areas used solely by the permitted project are considered a part of the project)
- j. Comply with applicable Federal, State and local laws and regulations including waste disposal, sanitary sewer or septic system regulations, and air quality requirements, including dust control
- k. Prevent adverse impact from the proposed activities to habitats mapped by the Massachusetts Natural Heritage & Endangered Species Program as endangered, threatened or of special concern, estimated habitats of rare wildlife and certified vernal pools, and priority habitats of rare species.
- l. Institute interim and permanent stabilization measures. The measures shall be instituted on a disturbed area as soon as practicable but no more than 14 days after construction activity has temporarily or permanently ceased on that portion of the site.
- m. Properly manage on-site construction and waste materials.
- n. Prevent off-site vehicle tracking of sediments.

10. Stormwater Management Performance Standards

A. Minimum Control Requirements

Projects must meet the standards of the Massachusetts Stormwater Management Policy. These standards are:

1. No new stormwater conveyances (*e.g.* outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or water of the Commonwealth.
2. Stormwater management systems must be designed so that post-development peak discharge rates do not exceed predevelopment peak discharge rates.

3. Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge rate from the pre-development or existing site conditions, based on soil types.
4. For new development, stormwater management systems must be designed to remove 80% of the average annual load (post development conditions) of Total Suspended Solids (TSS). It is presumed that this standard is met when:
 - (a) Suitable nonstructural practices for source control and pollution prevention are implemented;
 - (b) Stormwater management best management practices (BMPs) are sized to capture the prescribed runoff volume; and
 - (c) Stormwater management BMPs are maintained as designed.
5. Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs (see Stormwater Management Volume I: Stormwater Policy Handbook). The use of infiltration practices without pretreatment is prohibited.
6. Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas (see Stormwater management Volume I: Stormwater Policy Handbook). Critical areas are Outstanding Resource Waters (ORWs), shellfish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies.
7. Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.
8. Erosion and sediment controls must be implemented to prevent impacts during disturbance and construction activities.
9. All stormwater management systems must have an operation and maintenance plan to ensure that systems function as designed. When the proposed discharge may have an impact upon a sensitive receptor, including water bodies and wetlands, storm sewers and/or combined sewers, the Department of Public Works may require an increase in these minimum requirements, based on existing water quality conditions and/or stormwater system capacity.

B. Stormwater Management Measures

1. Stormwater management measures shall be required to satisfy the minimum control requirements and shall be according to the following order of preference:

- (a) Infiltration, flow attenuation, and pollutant removal of runoff on-site to existing areas with grass, trees, and similar vegetation and through the use of open vegetated swales and natural depressions;
- (b) Use of stormwater on-site to replace water used in industrial processes or for irrigation;
- (c) Stormwater detention structures for the temporary storage of runoff which is designed so as not to create a permanent pool of water; and
- (d) Stormwater retention structures for the permanent storage of runoff by means of a permanent pool of water.
- (e) Retention and evaporation of stormwater on rooftops or in parking lots.

2. Infiltration practices shall be utilized to reduce runoff volume increases. A combination of successive practices may be used to achieve the applicable minimum control requirements. Justification shall be provided by the applicant for rejecting each practice based on site conditions.

3. Best Management Practices shall be employed to minimize pollutants in stormwater runoff prior to discharge into a storm drainage system or water body.

4. All stormwater management facilities shall be designed to provide an emergency overflow system, and incorporate measures to provide a non-erosive velocity of flow along its length and at any outfall.

5. The designed release rate of any stormwater structure shall be modified if any increase in flooding or stream channel erosion would result at a downstream dam, highway, structure, or normal point of restricted stream flow.

G Discharges to the Municipal Storm Drain System

1. Illicit Discharges

No person shall dump, discharge, cause or allow to be discharged any pollutant or non-stormwater discharge into the municipal separate storm sewer system (MS4), into a watercourse, or into the waters of the Commonwealth.

2. Illicit Connections

No person shall construct, use, allow, maintain or continue any illicit connection to the municipal storm drain system, regardless of whether the connection was permissible under applicable law, regulation or custom at the time of connection.

3. Obstruction of Municipal Storm Drain System

No person shall obstruct or interfere with the normal flow of stormwater into or out of the municipal storm drain system without prior written approval from The Department of Public Works.

I. Notification of Spills

Notwithstanding other requirements of local, state or federal law, as soon as a person responsible for a facility or operation, or responsible for emergency response for a facility or operation has information of or suspects a release of materials at that facility or operation resulting in or which may result in discharge of pollutants to the municipal drainage system or waters of the Commonwealth, the person shall take all necessary steps to ensure containment, and cleanup of the release. In the event of a release of oil or hazardous materials, the person shall immediately notify the Town of Ludlow Fire, Police, Health, and Public Works Departments. In the event of a release of non-hazardous material, the reporting person shall notify the Authorized Enforcement Agency no later than the next business day. The reporting person shall provide to the Authorized Enforcement Agency written confirmation of all telephone, facsimile or in-person notifications within three business days thereafter. If the discharge of prohibited materials is from a commercial or industrial facility, the facility owner or operator of the facility shall retain on-site a written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least three years.

J. Maintenance

1. Operation, Maintenance and Inspection Agreement

a. Prior to issuance of any building permit for which stormwater management is required, the Department of Public Works shall require the applicant or owner to execute an operation, maintenance and inspection agreement binding on all subsequent owners of land served by the private stormwater management facility. The agreement shall be designed to ensure that water quality standards are met in all seasons and throughout the life of the system. Such agreement shall provide for access to the facility at reasonable times for regular inspections by the town or its authorized representative and for regular or special assessments of property owners to ensure that the facility is maintained in proper working condition to meet design standards and any provision established.

2. Maintenance Responsibility

a. The owner of the property on which work has been done pursuant to this bylaw for private stormwater management facilities, or any other person or agent in control of such property, shall maintain in good condition and promptly repair and restore all grade surfaces, walls, drains, dams and structures, vegetation, erosion and sediment control measures and other protective devices. Such repairs or restoration and maintenance shall be in accordance with approved plans.

b. A maintenance schedule shall be developed for the life of any stormwater management facility and shall state the maintenance to be completed, the time period for completion, and who shall be legally responsible to perform the maintenance. This maintenance schedule shall be printed on the stormwater management plan.

- c. Records of installation and maintenance shall be maintained by the property owner and shall be made available to Town officials by request. These records shall be stored by the property owner for a period of five years.
- d. Failure to maintain practices any stormwater management facility shall be subject to the enforcement and penalties identified in Section L herein.

Subdivision Rules and Regulations

In addition to the Zoning By-Laws, Ludlow has adopted Rules and Regulations Governing the Subdivision of Land. There are two sections of these subdivision regulations which address flood hazards and water resource protection. The subdivision design standards require easements for proper drainage, storm water system construction, and standards for retention and detention ponds.

Section III: Design Standards

B. Easements

- 2. Where the subdivision is traversed by a water course drainage way, channel, or stream, the Planning Board may require that there be provided a storm water easement or drainage right-of-way of adequate width to conform substantially to the lines of such water course, drainage way, channel, or stream, and to provide for construction or other necessary purposes.

E. Utilities

1. Storm Water System

- a. Storm water drains, including any of their related structures, shall be designed and installed by the applicant, wherever and whenever, in the opinion of the Planning Board, such are necessary to provide adequate disposal of surface water from all streets and lots within the subdivision and those lands and roadways immediately adjacent to the subdivision.
- b. ...The area to be used in the design computations of the storm drainage system, shall include the entire natural drainage basin tributary to the area being developed, including adjacent undeveloped land which shall be based on the ultimate development of the area in accordance with the existing zoning laws.
- c. The hydrology calculations for the subdivision must be submitted showing the 1, 2, 5, 10, 25, 50, and 100 year storm... .
- f. All storm water systems that eventually outlet to either a detention pond or a wetland area shall have hoods installed in all catch basins within the system.

J. Retention/Retention Pond Standards

2. Exit pipe shall be equipped with a trash rack of at least 1/2 inch metal with openings of no more than 4 inches in one direction.
3. All retention/detention ponds shall be provided with an emergency spillway capable of passing the 100 year flood event, and satisfactory to the Planning Board, the Board of Public Works and the Conservation Commission.
4. Computation for the sizing of the pond shall be provided with definitive plan submission. Said computation shall be based on a 1, 2, 5, 10, 25, 50, and 100 design storm and a zero increase in runoff assumption. All outlet structures shall have a three stage design.
6. An easement shall be provided for Town access. Said easement shall be sufficient in dimensions to allow for Town vehicles and personnel to perform routine maintenance work.

Section IV: Required Improvements

6. Development Within Flood Plain Districts

a. All subdivision proposals and other proposed development shall be reviewed to determine whether such proposals will be reasonably safe from flooding. If any part of a subdivision proposal or other new development is located within the Flood Plain District established under the Zoning Bylaw, it shall be reviewed to assure that:

- (1) the proposal is designed consistent with the need to minimize flood damage, and
- (2) all public utilities and facilities, such as sewer, gas, electrical, and water systems shall be located and constructed to minimize or eliminate flood damage, and
- (3) adequate drainage systems shall be provided to reduce exposure to flood hazards, and
- (4) base flood elevation (the level of the 100 year flood) data shall be provided for proposals greater than 50 lots or 5 acres, whichever if the lesser, for that portion within the Flood Plain District.

Special permit is also required in accordance with Section 5.0 of the Zoning Bylaw.

b. All mobile homes within the Flood Plain District shall provide that:

- (1) stands or lots are elevated on compacted fill or on pilings so that the lowest flood of the mobile home will be at or above the base flood level, and
- (2) adequate surface drainage and access for a hauler are provided, and

(3) in the instance of elevation on pilings, lots are large enough to permit steps, piling foundations are placed in stable soil no more than 10 feet apart, and reinforcement is provided for piers more than six feet above ground level.

Floodplain Regulations in Conservation Commission Bylaw

1. Purpose

The purpose of this bylaw is to assist the Conservation Commission in protecting the wetlands, water resources, and adjoining land areas in the Town of Ludlow by controlling activities deemed by the Conservation Commission likely to have a significant or cumulative effect upon resource area values, including but not limited to the following: public or private water supply, groundwater, flood control, erosion and sedimentation control, storm damage prevention, water quality, water pollution control, fisheries, wildlife habitat, rare species habitat including rare plant species, agriculture, aquaculture, and recreation values, deemed important to the community.

2. Jurisdiction

No person shall commence to remove, fill, dredge, build upon, degrade, discharge into, or otherwise alter the following resource areas: any freshwater wetlands, marshes, wet meadows, bogs, swamps, vernal pools, banks, reservoirs, lakes, ponds of any size, rivers, streams, creeks, beaches, lands under water bodies, lands subject to flooding or inundation by groundwater or surface water, and lands abutting any of the aforesaid resource areas (collectively the “resource areas protected by this By-law”). Said resource areas shall be protected whether or not they border surface waters. This jurisdiction shall extend to a buffer area of 100 feet away from any of the above described resource areas, and is extended to a buffer area of 200 feet away from a river or stream. Except where permitted by the Wetlands Protection Act, no person shall develop or disturb an area within 25 feet of the above described resource areas, to be known as a minimum non-disturb zone.

