The Town of Hadley

Hazard Mitigation Plan Update

Adopted by the Hadley Select Board on 12/14/16

Prepared by:

Hadley Hazard Mitigation Planning Committee

and

The Pioneer Valley Planning Commission

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Pioneer Valley Planning Commission

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1. PLANNING PROCESS

1.1 Introduction

The Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA) define hazard mitigation as any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards such as flooding, storms, high winds, hurricanes, wildfires, earthquakes, 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 Hadley in collaboration with 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 it.

Preparing, and updating every five years, a hazard mitigation plan before a disaster saves communities money and facilitates 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 their plan.

FEMA requires that a community adopt a hazard mitigation plan to be eligible for mitigation funding from the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), and the Pre-Disaster Mitigation (PDM) Program are programs with this requirement.

The Town of Hadley developed their first Hazard Mitigation plan in collaboration with PVPC in 2007-2009; this plan was approved by FEMA in February 2009 and expired in 2014. This plan is an update to the approved 2009 plan. While there have not been any significant changes in development in Hadley since 2009, the plan update reflects the Town staff's ongoing work to implement the prioritized mitigation strategies of the 2009 plan.

1.2 Hazard Mitigation Planning Committee

This document was prepared with the review and input of the Hadley Hazard Mitigation Planning Committee (members listed in Acknowledgements). The committee represents Town government and the members engaged their colleagues, including the Police and Fire Departments, the Planning Board and others, in the local hazard mitigation planning process.

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

- Reviewing and incorporating existing local plans and other information including considering how development that has happened in the last seven years since the previous Hazard Mitigation plan was approved by FEMA in February 2009, might have affected the Town's vulnerability to Natural Hazards,
- Updating the documentation of natural hazards that may impact the community since the previous plan
- Conducting a Vulnerability/Risk Assessment to identify the infrastructure at the highest risk for being damaged by the identified natural hazards, particularly flooding.
- Identifying and assessing the policies, programs, and regulations the community is currently implementing to protect against future disaster damages.
- Identifying deficiencies in the current capabilities, strategies and establishing goals for updating, revising or adopting new strategies.
- Adopting and implementing the final updated Natural Hazards Mitigation Plan.

The key product of this process was the development of a list of prioritized new mitigation strategies to be implemented during the next five years.

Committee Meetings

Meetings of the Hazard Mitigation Committee, which took place at the Hadley Public Safety Building, were held on the dates listed below.

Committee Meeting 1: May 6, 2016
Overview of hazard mitigation planning, identification and organizing of the planning team, identification of critical facilities, discussion of hazard identification and risk assessment, and review of existing mitigation strategies undertaken by the Town.

Committee Meeting 2: May 13
Re-visitation of critical facilities, discussion of history of natural hazard events, and discussion of potential mitigation strategies to be implemented. Reviewing of draft prioritized list of mitigation strategies, based on conversation at previous meeting.

Committee Meeting 3: May 20
Finalization of prioritized implementation strategies, discussion of the plan adoption process and procedures for regular maintenance of the plan.

Committee Meeting 4: June 13
Complete review of prioritized implementation schedule.

Committee Meeting 5: June 17
Review and address public comments.

Agendas and a list of Committee members present for each meeting can be found in Appendix B. While not all members of the Hazard Mitigation Committee were able to attend each meeting, all members collaborated on the plan and were updated on progress by fellow Committee members after meetings occurred.

Public Meetings

Two public meetings were held to solicit community input on this plan. These meetings took place at the Hadley Public Safety building on the dates listed below.

Public Meeting 1: May 18, 2016
Review and solicit input on the hazards and risks identified.

Public Meeting 2: June 29 2016
Review and solicit input on proposed mitigation strategies and priorities.

1.3 Participation by Stakeholders

A variety of stakeholders were provided with an opportunity to be involved in the update of the Hadley Hazard Mitigation Plan. The different categories of stakeholders that were involved, and the engagement activities that occurred, are described below.

Local and regional agencies involved in hazard mitigation activities and surrounding community engagement and input

The Pioneer Valley Planning Commission is a regional planning agency for 43 towns and cities in Massachusetts' Hampden and Hampshire Counties. PVPC regularly engages with the Town of Hadley as part of its regional planning efforts, which include the following:

- Developing the Pioneer Valley Regional Land Use Plan, Valley Vision 2, which advocates for sustainable land use throughout the region and consideration for the impact of flooding and other natural hazards on development.

- Developing the Pioneer Valley Climate Action and Clean Energy Plan, which assesses the impact that climate change will have on the region and recommends strategies for mitigation that can be implemented by local municipalities and businesses.

- Collaborating with state agencies, such as the Department of Conservation and Recreation, to maintain inventories of critical infrastructure throughout the region.

All of these PVPC initiatives considered the impact of natural hazards on the region and strategies for reducing their impact to people and property through hazard mitigation activities. The facilitation of the Hadley Hazard Mitigation Plan by PVPC ensured that the information from these plans was incorporated into the Hazard Mitigation Planning process.

In addition, the Pioneer Valley Planning Commission is actively involved in the Western Region Homeland Security Advisory Council (WRHSAC). WHRSAC, which includes representatives from Western Massachusetts municipalities, Fire Departments, Public Works Departments, Police Departments, area hospitals and regional transit from throughout the four counties of western Massachusetts, is responsible for allocating emergency preparedness funding from the US Department of Homeland Security. The representatives of these disciplines who serve on the WRHSAC are charged with sharing

the information discussed at meetings with their colleagues at their regular meetings. PVPC attends all WRHSAC meetings and all WRHSAC members are aware of the fact that Hadley was updating its Hazard Mitigation plan. Meetings of WRHSAC regularly involve discussion about how to improve emergency preparedness in western Massachusetts, and hazard mitigation activities are included in this discussion.

For the update of this Hazard Mitigation Plan, PVPC provided feedback from WRHSAC on regional mitigation activities and natural hazards pertaining to Ware. This was the method through which WRHSAC was engaged in the planning process.

In addition, PVPC staff regularly present to their Executive Committee and Commission (representatives from the 43 cities and towns that comprise the Pioneer Valley, when new projects are launched and when funding opportunities are available). As result, all the communities in the region were informed of Hadley's Hazard Mitigation Plan update process and encouraged to comment.

PVPC staff included a summary article on the status of Hazard Mitigation planning in the region in the quarterly Regional Reporter that is mailed to area Chambers of Commerce, all member municipalities, area colleges and universities and other key stakeholders in the region. In this way, businesses, educational institutions and other key stakeholders were educated about and informed of Hadley's hazard mitigation planning work.

Agencies that have the authority to regulate development

The Hadley Planning Board is the primary Town agency responsible for regulating development in town. Feedback to the Planning Board was ensured through the participation of a representative on the local Hazard Mitigation Committee supported with communication between the EMD and the Board and the Town Administrator and the Board. In addition, the Pioneer Valley Planning Commission has been engaged by the Town to assist with planning services and as the regional planning authority, works with all agencies that regulate development in Hadley, including the municipal entities listed above and state agencies, such as the Department of Conservation and Recreation and the MassDOT. This regular involvement ensured that during the development of the Hadley Hazard Mitigation Plan, the operational policies and any mitigation strategies or identified hazards from these entities were incorporated into the Hazard Mitigation Plan.

Capability Assessment Summary: Existing Authorities Policies, Programs, & Resources and Ability to Expand on & Improve Existing Policies & Programs

The local Hazard Committee, with assistance provided by the PVPC, used the FEMA Capability Assessment worksheet to systematically document and assess Hadley’s existing hazard mitigation capabilities. The completed worksheet is included in the Appendix D, and