2.b. Flood Control:

Any proposed work in the Floodplain or Isolated Areas or Bordering Land subject to Flooding may not begin without first filing a Notice of Intent with the Conservation Commission and must be in compliance with Chapter 131, Section 40 of the Massachusetts General Laws, and 310 CMR 10.57, and the Massachusetts Building Code pertaining to construction in the Floodplains.

The Floodplain District is delineated on the Ludlow Flood Insurance Rate Map (FIRM), dated May 19, 1981, as Zones A, A 1-30 to indicate the 100-year floodplain. The precise boundaries of the district are defined by the 100-year flood elevations shown on the FIRM and further defined by the Flood Profiles contained in the Flood Insurance Study dated May 19, 1981. Within Zone A, where the 100-year flood elevation is not provided on the FIRM, the developer/applicant shall obtain any existing flood elevation data and it shall be reviewed by the Department of Public Works. If the data is sufficiently detailed and accurate it shall be relied upon to require compliance with this Bylaw and the State Building Code.

River and Stream Protection

The Town of Ludlow follows the standards established by the Wetlands Protection Act, which protects water bodies and wetlands through the town Conservation Department.

Stormwater Project Priority List

The Town's Department of Public Works keeps a current prioritized list of project needs for stormwater management, localized flood-prone areas, and culvert replacements and repairs. The current top priority is a stormwater control project in the River Street neighborhood, and the DPW has applied to the Hazard Mitigation Grant Program (HGMP) to help fund this project. The other top priority is augmenting stormwater drainage in the Electric Park neighborhood to increase its capacity and prevent flooding.

Ludlow Open Space and Recreation Plan

Recent efforts by the Ludlow Open Space Committee and others have resulted in the creation of municipal plans that are useful for flood hazard mitigation purposes. In 2006, the Town updated its Open Space and Recreation Plan. The intent of the document is not to address hazard mitigation or flood control in a direct or comprehensive way; however, it inventories the natural features and environments in the Town, many of which, such as wetlands, aquifer recharge areas, farms, rivers, streams, and brooks, contain floodplain, dam failure inundation or localized flooding areas.

The plan highlights the importance of balancing future development with the preservation of the community's natural and scenic resources. The preservation of open space and farmland will provide flood storage capacity, which reduces the amount of impervious surfaces in an area, as well as other benefits not directly related to natural hazard mitigation.

Furthermore, the plan identifies several potential initiatives, including adopting a Low Impact Development By-Law and pursuing land acquisition programs, which would help provide a higher level of protection to areas near major water bodies. In addition, one key goal is to "protect the rivers, streams, ponds, and wetlands of Ludlow and the watersheds that sustain them".

National Flood Insurance Program

The Town of Ludlow participates in the National Flood Insurance Program. As of 2006, there were twelve (12) policies in effect in Ludlow for a total of \$2,169,100 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 that a town has taken to control flood losses.

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. To participate in the CRS, a community must fill out an application and submit documentation that shows what it is doing and that its activities deserve at least 500 points. More information including instructions and applications is available at <http://training.fema.gov/EMIWeb/CRS/m3s1main.htm>

Table 5-1: Existing Flood Hazard Mitigation Measures

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
Flood Control Structures	One dam and two dikes.	Flood inundation zone below Collins Dam and areas along Chicopee River adjacent to dikes.	Not known.	Map location of dikes and areas protected from flooding.
Zoning By-Laws				
Special Permits	Requires proposed development to address and mitigate any flood hazards.	Only site in proposal.	Very effective for preventing flood damages, but only in a limited area.	Add topographic change, increased runoff, removal of vegetation, and erosion risk.
Overlay District – Water Supply Protection	Areas delineated as part of the watershed for the two water supply sources are protected by strict use regulations.	Springfield and Nash hill Reservoirs’ watersheds	Very effective for controlling impacts from storm water runoff, and for preventing development in those two floodplain areas.	Revise to keep consistent with DEP example Source Water Protection bylaw – clarify definitions.
Stormwater Regulations	Stormwater and erosion control plans are required for any new commercial development or project larger than 1 acre.	Entire town.	Very effective for controlling impacts from stormwater runoff.	None.
Subdivision Rules and Regulations				

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
Design Standards	Requirements for storm water management systems – easements, detention/retention ponds, etc.	Proposed subdivisions	Somewhat effective for controlling impacts from storm water runoff	Add infiltration requirements, impervious surface limits, etc.
Required Improvements	Development limitations within the floodplain.	100-year floodplain	Very effective for preventing incompatible development within the floodplain.	Consider making this effective for all subdivisions.
Conservation Commission Bylaw				
Floodplain Management	Areas within the 100-year floodplain are strictly regulated and new development is restricted.	100-year floodplain	Somewhat effective for preventing development in flood prone areas; not sufficient to meet FEMA standards for NFIP.	Per MEMA recommendation move this language back into Zoning Code – thereby creating a Floodplain Zone District.
Other Mitigation Measures				
River and Stream Protection	Required enforcement of standards established by Wetlands Protection Act.	Entire town.	Effective at protecting water bodies and wetlands.	None.
Stormwater Project Priority List	Prioritized list of culvert replacements, repairs, and other stormwater management needs.	Entire town.	Effective in managing necessary improvements to flood prone areas.	Replace priority culverts, from top priorities on list.
Ludlow Open Space 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	Entire town.	Effective in identifying sensitive resource areas, including floodplains. Encourages forestland	Implement the recommended Actions, particularly regarding the Low Impact Development by-law and open space acquisition

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
	brooks.		and farmland protection, which will help conserve the town's flood storage capacity.	program.
Participation in the National Flood Insurance Program	As of 2006, there were twelve 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.	Initiate process to become a part of FEMA's Community Rating System.

Severe Snowstorms/Ice Storms

Winter storms can be especially challenging for emergency management personnel even though the storm has usually been forecast. 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.

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 5-1 can also be considered as mitigation measures for severe snowstorms/ice storms.

Management Plans¹²

The CEM Plan for Ludlow lists the following generic mitigation measures for severe winter storms:

1. Develop and disseminate emergency public information concerning winter storms, especially material which instructs individuals and families how to stock their homes, prepare their vehicles, and take care of themselves during a severe winter storm.
2. 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.
3. Maintain plans for managing all winter storm emergency response activities.

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

1. Ensure that warning/notification, and communications systems are in readiness.
2. Ensure that appropriate equipment and supplies, (especially snow removal equipment), are in place and in good working order.
3. Review mutual aid agreements.
4. Designate suitable shelters throughout the community and make their locations known to the public.
5. Implement public information procedures during storm 'warning' stage.
6. Prepare for possible evacuation and sheltering of some populations impacted by the storm (especially the elderly and special needs).
7. Broadcast storm warning/notification information and instructions.
8. Conduct evacuation, reception and sheltering activities.
9. If appropriate, activate media center. Refer to Resource Manual for media center information.
10. Dispatch search and rescue teams.

11. Dispatch emergency medical teams.
12. Take measures to guard against further danger from power failure, downed trees and utility lines, ice, traffic problems, etc.
13. Close roads, and/or limit access to certain areas if appropriate.
14. Provide assistance to homebound populations needing heat, food, and other necessities.
15. Provide rescue and sheltering for stranded/lost individuals.

Land Use Regulations that Mitigate Impacts of Severe Storms

There are no restrictions on development that are directly related to severe winter storms. However, Ludlow's Subdivision Rules and Regulations set grade limits on streets, which, although not specified as weather hazard mitigation, can serve to minimize accident potential and power loss from severe winter storms:

Section III – Design Standards – Street

3. Grade

Grades of streets shall be not less than 0.5%. Grades shall not be more than 6.0% for connector streets, and not more than 8.0% for minor and major residential streets. As far as practicable, all roads shall follow natural contours.

Section III: Design Standards - Utilities

4. Electrical Transmission Lines

All line and/or wires used for the transmission of electricity and/or intelligence shall be placed underground within the subdivision....

(1) All lines and appurtenances for the distribution of electricity shall be buried at a minimum of three (3) feet below the approved final grade of streets, walks, or tree belts.

(2) All lines and appurtenances for the distribution of intelligence shall be buried at a minimum depth of eighteen (18") inches below the approved final grade of the streets.

(3) In areas serviced by cable television, appropriate provisions shall be included for such services.

Other Mitigation Measures

Severe snowstorms or ice storms can often result in a small or widespread loss of electrical service. The Ludlow Public Safety Building, the High School, and the Middle School are all served by large pad-mounted generators that will provide electric power in the event of primary power failure. Health South also has on-site electric generator power. Mass Municipal Wholesale Electric Company is located with town and is a good resource as a source of electricity in case of an emergency, but is not responsible for local service.

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. The Town of Ludlow currently has a Building Commission who manages all building inspection services.

Table 5-2: Existing Severe Snowstorms/Ice Storms Hazard Mitigation Measures

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
Subdivision Rules and Regulations				
Design Standards - Streets	Standards include street grade regulations (6-8%t maximum).	New subdivisions.	Effective.	None.
Design Standards – Utilities	Regulates electrical transmission lines placement underground.	New subdivisions.	Somewhat effective for ensuring that utility service is uninterrupted by severe storms.	Contract with utility companies to put underground new utility lines and existing utility lines in locations where repetitive outages occur.
Other Mitigation Measures				
Urban Preservation Plan	Plan to manage trees in town – pruning, planting, etc, coordinated with WMECO.	Entire town	Effective.	None.
Backup Electric Power	Three shelters (Health South, High School and Middle School) and Public Safety Building all have generators	Entire town.	Effective.	None.
State Building Code	The Town of Ludlow has adopted the Massachusetts State Building Code.	Entire town.	Effective.	None.
Debris Management Plan	A debris management plan could be developed. ¹⁴	Entire town.	Effective.	Participate in the creation of a Regional Debris Management Plan.

¹⁴ 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>.

Hurricanes/Severe Thunderstorms

Of all the natural disasters that could potentially impact Ludlow, 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). 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. The Ludlow Comprehensive Emergency Management (CEM) Plan identifies the dense area in the southwest corner of town, along the Chicopee River, as the highest risk in case of hurricanes..

The Town of Ludlow's wireless communications bylaw, height restrictions on development, and State Building Code regulations, as listed below, are equally applicable to wind events such as hurricanes and tornadoes.

Management Plans¹²

The CEM Plan for Ludlow includes the following generic mitigation measures for hurricane planning and response:

1. Develop and disseminate emergency public information and instructions concerning hurricane preparedness and safety.
2. Community leaders should ensure that Ludlow is enrolled in the National Flood Insurance Program.
3. 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.
4. Maintain plans for managing all hurricane emergency response activities.

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

1. Ensure that warning/notification systems and equipment is ready for use at the 'hurricane warning' stage.
2. Review mutual aid agreements.
3. Designate suitable wind and flood resistant shelters in the community and make their locations known to the public.
4. Prepare for coordination of evacuation from potentially impacted areas including alternate transportation systems and locations of special needs facilities.
5. Activate warning/notification systems to inform public of protective measures to be taken including evacuation where appropriate.

6. Conduct evacuation of affected populations.
7. Open and staff shelters and reception centers.
8. Dispatch search and rescue teams.
9. Dispatch emergency medical teams.
10. Activate mutual aid activities.
11. Take measures to guard against further danger from downed trees and utility lines, debris, etc.

Evacuation Options

The Ludlow CEM Plan identifies five special needs facilities at risk during a hurricane including: St. John the Baptist School, State Street and Chestnut Street Housing for Elderly, the Early Childhood Center, and the Boys and Girls Club (the same as for flooding). According to the Ludlow CEM Plan, local officials have stated that the Ludlow High School, Baird Middle School, Chapin Street School, and East Street School are the appropriate shelters for residents in the case of a hurricane. The Plan also identifies that approximately 5,000 people would be affected by a hurricane, 47 of which would need special assistance. The primary area of concern is downtown, near the Chicopee River, and evacuees would be transported out in their own vehicles, as well as with ten buses, two wheelchair vans, and two ambulances, if necessary.

Land Use Regulations that Mitigate Hurricane Impacts

Zoning By-Laws

There are no wind-related restrictions on development in the Ludlow Land Development Ordinance. However, the Ordinance does state “height” as one feature of development able to be regulated “to promote the general welfare of the Town of Ludlow, to protect the health of its inhabitants, to encourage the most appropriate use of land within the Town, to increase the amenities of the Town, and to provide an adequate supply of light and air and reduce the hazard from fire.” Although height is addressed in the general dimensional requirements, it exempts several structures which could be hazardous in high winds. Height is also addressed in a subsection dedicated to wireless communications.

Section IV: Dimensional and Density Regulations – General Dimensional Requirements

4.0.11 Height Provisions

- a. See Table of Dimensional Regulations for height provisions.
- c. Exceptions: The height provisions of this bylaw shall not apply to such structures as belfries, chimneys, flags, television or radio poles, windmills, silos, barns, elevator enclosures, water tanks, scenery lofts, bulkheads, and similar structures not used for residence purposes.

Section VI: Special Land Use Regulations – Wireless Communications Facilities

6.7.1 Intent

The intent of this section is to regulate the siting and design of commercial and public utility-operated wireless communications facilities and to minimize any adverse impact that may be associated with facilities such as, but not limited to, cellular telecommunications towers.

6.7.3 Design Standards for Facilities

Wireless communications facilities are subject to the requirements of the underlying zone and the following site design standards.

- a. Height. Ground-mounted facilities shall not exceed the permitted height of the underlying zone. For roof-, side-, and facade-mounted facilities, the sixteen (16) feet above the existing roof line. In the case of an existing building height of sixteen (16) feet or less, the height of a roof - or facade-mounted facility shall not exceed the height of the existing building as defined in Table 2.

Subdivision Rules and Regulations

Within the Subdivision Standards section, there are other relevant requirements, specifically regarding underground utilities.

Section III: Design Standards - Utilities

4. Electrical Transmission Lines

All line and/or wires used for the transmission of electricity and/or intelligence shall be placed underground within the subdivision....

- (1) All lines and appurtenances for the distribution of electricity shall be buried at a minimum of three (3) feet below the approved final grade of streets, walks, or tree belts.
- (2) All lines and appurtenances for the distribution of intelligence shall be buried at a minimum depth of eighteen (18") inches below the approved final grade of the streets.
- (3) In areas serviced by cable television, appropriate provisions shall be included for such services.

State Building Code

For new or recently built structures, the primary protection against wind-related damage is construction that adheres to the State Building Code, which, when followed, results in buildings that withstand high winds. The Town of Ludlow currently employs a Building Commissioner to oversee all building inspections.

Tornadoes/Microbursts

Worcester County and areas just to its west, including portions of Hampden County, have been dubbed the “tornado alley” of the state because the majority of significant tornadoes in Massachusetts’s weather history have occurred in that region. Like earthquakes, the location and extent of potential damaging impacts of a tornado are completely unpredictable. Most damage from tornadoes comes from high winds that can fell trees and electrical wires, generate hurtling debris and, possibly, hail. According to the *Institute for Business and Home Safety*, the wind speeds in most tornadoes are at or below design speeds that are used in current building codes.¹⁵

Management Plans¹²

The CEM Plan for Ludlow includes the following generic mitigation measures for tornado planning and response:

1. 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.
2. Strict adherence should be paid to building code regulations for all new construction.
3. 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 Ludlow includes the following generic preparedness and response measures for tornadoes:

1. Designate appropriate shelter space in the community that could potentially withstand tornado impact.
2. Periodically test and exercise tornado response plans.
3. Put Emergency Management on standby at tornado ‘watch’ stage.
4. At tornado ‘warning’ stage, broadcast public warning/notification safety instructions and status reports.
5. Conduct evacuation, reception, and sheltering services to victims.
6. Dispatch search and rescue teams.
7. Dispatch emergency medical teams.
8. Activate mutual aid agreements.
9. Take measures to guard against further injury from such dangers as ruptured gas lines, downed trees and utility lines, debris, etc.
10. Acquire needed emergency food, water, fuel, and medical supplies.
11. Take measures relating to the identification and disposition of remains of the deceased.

Evacuation Plans

There is no shelter for tornado victims identified in the Ludlow CEM Plan.

¹⁵ www.ibhs.org.

Table 5-3: Existing Hurricane and Tornado Hazard Mitigation Measures (Wind-Related)

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
Zoning By-Laws				
Height Restrictions	The town restricts height of development based on use and zoning district.	Entire town.	Somewhat effective for preventing wind damage.	Consider restricting heights on building structures such as chimneys, etc.
Trailers/Mobile Homes Regulations	Mobile homes are an allowed use in all districts.	Entire town.	Does not address the potential for wind-related damage to mobile homes.	Consider revising to ensure safety of mobile homes in case of wind-related hazard.
Subdivision Rules and Regulations				
Design Standards - Utilities	Electric, cable, and communications utility lines are to be placed underground.	New subdivisions	Somewhat effective for ensuring that utility service is uninterrupted by severe storms.	Contract with utility companies to put underground new utility lines in general and existing utility lines in locations where repetitive outages occur.
Other Mitigation Measures				
State Building Code	The Town of Ludlow has adopted the Massachusetts State Building Code.	Entire town.	Effective.	None.
Debris Management Plan	A debris management plan could be developed. ¹⁶	Entire town.	Effective.	Participate in the creation of a Regional Debris Management Plan.

¹⁶ 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>.

Wildfires/Brushfires

Hampshire County has approximately 252,000 acres of forested land, which accounts for 71 percent of total land area. Forest fires are therefore a potentially significant issue. In Ludlow, approximately 58 percent of the town's total land area is in forest, or about 10,650 acres, and is therefore at risk of fire. Between 1996 and 2006, there were 238 brush fires reported in Ludlow according to Ludlow Fire Department, with 18 occurring in 2006 alone.

Restrictions on Development

There are currently no restrictions on development that are based on the need to mitigate the hazards of wildfires/brushfires. However, the Fire Department is involved in subdivision and site plan review.

Subdivision and Site Plan Review

Providing supplemental water supply is a required improvement necessary for subdivision review. A Fire Control Plan is a component of this, and involves review from the Ludlow Fire Department. In addition, the Fire Department is able to review site plans if the Planning Board enlists its expertise.

Regulatory Measures

Burn Permits

Burn permits for the Town are issued from the Ludlow Fire Department. The number of permits issued annually depends significantly on climate conditions each year. Some years, if conditions are too dry, burn season is cancelled all together. During the issuance of a burn permit, the applicant must read guidelines for when and where the burn may be conducted as well as fire safety tips. 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.

Public Education/Outreach

The Ludlow Fire Department also receives state grant funding to implement its SAFE Program (Student Awareness of Fire Education) every October, visiting several schools and daycares to target all elementary school-age children, grades pre-K through fifth. The Town's Fire Prevention Officer also runs a program with senior citizens, and visits the home economics and health classes in the High School every year. Representatives from the Fire Department also attend annual health fairs at the High School and Senior Center.

Table 5-4: Existing Wildfire/Brushfire Hazard Mitigation Measures

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
Overlay District – Water Supply Protection	Areas delineated as part of the watershed for the two water supply sources are protected by strict use regulations.	Springfield and Nash Hill Reservoirs’ watersheds	Effective for protecting groundwater infiltration and regulating hazardous materials/wastes in sensitive areas.	Revise to keep consistent with DEP example Source Water Protection bylaw – clarify definitions.
Subdivision and Site Plan Review for Fire Safety	The Fire Department is involved in the review of subdivision and site plans.	Entire town.	Effective.	None.
Burn Permits	Residents are permitted to obtain burn permits. Fire Department personnel provide information on safe burn practices.	Entire town.	Effective.	None.
Public Education/ Outreach	The Fire Department has an ongoing educational program in the schools, and with senior citizens.	Entire town.	Effective.	None.

Earthquakes

Although there are five mapped seismological faults in Massachusetts, there is no discernable pattern of previous earthquakes along these faults 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.

In addition, earthquakes precipitate several potential devastating secondary effects such as building collapse, utility pipeline rupture, water contamination, and extended power outages. Therefore, many of the mitigation efforts for other natural hazards identified in this plan may be applicable during the Town's recovery from an earthquake.

Management Plans¹²

The Ludlow CEM Plan lists the following generic mitigation measures for earthquakes:

1. 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.
2. Strict adherence should be paid to land use and earthquake resistant building codes for all new construction.
3. Periodic evaluation, repair, and/or improvement should be made to older public structures.
4. Emergency earthquake public information and instructions should be developed and disseminated.
5. Earthquake drills should be held in schools, businesses, special care facilities, and other public gathering places.

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

1. Earthquake response plans should be maintained and ready for immediate use.
2. All equipment, supplies and facilities that would be needed for management of an earthquake occurrence should be maintained for readiness.
3. Emergency Management personnel should receive periodic training in earthquake response.
4. If the designated Emergency Operations Center (EOC) is in a building that would probably not withstand earthquake impact, another building should be chosen for an earthquake EOC.
5. Mass Care shelters for earthquake victims should be pre-designated in structures that would be most likely to withstand earthquake impact.
6. EOC will be activated and response will immediately be engaged to address any and all earthquake effects listed.

7. Emergency warning/notification information and instructions will be broadcast to the public.
8. Search and rescue teams will be dispatched.
9. Emergency medical teams will be dispatched.
10. Firefighters will address fires/explosions, and HAZMAT incidents.
11. Law enforcement personnel will coordinate evacuation and traffic control.
12. Reception centers and shelters will be opened and staffed.
13. Animal control measures will be taken.
14. Law enforcement personnel will protect critical facilities and conduct surveillance against criminal activities.
15. Immediate life-threatening hazards will be addressed such as broken gas lines, downed utility wires, and fire control resources.
16. Emergency food, water, and fuel will be acquired.
17. Activate mutual aid.
18. Measures will be taken relating to identification and disposition of remains of deceased by the Chief Medical Examiner.

Evacuation Options

The maximum peak population affected by an earthquake is estimated at 18,786 people, 604 would be without transportation, and 190 would need special assistance. The CEM Plan identifies evacuation routes, and specifies that up to 15 buses, 3 vans, and 5 ambulances may need to be used in addition to private vehicles. According to the Ludlow CEM Plan, earthquake victims can seek shelter at all shelters identified.

Land Use Regulations that Mitigate Earthquake Impacts

Subdivision Rules and Regulations

Within the Subdivision Standards section, there are some relevant requirements, specifically regarding underground utilities.

Section III: Design Standards - Utilities

4. Electrical Transmission Lines

All line and/or wires used for the transmission of electricity and/or intelligence shall be placed underground within the subdivision....

(1) All lines and appurtenances for the distribution of electricity shall be buried at a minimum of three (3) feet below the approved final grade of streets, walks, or tree belts.

(3) All lines and appurtenances for the distribution of intelligence shall be buried at a minimum depth of eighteen (18") inches below the approved final grade of the streets.

(4) In areas serviced by cable television, appropriate provisions shall be included for such services.

5. Gas Transmission Lines

All main or distribution pipelines used for the transmission of gas shall be placed underground within the subdivision, in a location and at a depth approved by the Planning Board. Related equipment and accessories shall be installed in conformance with the Department of Public Safety Standards.

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, 6th Edition of the Massachusetts State Building Code. Given that most structures in Massachusetts were built before 1975, of many buildings and structures do not have specific earthquake resistant design features. According to the 2000 U.S. Census, 56 percent of the housing in Ludlow 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 5-5: Existing Earthquake Hazard Mitigation Measures

Type of Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
Subdivision Rules and Regulations				
Design Standards - Utilities	Electric, cable, and communications utility lines are to be placed underground.	New subdivisions	Somewhat effective for ensuring that utility service is uninterrupted by earthquakes.	Contract with utility companies to put underground new utility lines in general and existing utility lines in locations where repetitive outages occur.
Other Mitigation Measures				
State Building Code	The Town of Ludlow has adopted the State Building Code.	Entire town but applies to new construction only.	Effective for new buildings only.	Evaluate older structures to be used as shelters to determine if they are earthquake resistant.
Debris Management Plan	A debris management plan could be developed.	Entire town.	Effective.	Participate in the creation of a Regional Debris Management Plan.
Shelters	Shelters have been identified for victims of earthquakes in Ludlow.	Entire town.	Effective.	Ensure shelters are earthquake proof.

Dam Failures

The only mitigation measures in place for dams are the state regulations that control their construction and inspection.

Management Plans and Regulatory Measures¹²

The Ludlow 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

1. Activate EOC
2. Activate all communication networks
 - Establish communications with Command Position on a 24-hour basis.
3. Release public information
4. Notify:
 - MEMA Region Headquarters
 - American Red Cross
 - Downstream communities
5. Review Plans for evacuation and sheltering
 - a. Evacuation
 - routes
 - notification
 - b. Shelter
 - availability and capacity
 - food, supplies, and equipment
 - shelter owners and managers
 - other communities (if out of town sheltering is required)
6. Require “Stand By” status of designated emergency response forces.

Type 2: Rapidly Developing Condition

1. Establish a 24-hour communications from dam site to EOC.
2. Assemble, brief and assign specific responsibilities to emergency response forces.
3. Release public information.
4. Obtain and prepare required vehicles/equipment for movement.
5. Prepare to issue warning.

Type 3: Practically Instantaneous Failure

1. Issue warning
2. Commence immediate evacuation.
3. Commit required resources to support evacuation.
4. Activate shelters or coordinate activation of shelters located outside the community.
5. Notify:
 - MEMA Region Headquarters
 - Red Cross
6. Initiate other measures as required to protect lives and property.

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

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

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

1. Pre-place adequate warning/notification systems in areas potentially vulnerable to dam failure impact.
2. Pre-place procedures for monitoring dam site conditions at first sign of any irregularity that could precipitate dam failure.
3. Identify special needs populations, evacuations routes, and shelters for dam failure response.
4. Have sandbags, sand, and other items to reinforce dam structure or flood proof flood prone areas.
5. Disseminate warning/notification of imminent or occurring dam failure.
6. Coordinate evacuation and sheltering of affected populations.
7. Dispatch search and rescue teams.

8. Coordinate evacuation and sheltering of affected populations.
9. Activate mutual aid if needed.
10. Acquire additional needed supplies not already in place, such as earth moving machinery.
11. Establish incident command post as close to affected area as safely possible.
12. Provide security for evacuated public and private property.

Evacuation Options

The Ludlow CEM Plan identifies the several dams and their associated inundation zones and evacuation routes. Depending on the dam that failed, there could be an estimated peak population of up to 10,000 people downstream, and several special needs facilities. The Ludlow CEM Plan does not note any potential for dam hazards emanating from dams upstream of the town.

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 Hazards are inspected every ten (10) years, dams that are rated as Medium/Significant Hazards are inspected every five (5) years, and dams that are rated as High Hazards are inspected every two (2) years. This is the responsibility of the dam owner.

Zoning

There is no mention made regarding the construction of new dams in the Town of Ludlow zoning or subdivision regulations, although alterations of watercourses must be reported.

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.

Table 5-6: Existing Dam Failure Hazard Mitigation Measures

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
New Dam Construction Permits	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, medium, high hazard).	Entire town.	Unknown. The responsibility for this is now on dam owners, who may or may not have sufficient funding to comply.	None.
Evacuation Plans	Evacuation plans ensure the safety of the citizens in the event of dam failure, map out routes.	Inundation areas in town.	None.	Obtain all maps of inundation areas and evacuation routes for all high hazard dams—required by state as part of Emergency Action Plans. Educate citizens living within inundation areas about evacuation routes.

Drought

Although Massachusetts does not face extreme droughts like many other places in the country, it is susceptible to dry spells and drought. And unlike other places, drought can most likely be effectively mitigated in regions like the Pioneer Valley if measures are put into place. Ludlow has several water protection regulations in place, as evidenced in the section on flooding. Additional regulations and mitigation options, specific to drought mitigation, are included here.

Land Development Regulations that Mitigate Impacts of Drought

Ludlow's Land Development Ordinance has some sections governing flood and stormwater management and proper drainage. The by-laws protecting these features of the landscape can also be seen as preventing drought, as they promote the natural processes of infiltration and groundwater recharge. In addition, Ludlow adopted an overlay zone district to protect the town's water supply, which is included here:

Section V: Overlay District Regulations – Water Supply Protection District

5.3.1 Purpose of District

To promote the health, safety, and welfare of the community by protecting and preserving the surface and groundwater resources of the Town and the region from any use of land or buildings which may reduce the quality of its water resources.

5.3.3 District Delineation

a. The Water Supply Protection District is herein established to include all lands within the Town of Ludlow lying within the watershed areas of the Springfield Reservoir and the Nash Hill Reservoir which now or may in the future provide public water supply. The map entitled "Ludlow Water Supply Protection District", Town of Ludlow, on file with the Town clerk, delineates the boundaries of the district.

5.3.4 Prohibited uses

[Several incompatible uses listed.]

5.3.5 Restricted uses

- a. Excavation for removal of earth, sand, gravel, and other soils shall not extend closer than five (5) feet above the annual high groundwater table.
- b. Sodium chloride for ice control shall be used at the minimum salt to sand ratio which is consistent with the public highway safety requirements, and its use shall be eliminated on roads which may be closed to the public in winter.
- c. Salt storage areas shall be covered and be located on a paved surface, with berms to prevent run-off from leaving the site.

d. Fertilizers, pesticides, herbicides, lawn care chemicals, or other leachable materials shall be used with manufacturer's label instructions and all other necessary precautions to minimize adverse impacts on surface and groundwater.

e. Above-ground storage tanks for oil, gasoline, or other petroleum products shall be placed in a building, either in a concrete basement, or other indoor location on a diked, impermeable surface sufficient to contain the volume of the tank plus 10% to prevent spills or leaks from reaching groundwater.

f. Installation of on-site sewage disposal systems shall not be installed in areas where soil percolation rates are faster than two minutes per inch without additional measures imposed by the Board of Health.

5.3.6 Drainage

For commercial and industrial uses, to the extent feasible, run-off from impervious surfaces shall be recharged on the site by being diverted toward areas covered with vegetation for surface infiltration. such run-off shall not be discharged directly to rivers, streams, or other surface water bodies. Dry wells shall be preceded by oil, grease, and sediment traps to facilitate removal of contamination. All recharge areas shall be permanently maintained in full working order by the owner(s).

5.3.7 Special Permit uses

a. Uses Allowed by special Permit

The following uses may be allowed by Special Permit obtained from the Planning Board:

- (1) Commercial and industrial uses which are allowed in the Table of Uses;
- (2) Any enlargement, intensification, or alteration of an existing commercial or industrial use;
- (3) The rendering impervious of more than 20% of any single residential lot.

5.3.8 Requirements for Special Permit in the Water Supply Protection District

The site plan shall at a minimum include the following information where pertinent.

- a. A complete list of chemicals, pesticides, fuels, and other potentially hazardous materials to be used or stored on the premises in quantities greater than those associated with normal household use.
- b. Those businesses using or storing such hazardous materials shall file a hazardous materials management plan with the Planning Board, Hazardous materials coordinator, Fire chief, and Board of Health which shall include:

(1) Provisions to protect against the discharge of hazardous materials or wastes to the environment due to spillage, accidental damage, corrosion, leakage or vandalism, including spill containment and clean-up procedures.

(2) Provisions for indoor, secured storage of hazardous materials and wastes with impervious floor surfaces.

(3) Evidence of compliance with the Regulations of the Massachusetts Hazardous Waste Management Act 310 CMR 30, including obtaining an EPA identification number from the Mass Department of Environmental Protection.

c. Drainage recharge features and provisions to prevent loss of recharge.

d. Provisions to control soil erosion and sedimentation, soil compaction, and to prevent see page from sewer pipes.

5.3.9 Additional Procedures for Special Permit in the Water Supply Protection District

b. The Planning Board may grant the required special permit only upon finding that the proposed use meets the following standards:

(1) in no way, during construction or thereafter, adversely affect the existing or potential quality or quantity of water that is available in the Water Supply Protection District, and;

(2) be designed to avoid substantial disturbance of the soils, topography, drainage, vegetation, and other water-related natural characteristics of the site to be developed.

5.3.10 Requires Buffer strip Along River and Stream Banks

The following requirements shall apply to all uses allowed by right or by Special Permit:

a. A buffer strip extending one hundred (100) feet in width landward from the bank of all rivers and streams shall be required for all land within the Water Supply Protection District. If any lot existing at the time of adoption of this bylaw does not contain sufficient depth measured landward from the riverbank to provide a one hundred foot buffer strip, the buffer strip may be reduced to 50% of the available lot depth, measured landward from the river or stream bank.

b. The buffer strip shall include trees and shall be kept in a natural condition.

c. No buildings nor structures shall be erected, enlarged, altered or moved from within the buffer strip.

d. On-site waste water disposal systems shall be located no less than 150 feet from the normal high water mark of a river or stream.

Ludlow Open Space and Recreation Plan

The Ludlow Open Space and Recreation Plan serves as an inventory of the water resources in town, and identifies several goals for protecting them.

Goal: Protect the rivers, streams, ponds and wetlands of Ludlow and the watersheds that sustain them.

Objectives:

- Educate residents of the effects of their activities on the various waterways
- Collaborate with the Chicopee Watershed Committee to ensure protection of valuable wetlands.
- Ensure all state and federal wetland protections laws are strictly followed

Table 5-7: Existing Drought Hazard Mitigation Measures

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
Zoning By-Laws				
Water Supply Protection District	Areas delineated as part of the groundwater recharge zones are protected by strict use regulations.	Groundwater recharge areas.	Effective for preventing groundwater contamination and for controlling stormwater runoff.	Revise to keep consistent with DEP example Source Water Protection bylaw – clarify definitions.
Other Mitigation Measures				
Ludlow Open Space and Recreation Plan	Identifies Ludlow’s water resources.	Entire town.	Somewhat effective at promoting coordination and awareness of water resources protection.	Consider using facts from plan to predict future water supply needs. Implement recommendations to protect waterbodies and watersheds.

Man-Made Hazards/Hazardous Materials

Hazardous materials are in existence throughout Town, and are constantly being moved on Ludlow's roads and highways. However, there is no way to anticipate where and when a hazardous materials spill or explosion could take place. Therefore, it makes it somewhat difficult to determine mitigation strategies, but Ludlow has some regulations currently in place to mitigate the impacts of a hazardous materials disaster.

Management Plans¹²

The Ludlow CEM Plan does not have specific preparedness actions, but instead serves as a resource in the event of a hazardous materials disaster. It compiles all necessary information, and describes how to be trained, thereby making the community more prepared in case of an event.

For the Buckeye and Mobile pipelines, the owners conduct annual training for town personnel. Copies of the hazard plans for each pipeline are also on file with the Fire Chief. For the Bay State Natural Gas LNG Plant, there is also a hazard plan on file with the Fire Chief that is updated annually by the gas company.

Land Development Regulations that Mitigate Impacts of Hazardous Materials

Ludlow's Land Development Ordinance addresses hazard materials management, albeit briefly. It primarily governs hazardous materials through its Water Supply Protection District. (See Zoning By-Law language in previous section, *Drought*.) The overlay district contains strict restrictions on uses, as well as regulations for the use and storage of hazard materials by allowed uses. However, there are no hazardous materials regulations for areas outside of the Water Supply Protection District.

Ludlow Open Space and Recreation Plan

The Open Space and Recreation Plan for Ludlow briefly discusses the status of some hazardous waste sites and brownfields remediation in town. It also identifies sources of assistance: Pioneer Valley Planning Commission and the revolving loan fund for EPA Remediation projects.

Table 5-8

Existing Man-Made Hazard/Hazardous Materials Mitigation Measures

Existing or Proposed Protection	Description	Area Covered	Effectiveness	Potential Changes
Zoning By-Laws				
Water Supply Protection District	Restricts uses in groundwater recharge areas, regulates how to correctly store haz-mats.	Groundwater recharge areas.	Effective for preventing hazardous material spills and leaks.	Revise to keep consistent with DEP example Source Water Protection bylaw – clarify definitions.
Other Mitigation Measures				
Open Space and Recreation Plan	Discusses hazardous materials storage and brownfield sites.	Entire town.	Somewhat effective for raising awareness of hazardous materials sites in town.	None.

6 – FUTURE MITIGATION STRATEGIES

Goal Statements and Action Items

As part of the natural hazards mitigation planning process that will be undertaken by the Ludlow Local Emergency Planning Committee, existing gaps in protection and possible deficiencies will be identified and discussed. The committee will then 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.

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.

General Mitigation Action Items

Goal Statement: To provide adequate shelter, water, food and basic first aid to displaced residents in the event of a natural disaster and to provide adequate notification and information regarding evacuation procedures, etc., to residents in the event of a natural disaster.

Action Item: Revisit feasibility study of implementing Reverse 911,¹⁷ review preliminary project proposal and cost estimate for any potential adjustments.

Responsible Department/Board: Board of Selectmen, Local Emergency Planning Committee

Proposed Completion Date: 2009

Action Item: Collect, update, and disseminate emergency information to the public (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).

Responsible Department/Board: Local Emergency Planning Committee

Proposed Completion Date: 2008

Action Item: Establish arrangements with local vendors for supplying shelters with food and first aid supplies in the event of a natural disaster.

¹⁷ In essence, Reverse 911 is a Windows compatible software program, which uses GIS and database technology to create call lists of phone numbers within a specified geographical area and provide prerecorded messages to the residents at those numbers. Call lists can be created ahead of time or as emergency or other situations arise. The system is voluntary and it is a simple matter to remove those residents who do not wish to participate. Cost of the system varies depending on a number of factors. The Town of Green Tree, Pennsylvania was able to subsidize their purchase of a Reverse 911 system through a \$10,000 Community Development Block Grant.

Responsible Department/Board: Local Emergency Planning Committee, Emergency Management Director, School Department

Proposed Completion Date: Ongoing

Action Item: Work to certify Local Emergency Planning Committee with full status for Hazardous Materials emergency planning.

Responsible Department/Board: Local Emergency Planning Committee, Emergency Management Director

Proposed Completion Date: Ongoing

Action Item: Review with municipal boards the hazard mitigation purposes-of bylaws, zone districts, and subdivision regulations.

Responsible Department/Board: Conservation Commission, Department of Public Works, Local Emergency Planning Committee, Agricultural Commission

Proposed Completion Date: 2008

Flooding

Overall, the Town of Ludlow's existing land use regulations control the quantity and quality of stormwater runoff, but do little to reduce localized flooding events. Long-range planning documents such as the town's Open Space and Recreation Plan also addresses flood prevention and mitigation either directly or indirectly in the goals and objectives listed in these documents.

Goal Statement: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to flooding.

Action Item: Remove floodplain regulations from Conservation Commission bylaw and move into zoning bylaws to create new Floodplain Zone District, pending availability of funding.

Responsible Department/Board: Planning Board, Board of Selectmen

Proposed Completion Date: 2007

Action Item: Replace priority culverts on Stormwater Management Project List, pending availability of funding.

Responsible Department/Board: Department of Public Works

Proposed Completion Date: 2007

Action Item: Implement Beaver Management Strategy.

Responsible Department/Board: Board of Health, Conservation Commission

Proposed Completion Date: Ongoing

- Action Item:** Revise the Water Supply Protection Overlay District bylaw, utilizing the state model from DEP, with a focus on clarifying definitions, pending availability of funding.
- Responsible Department/Board:** Planning Board, Conservation Commission
- Proposed Completion Date:** 2009
- Action Item:** Identify zoning tools needed to provide incentives for guiding development to the most suitable and least hazardous areas of Town, pending availability of funding.
- Responsible Department/Board:** Planning Board
- Proposed Completion Date:** 2011
- Action Item:** Add more specific language in the Special Permit approval process and Subdivision Design Standards to address topographic change, removal of cover vegetation, risk of erosion or siltation and increased stormwater runoff.
- Responsible Department/Board:** Planning Board, Conservation Commission
- Proposed Completion Date:** 2010
- Action Item:** In regards to the Ludlow Open Space and Recreation Plan, implement relevant recommendations, particularly those dealing with LID bylaw, and protection of forests and farmland.
- Responsible Department/Board:** Conservation Commission, Planning Board, Board of Selectmen, Agricultural Commission
- Proposed Completion Date:** Ongoing
- Action Item:** Inventory dams, bridges, power lines, telephone lines and develop estimate of what would cost to replace with major events, pending availability of funding.
- Responsible Department/Board:** Department of Public Works, Board of Assessors
- Proposed Completion Date:** 2010
- Action Item:** Obtain information on location of dikes owned by Western Massachusetts Electric and the areas protected from flooding, pending availability of funding.
- Responsible Department/Board:** Department of Public Works
- Proposed Completion Date:** 2010
- Action Item:** Initiate process to become a part of FEMA's Community Rating System, pending availability of funding.

Responsible Department/Board: Board of Selectmen, Board of Assessors, Emergency Management Director

Proposed Completion Date: 2009

Action Item: Educate citizens living in the floodplain about the NFIP, pending availability of funding.

Responsible Department/Board: Building Inspector

Proposed Completion Date: 2009

Action Item: Identify all Pre-FIRM structures throughout town that need flood prevention modifications.

Responsible Department/Board: Building Inspector

Proposed Completion Date: 2010

Severe Snowstorms/Ice Storms

Goal Statement: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to severe snow and ice storms.

Action Item: Contract with utility companies to put underground new utility lines in general and existing utility lines in locations where repetitive outages occur.

Responsible Department/Board: Department of Public Works

Proposed Completion Date: Ongoing

Action Item: Participate in the creation of a Regional Debris Management Plan, pending the availability of funding.

Responsible Department/Board: Board of Selectmen, Planning Board, Department of Public Works

Proposed Completion Date: 2010

Hurricanes and Tornadoes

The Action Items listed above, under flooding, address the flooding that can result from a hurricane.

Goal Statement: 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 hurricanes and tornadoes.

Action Item: Contract with utility companies to put underground new utility lines in general and existing utility lines in locations where repetitive outages occur.

Responsible Department/Board: Department of Public Works

Proposed Completion Date: Ongoing

Action Item: Participate in the creation of a Regional Debris Management Plan, pending the availability of funding.

Responsible Department/Board: Board of Selectmen, Planning Board, Department of Public Works

Proposed Completion Date: 2010

Wildfires/Brushfires

Goal Statement: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to wildfires/brushfires.

Action Items: Revise the Water Supply Protection Overlay District, utilizing the state model from DEP, with a focus on clarifying definitions, pending availability of funding.

Responsible Department/Board: Planning Board, Conservation Commission

Proposed Completion Date: 2009

Earthquakes

Goal Statement: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to earthquakes.

Action Item: Contract with utility companies to put underground new utility lines in general and existing utility lines in locations where repetitive outages occur.

Responsible Department/Board: Department of Public Works

Proposed Completion Date: Ongoing

Action Item: Evaluate the Public Safety Building and the High School (older structures) to determine if they are earthquake resistant.

Responsible Department/Board: Building Inspector, Emergency Management Director

Proposed Completion Date: 2008

Action Item: Ensure that all identified shelters have sufficient back-up utility service in the event of primary power failure.

Responsible Department/Board: Emergency Management Director

Proposed Completion Date: 2009

Action Item: Participate in the creation of a Regional Debris Management Plan, pending the availability of funding.

Responsible Department/Board: Board of Selectmen, Planning Board, Department of Public Works

Proposed Completion Date: 2010

Dam Failure

Goal Statement: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to dam failures.

Action Item: Obtain all most recent maps of inundation areas and evacuation routes for high hazard dams.

Responsible Department/Board: Emergency Management Director

Proposed Completion Date: 2008

Action Item: Work with maps of inundation zones for high hazard dams and analyze development trends in these locations, pending availability of funding.

Responsible Department/Board: Planning Board

Proposed Completion Date: 2009

Action Item: Educate citizens living in inundation zones about evacuation routes in case of dam failure, pending the availability of funding.

Responsible Department/Board: Local Emergency Planning Committee

Proposed Completion Date: 2009

Drought

Goal Statement: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to severe drought.

Action Item: Draft water conservation plan, pending availability of funding.

Responsible Department/Board: Department of Public Works, Conservation Commission

Proposed Completion Date: 2009

Action Items: -Revise the Water Supply Protection Overlay District, utilizing the state model from DEP, with a focus on clarifying definitions, pending availability of funding.

Responsible Department/Board: Planning Board, Conservation Commission

Proposed Completion Date: 2009

Action Item: In regards to the Ludlow Open Space and Recreation Plan, implement relevant recommendations, particularly those dealing with protection of waterbodies and watersheds.

Responsible Department/Board: Conservation Commission, Planning Board, Board of Selectmen

Proposed Completion Date: Ongoing

Man-Made Hazards/Hazardous Materials

Goal Statement: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to hazardous materials accidents.

Action Items: Revise the Water Supply Protection Overlay District, utilizing the state model from DEP, with a focus on clarifying definitions, pending availability of funding.

Responsible Department/Board: Planning Board, Conservation Commission

Proposed Completion Date: 2009

Action Item: Work to certify Local Emergency Planning Committee with full status to continue to update the hazardous materials emergency plan.

Responsible Department/Board: Local Emergency Planning Committee

Proposed Completion Date: 2007

Prioritized Implementation Schedule

Summary of Critical Evaluation

The Ludlow Local Emergency Planning Committee reviewed each of the actions identified above, as well as existing mitigation strategies using the following factors to prioritize mitigation projects:

- Ability to reduce disaster damage
- Social acceptability
- Ability to complete or be combined w/other actions
- Technical feasibility / potential success
- Impact on the environment
- Administrative workability
- Ability to meet regulations
- Political acceptability
- Ability to save or protect historic structures
- Legal implementation
- Ability to meet other community objectives
- Economic impact
- The duration of its implementation period
- Environmental compatibility

Project Prioritization

The Ludlow Local Emergency Planning Committee created the following prioritized schedule for implementation of prioritized items. The table lists items in order of priority.

Note: As additional information becomes available regarding project leadership, timeline, funding sources, and/or cost estimates, the Plan will be reviewed and amended accordingly.

**PRIORITIZED IMPLEMENTATION SCHEDULE
(ACTION PLAN)**

IMPLEMENTATION STRATEGY FOR PRIORITY MITIGATION ACTIONS

The Ludlow Local Emergency Planning Committee created the following prioritized schedule for implementation:

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	POTENTIAL FUNDING SOURCE(S)	ESTIMATED COST
Remove floodplain regulations from Conservation Commission bylaw and move into zoning bylaws to create new Floodplain Zone District.—(See page 88)	Planning Board, BOS	2007	Local Technical Assistance Grant (PVPC)	\$2,000
Replace priority culverts on Stormwater Management Project List. (See page 88)	DPW	2007	FEMA Grant Programs	\$200,000
Work to certify Local Emergency Planning Committee with full status for Hazardous Materials emergency planning. (See page 88)	LEPC	Ongoing	Town Staff/Volunteers	N/A
Review with municipal boards the hazard mitigation purposes of bylaws, zone districts, and subdivision regulations. (See page 88)	Conservation Commission, Agricultural Commission, DPW, LEPC	2008	Town Staff/Volunteers	N/A
Collect, update, disseminate emergency information to the public ('home survival kit'; home preparation for natural disasters, evacuation procedures, etc.) (See page 87)	LEPC	2008	Town Staff/Volunteers	N/A
Establish arrangements with local vendors to supply shelters in case of natural disaster. (See page 87)	LEPC, EMD, School Department	Ongoing	Town Staff/Volunteers	N/A
Obtain all most recent maps of inundation areas and evacuation routes for high hazard dams. (See page 92)	EMD	2008	Town Staff	N/A
Evaluate the older structures to be used as emergency shelters (Public Safety building and high school) to determine if they are earthquake resistant. (See page 92)	Building Inspector, EMD	2008	Town Staff	N/A
Revisit feasibility of implementing Reverse 911. (See page 87)	BOS, LEPC	2009	Town Staff/Volunteers	N/A

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	POTENTIAL FUNDING SOURCE(S)	ESTIMATED COST
Implement Beaver Management Strategy. (See page 89)	Board of Health, Conservation Commission	Ongoing	Town Staff	N/A
Revise the Water Supply Protection District Bylaw. (See page 93)	Planning Board, Conservation Commission	2009	Smart Growth Technical Assistance Grant (PVPC)	\$2,500
Initiate process to become a part of FEMA's Community Rating System. (See page 90)	BOS, Board of Assessors, EMD	2009	Town Staff	N/A
Educate citizens living in the floodplain about the NFIP. (See page 90)	LEPC, Building Inspector	2009	Town Staff/Volunteers, FEMA Grant Programs	\$3,000
Ensure that all identified shelters have sufficient back-up utility service in case of primary power failure. (See page 92)	EMD	2009	Town Staff	N/A
Work with maps of inundation zones for high hazard dams and analyze development trends in these locations. (See page 93)	Planning Board	2009	Town Staff, FEMA Grant Programs	TBD
Educate citizens living in inundation zones about evacuation routes in case of dam failure. (See page 93)	LEPC	2009	Dam Owners, FEMA Grant Programs	TBD
Draft water conservation plan. (See page 93)	DPW, Conservation Commission	2009	Smart Growth Technical Assistance Grant (PVPC)	\$2,500
Identify zoning tools needed to provide incentives for guiding development to the most suitable and least hazardous areas of Town. (See page 89)	Planning Board	2010	Smart Growth Technical Assistance Grant (PVPC)	\$2,500
Add more specific language in the Special Permit approval process and Subdivision Design Standards. (See page 89)	Planning Board; Conservation Commission	2010	Town Staff/Volunteers	N/A
Identify all pre-FIRM structures that need flood prevention modifications. (See page 90)	Building Inspector	2010	Town Staff	N/A
Participate in the creation of a Regional Debris Management Plan. (See page 91)	DPW	2010	Western Regional Homeland Security Advisory Council	TBD

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	POTENTIAL FUNDING SOURCE(S)	ESTIMATED COST
Implement recommendations in Open Space and Recreation Plan. (See page 89)	Conservation Commission, Planning Board, BOS, Agricultural Commission	Ongoing	Town Staff/Volunteers	N/A
Contract with utility companies to put underground new utility lines in general and existing utility lines in locations where repetitive outages occur. (See page 90)	DPW	Ongoing	Town Staff	N/A
Inventory dams, bridges, power lines, telephone lines and develop estimate of what would cost to replace with major events. (See page 89)	DPW, Board of Assessors	2010	FEMA Grant Programs	\$5,000
Obtain information on location of dikes owned by Western Massachusetts Electric and areas protected from flooding. (See page 89)	DPW	2010	FEMA Grant Programs	\$600

7 – PLAN ADOPTION & IMPLEMENTATION

Plan Adoption

Upon completion, copies of the Draft Local Hazards Mitigation Plan for the Town of Ludlow were distributed to the town boards for their review and comment. A public meeting was held by the Ludlow Select Board to present the draft copy of the Ludlow Local Natural Hazards Mitigation Plan to town officials and residents and to request comments from this committee and the general public. The Natural Hazards Mitigation Plan was formally approved by the Select Board and forwarded to the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA) for their approval.

Plan Implementation

The implementation of the Ludlow Local Natural Hazards Mitigation Plan will begin following its formal adoption by the Ludlow Select Board and approval by MEMA and FEMA. Those town departments and boards responsible for ensuring the development of policies, bylaw revisions, and programs as described in Sections 5 and 6 of this plan will be notified of their responsibilities immediately following approval. The Ludlow Local Emergency Planning Committee will oversee the implementation of the plan.

Furthermore, the Town has recently hired a planner who will integrate recommendations of the Ludlow Local Natural Hazards Mitigation Plan into his work plan. The Ludlow Local Natural Hazards Mitigation Plan will also serve as a foundation document as the Town moves into the development of a comprehensive plan.

Plan Monitoring and Evaluation

The Ludlow Local Emergency Planning Committee will meet on an annual basis in September of each of the following years: 2008, 2009, 2010, 2011, 2012, and ~~or~~ as needed (*i.e.*, following a natural disaster). The public will be notified of these meetings in advance through a posting of the agenda at Town Hall. In addition, responsible parties identified for specific mitigation actions on the schedule shown below will be asked to submit their reports in advance of the meeting. Meetings of the committee will be organized and facilitated by the Emergency Management Director or the Ludlow Board of Selectmen. Meetings will entail the following actions:

- Review events of the year to discuss and evaluate major issues, effectiveness of current mitigation, and possible mitigation for future events.
- Review and evaluate progress toward implementation of the current mitigation plan based on reports from responsible parties.
- Amend current plan to improve mitigation practices.

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. The committee will review and update the Ludlow Local Natural Hazards Mitigation Plan every five years. The first updated plan will be submitted to MEMA and FEMA in the fall of 2012.

**REPORTING SCHEDULE FOR MITIGATION ACTION
(BASED ON PRIORITIZED IMPLEMENTATION)**

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	REPORTING DATE TO LEPC
Remove floodplain regulations from Conservation Commission bylaw and replace with move into zoning bylaws to create a new Floodplain Zone District in Zoning Bylaw .	Planning Board, BOS	2007	September 2008
Replace priority culverts on Stormwater Management Project List.	DPW	2007	September 2008
Work to certify Local Emergency Planning Committee with full status for Hazardous Materials emergency planning.	LEPC	Ongoing	September 2008 September 2009 September 2010 September 2011 September 2012
Review with municipal boards the hazard mitigation purposes of bylaws, zone districts, and subdivision regulations.	Conservation Commission, Agricultural Commission, DPW, LEPC	2008	September 2009
Collect, update, disseminate emergency information to the public ('home survival kit'; home preparation for natural disasters, evacuation procedures, etc.)	LEPC	2008	September 2009
Establish arrangements with local vendors to supply shelters in case of natural disaster.	LEPC, EMD, School Department	Ongoing	September 2008 September 2009 September 2010 September 2011 September 2012
Obtain all most recent maps of inundation areas and evacuation routes for high hazard dams.	EMD	2008	N/A
Evaluate the older structures to be used as emergency shelters (Public Safety building and high school) to determine if they are earthquake resistant.	Building Inspector, EMD	2008	September 2009
Revisit feasibility of implementing Reverse 911.	BOS, LEPC	2009	September 2010
Implement Beaver Management Strategy	Board of Health, Conservation Commission	Ongoing	September 2008 September 2009 September 2010 September 2011 September 2012

Revise the Water Supply Protection District Bylaw.	Planning Board, Conservation Commission	2009	September 2010
Initiate process to become a part of FEMA's Community Rating System	BOS, Board of Assessors, EMD	2009	September 2010
Educate citizens living the floodplain about the NFIP.	LEPC, Building Inspector	2009	September 2010
Ensure that all identified shelters have sufficient back-up utility service in case of primary power failure.	EMD	2009	September 2010
Work with maps of inundation zones for high hazard dams and analyze development trends in these locations.	Planning Board	2009	September 2010
Educate citizens living in inundation zones about evacuation routes in case of dam failure.	LEPC	2009	September 2010
Draft water conservation plan.	DPW, Conservation Commission	2009	September 2010
Identify zoning tools needed to provide incentives for guiding development to the most suitable and least hazardous areas of Town.	Planning Board	2010	September 2011
Add more specific language in the Special Permit approval process and Subdivision Design Standards.	Planning Board; Conservation Commission	2010	September 2011
Identify all pre-FIRM structures that need flood prevention modifications.	Building Inspector	2010	September 2011
Participate in the creation of a Regional Debris Management Plan.	DPW	2010	September 2011
Implement recommendations in Open Space and Recreation Plan.	Conservation Commission, Planning Board, BOS, Agricultural Commission	Ongoing	September 2008 September 2009 September 2010 September 2011 September 2012
Contract with utility companies to put underground new utility lines in general and existing utility lines in locations where repetitive outages occur.	DPW	Ongoing	September 2008 September 2009 September 2010 September 2011 September 2012
Inventory dams, bridges, power lines, telephone lines and develop estimate of what would cost to replace with major events.	DPW, Board of Assessors	2010	September 2011
Obtain information on location of dikes owned by Western Massachusetts Electric and areas protected from flooding.	DPW	2010	September 2011

APPENDICES

Appendix A – Technical Resources

1) Agencies

Massachusetts Emergency Management Agency (MEMA).....	508/820-2000
Hazard Mitigation Section	617/626-1356
Federal Emergency Management Agency (FEMA)	617/223-4175
MA Regional Planning Commissions:	
Berkshire Regional Planning Commission (BRPC).....	413/442-1521
Cape Cod Commission (CCC).....	508/362-3828
Central Massachusetts Regional Planning Commission (CMRPC).....	508/693-3453
Franklin Regional Council of Governments (FRCOG).....	413/774-3167
Martha’s Vineyard Commission (MVC).....	508/693-3453
Merrimack Valley Planning Commission (MVPC).....	978/374-0519
Metropolitan Area Planning Council (MAPC).....	617/451-2770
Montachusett Regional Planning Commission (MRPC).....	978/345-7376
Nantucket Planning and Economic Development Commission (NP&EDC).....	508/228-7236
Northern Middlesex Council of Governments (NMCOG).....	978/454-8021
Old Colony Planning Council (OCPC).....	508/583-1833
Pioneer Valley Planning Commission (PVPC).....	413/781-6045
Southeastern Regional Planning and Economic Development District (SRPEDD).....	508/823-1803
MA Board of Building Regulations & Standards (BBRS).....	617/227-1754
MA Coastal Zone Management (CZM).....	617/626-1200
DCR Water Supply Protection.....	617/626-1379
DCR Waterways.....	617/626-1371
DCR Office of Dam Safety.....	508/792-7716
DFW Riverways.....	617/626-1540
DFP Wetlands and Waterways.....	XXX/XXX-XXX
MA Dept. of Housing & Community Development.....	617/573-1100
Woods Hole Oceanographic Institute.....	508/457-2180
UMass-Amherst Cooperative Extension.....	413/545-4800
National Fire Protection Association (NFPA).....	617/770-3000
New England Disaster Recovery Information X-Change (NEDRIX – an association of private companies & industries involved in disaster recovery planning).....	781/485-0279
MA Board of Library Commissioners.....	617/725-1860
MA Highway Dept, District 2.....	413/582-0599
MA Division of Marine Fisheries.....	617/626-1520
MA Division of Capital & Asset Management (DCAM).....	617/727-4050
Massachusetts Association of Regional Planning Agencies (MARPA).....	XXX/XXX-XXX
University of Massachusetts/Amherst.....	413/545-0111
Natural Resources Conservation Services (NRCS).....	413/253-4350
MA Historical Commission.....	617/727-8470
U.S. Army Corps of Engineers.....	978/318-8502
Northeast States Emergency Consortium, Inc. (NESEC).....	781/224-9876
US Department of Commerce: National Oceanic and Atmospheric Administration: National Weather Service; Tauton, Massachusetts	508/824-5116
US Department of the Interior: US Fish and Wildlife Service	413/253-8200
US Geological Survey	508/490-5000

2) Mitigation Funding Resources

404 Hazard Mitigation Grant Program (HMGP)	Massachusetts Emergency Management Agency
406 Public Assistance and Hazard Mitigation	Massachusetts Emergency Management Agency

Community Development Block Grant (CDBG).....	DHCD, also refer to RPC
Dam Safety Program.....	MA Division of Conservation and Recreation
Disaster Preparedness Improvement Grant (DPIG)	Massachusetts Emergency Management Agency
Emergency Generators Program by NESEC [†]	Massachusetts Emergency Management Agency
Emergency Watershed Protection (EWP) Program.....	USDA, Natural Resources Conservation Service
Flood Mitigation Assistance Program (FMAP)	Massachusetts Emergency Management Agency
Flood Plain Management Services (FPMS).....	US Army Corps of Engineers
Mitigation Assistance Planning (MAP).....	Massachusetts Emergency Management Agency
Mutual Aid for Public Works.....	Western Massachusetts Regional Homeland Security Advisory Council
National Flood Insurance Program (NFIP) [†]	Massachusetts Emergency Management Agency
Power of Prevention Grant by NESEC [†]	Massachusetts Emergency Management Agency
Roadway Repair & Maintenance Program(s).....	Massachusetts Highway Department
Section 14 Emergency Stream Bank Erosion & Shoreline Protection	US Army Corps of Engineers
Section 103 Beach Erosion.....	US Army Corps of Engineers
Section 205 Flood Damage Reduction.....	US Army Corps of Engineers
Section 208 Snagging and Clearing	US Army Corps of Engineers
Shoreline Protection Program.....	MA Department of Conservation and Recreation
Various Forest and Lands Program(s).....	MA Department of Environmental Protection
Wetlands Programs	MA Department of Environmental Protection

[†]NESEC – Northeast States Emergency Consortium, Inc. is a 501(c)(3), not-for-profit natural disaster, multi-hazard mitigation and emergency management organization located in Wakefield, Massachusetts. Please, contact NESEC for more information.

[†]Note regarding National Flood Insurance Program (NFIP) and Community Rating System (CRS): The National Flood Insurance Program has developed suggested floodplain management activities for those communities who wish to more thoroughly manage or reduce the impact of flooding in their jurisdiction. Through use of a rating system (CRS rating), a community’s floodplain management efforts can be evaluated for effectiveness. The rating, which indicates an above average floodplain management effort, is then factored into the premium cost for flood insurance policies sold in the community. The higher the rating achieved in that community, the greater the reduction in flood insurance premium costs for local property owners. MEMA can provide additional information regarding participation in the NFIP-CRS Program.

3) Websites

Sponsor	Internet Address	Summary of Contents
Natural Hazards Research Center, U. of Colorado	http://www.colorado.edu/litbase/hazards/	Searchable database of references and links to many disaster-related websites.
Atlantic Hurricane Tracking Data by Year	http://wxp.eas.purdue.edu/hurricane	Hurricane track maps for each year, 1886 – 1996
National Emergency Management Association	http://nemaweb.org	Association of state emergency management directors; list of mitigation projects.
NASA – Goddard Space Flight Center “Disaster Finder:	http://www.gsfc.nasa.gov/ndrd/disaster/	Searchable database of sites that encompass a wide range of natural disasters.
NASA Natural Disaster Reference Database	http://ltpwww.gsfc.nasa.gov/ndrd/main/html	Searchable database of worldwide natural disasters.
U.S. State & Local Gateway	http://www.statelocal.gov/	General information through the federal-state partnership.
National Weather Service	http://nws.noaa.gov/	Central page for National Weather Warnings, updated every 60 seconds.
USGS Real Time Hydrologic Data	http://h20.usgs.gov/public/realtime.html	Provisional hydrological data
Dartmouth Flood Observatory	http://www.dartmouth.edu/artsci/geog/floods/	Observations of flooding situations.
FEMA, National Flood Insurance Program, Community Status Book	http://www.fema.gov/fema/csb.html	Searchable site for access of Community Status Books
Florida State University Atlantic Hurricane Site	http://www.met.fsu.edu/explores/tropical.html	Tracking and NWS warnings for Atlantic Hurricanes and other links
National Lightning Safety Institute	http://lightningsafety.com/	Information and listing of appropriate publications regarding lightning safety.
NASA Optical Transient Detector	http://www.ghcc.msfc.nasa.gov/otd.html	Space-based sensor of lightning strikes
LLNL Geologic & Atmospheric Hazards	http://www.wep.es.llnl.gov/wwwep/ghp.html	General hazard information developed for the Dept. of Energy.
The Tornado Project Online	http://www.tornadoproject.com/	Information on tornadoes, including details of recent impacts.
National Severe Storms Laboratory	http://www.nssl.uoknor.edu/	Information about and tracking of severe storms.
Independent Insurance Agents of America IIAA Natural Disaster Risk Map	http://www.iaa.iix.com/ndemap.html	A multi-disaster risk map.
Earth Satellite Corporation	http://www.earthsat.com/	Flood risk maps searchable by state.
USDA Forest Service Web	http://www.fs.fed.us/land	Information on forest fires and land management.

Appendix B – Documentation of the Planning Process

Reviewing and Incorporating Existing Plans

Existing plans, studies, reports and technical information were reviewed and incorporated throughout the planning process. This included significant information from the following key documents:

- ☞ *Ludlow Comprehensive Emergency Management Plan* (particularly the Critical Infrastructure Section) – the Critical Infrastructure section was used to identify those infrastructure components in Ludlow that have been identified as crucial to the function of the Town; also, this resource was used to identify special needs populations as well as potential emergency shortcomings.
- ☞ *Ludlow Open Space and Recreation Plan* – this Plan was used to identify the natural context within which mitigation planning would take place. This proved useful insofar as it identified water bodies, rivers, streams, infrastructure components (i.e. water and sewer, or the lack thereof), as well as population trends. This was incorporated to ensure that the Town’s mitigation efforts would be sensitive to the surrounding environment. During the OSRP update, Ludlow can use the work of the PDM Plan to incorporate identified hazard areas into open space and recreation planning. This could either take the form of acquiring parcels of land that are currently un-developed, but situated within an identified hazard area, as permanent open space, thereby minimizing the likelihood that critical infrastructure components will be constructed in an area prone to damage from natural hazards.
- ☞ *Ludlow Community Development Plan*—this Plan was used to identify any action items that might prove successful, based on previous planning efforts.
- ☞ *Ludlow Zoning Bylaw/Ordinance* - The Town’s Zoning Bylaw was used to gather and identify those actions that the Town is already taking that are reducing the potential impacts of a natural hazard (i.e. floodplain regulations) to avoid duplicating existing successful efforts.
- ☞ *Draft State of Massachusetts’ Multi-Hazard Mitigation Plan* - This plan was used to ensure that the Town’s Hazard Mitigation Plan is consistent with the State’s Plan.

Ludlow Pre-Disaster Mitigation Plan
Ludlow Local Emergency Planning Committee
Meeting #1

AGENDA

November 16, 2006

3:00 pm

Ludlow Fire Department

1) Introduction

2) Purpose of Committee

- Why selected to serve on Committee
- What we are doing and why

3) What is Hazard Mitigation Planning?

- PowerPoint Presentation on Hazard Mitigation

4) Organize Hazard Mitigation Team

- Establish a chairperson/point of contact

5) What must we do to prepare a Hazard Mitigation Plan?

- Explain/set milestones (4-5 committee meetings)
- Agree on next committee meeting date

6) Question and Answer Period

Ludlow Pre-Disaster Mitigation Plan
Ludlow Local Emergency Planning Committee
Meeting #2

AGENDA

December 14, 2006

3:00 p.m.

Ludlow Fire Department

1) Identify Hazards (past and potential) on Base Map

- What are the hazards?
- What is at risk from those hazards?

2) Develop Base Map with Critical Facilities

- Identify Critical Facilities on Base Map. The following list contains items that should be clearly identified on the map, as they apply to your community:

- | | |
|--------------------------------|----------------------------------|
| - Emergency Operations Center | - Nursing Homes |
| - Emergency Fuel Facilities | - Elderly Housing |
| - Town/City Hall | - Day-Care Facilities |
| - Police Station | - Correctional Facilities |
| - Fire Station | - Other Congregate Care |
| Facilities | |
| - Public Works Garages | - Shelters |
| - Water Treatment Facilities | - Special Needs Populations |
| - Sewage Treatment Plants | - Hazardous Materials Facilities |
| - Water Tower/Supply Pumps | - Access Roads to Critical |
| Facilities | |
| - Power Plants | - Evacuation Routes |
| - Electrical Power Substations | - Unique or Historic Resources |
| - Schools | - Commercial Economic Impact |
| Areas | |
| - Major Highways and Roadways | - Socio-Economic Impact Areas |
| - Bridges | - Areas with Second Language |
| Needs | |
| - Dams | - Hospitals |

3) Question and Answer Period

4) Set Goals for Next Meeting

Ludlow Pre-Disaster Mitigation Plan
Ludlow Local Emergency Planning Committee
Meeting #3

AGENDA

January 18, 2007

3:00 pm

Ludlow Fire Department

1) Review Identification of Hazards

- Past and Potential hazards
 - Flood map
 - Critical Facilities
- Is this information correct?

2) Review the PDM Plan

- Is the information correct?
- What is missing?

3) Analyze Development Trends

- Looking at Community Change
- Map out Development Patterns

4) Question and Answer Period

5) Schedule Next Meeting

February 15, 3:00pm

Ludlow Pre-Disaster Mitigation Plan
Ludlow Local Emergency Planning Committee
Meeting #4

AGENDA

February 15, 2007
3:00 p.m.
Ludlow Fire Department

1) Identify What's in Place and What's Missing

- Review of Draft Existing Protection Measures
- Identify Gaps in Current Protection

2) Review Draft Goal Statements

3) Brainstorm Mitigation Actions

- What actions can be taken?
- Evaluating Action Feasibility

4) Question and Answer Period

5) Set Goals for and Schedule Next Meeting

Proposed date – March 15, 3:00 pm

Ludlow Pre-Disaster Mitigation Plan
Ludlow Local Emergency Planning Committee
Meeting #5

AGENDA

March 15, 2007

3:00 p.m.

Ludlow Fire Department

- (1) Establish a Minimum Acceptable Level for Actions**
- (2) Prioritize Final List of Actions**
 - Select Actions which Best Suit Community's Needs
 - Include actions that can be implemented quickly
- (3) Develop Strategy to Implement Selected Prioritized Actions:**
 - Who will be responsible for implementing each prioritized action;
 - When will these actions be implemented;
 - How will the community fund the projects?
- (4) Develop Process for Adoption and Monitoring of the Plan**
- (5) Review & Revise as Necessary Final Draft of the *Ludlow Hazard Mitigation Plan***
- (6) Discuss Next Steps for the *Ludlow Hazard Mitigation Plan* including FEMA Review and Adoption by the Board of Selectmen**
- (7) Question and Answer Period**



Town of Ludlow, Massachusetts



**Ludlow Local Emergency
Planning Committee**

574 Center Street, P. O. Box 382
Ludlow, Massachusetts 01056
Tel: 413-583-8332 Fax: 413-583-5635

NOTICE OF MEETING

Date: Thursday, October 18, 2007

Time: 3:00 p.m. EST

Location: Ludlow Fire Department
574 Center Street
Ludlow, MA 01056

MEETING AGENDA

1. Approval of September 20, 2007 minutes.
2. Treasurer's Report
3. Need to fill out and complete "Attachment F" – ("Training Levels of Response Personnel").
4. Patty Gambarini, Lower Pioneer Valley Planning Commission.
5. Miscellaneous items.

Town of Ludlow, Massachusetts

Ludlow Local Emergency Planning Committee

574 Center Street, P. O. Box 382
Ludlow, Massachusetts 01056
Tel: 413-583-8332 Fax: 413-583-5635

NOTICE OF MEETING

Date: Thursday, November 15, 2007

Time: 3:00 p.m. EST

Location: Ludlow Fire Department
574 Center Street
Ludlow, MA 01056

MEETING AGENDA

1. Approval of October 18, 2007 minutes.
2. Treasurer's Report
3. Review components for the application for Full Certification.
4. Patty Gambarini - LPVPC
5. Miscellaneous items.

BLOGS

Breaking News

- Agawam High School stays open despite fire 2:26 p.m. ET
- Springfield employees to receive diversity training 1:37 p.m. ET
- More Entries

News Briefs

- Monday's News Briefs

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- Teen gets custody of a special violin

'Predisaster plans' readied for grants

Sunday, September 23, 2007

By **NANCY H. GONTER**
ngonter@repub.com

It's the public's turn to weigh in on plans prepared by local communities to keep the damage from natural disasters to a minimum.

Sixteen "predisaster mitigation plans," developed by the Pioneer Valley Planning Commission working with local officials from each community, are part of an effort to secure grant money from the Massachusetts Emergency Management Agency, said Catherine M. Miller, principal planner with the commission.

"This comes from an effort by the Federal Emergency Management Agency that while we are aware you can't prevent natural disasters from happening, you can prevent the long term consequences," Miller said.

[CONTINUE STORY](#)

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Comments may be made by calling Andrew Smith at the Commission at (413) 781-6045 or by e-mailing him at asmith@pvpc.org by Nov. 30.

The plans were developed with a state grant of \$224,962 which was supplemented by local communities for total cost of just under \$300,000, she said.

Each plan looks at the risks communities may face from natural disasters such as flooding, tornadoes, drought and earthquakes, and what can be done to prevent damage to property and loss of life. They also prioritize projects for funding for mitigation efforts, Miller said.

An example of a mitigation project is Greenfield's purchase of the Wedgewood Gardens mobile home park which was badly flooded by the Green River in 2005 and had previously been flooded, although that was not part of this program, Miller said.

The commission is working with 32 communities in this area and a second round of 16 more communities will soon be started. They are Amherst, Belchertown, Brimfield, Chicopee, Cummington, Goshen, Granby, Huntington, Palmer, Southampton, Springfield, Westfield, West Springfield, Westhampton, Williamsburg and Worthington.

After that, a plan for the entire region will be prepared, Miller said.

Northampton Deputy Fire Chief Dana Cheverette, a member of the local committee that worked with the commission on the city's plan, said going through the process of preparing the plan was helpful.

"You identify the flood plans and you identify the area where you need to put your resources. In 1968 when the Oxbow area flooded, a lot of people got isolated. Now we know where the people could get isolated," Cheverette said.



INSIDE NEWS

- Death N
- Editorial
- Letters

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Appendix C – List of Acronyms

FEMA	Federal Emergency Management Agency
MEMA	Massachusetts Emergency Management Agency
PVPC	Pioneer Valley Planning Commission
EPA	Environmental Protection Agency
DEP	Massachusetts' Department of Environmental Protection
NWS	National Weather Service
HMGP	Hazard Mitigation Grant Program
FMA	Flood Mitigation Assistance Program
SFHA	Special Flood Hazard Area
CIS	Community Information System
DCR	Massachusetts Department of Conservation and Recreation
FERC	Federal Energy Regulatory Commission
TRI	Toxics Release Inventory
FIRM	Flood Insurance Rate Map
NFIP	National Flood Insurance Program
CRS	Community Rating System
BOS	Board of Selectmen
DPW	Department of Public Works
LEPC	Local Emergency Planning Committee
EMD	Emergency Management Director
Con Com	Conservation Commission
Ag Com	Agricultural Commission
EOC	Emergency Operations Center
CEM Plan	Comprehensive Emergency Management Plan
WMECO	Western Massachusetts Electric Company
HAZMAT	Hazardous Materials

Appendix D – Past & Potential Hazards/Critical Facilities Map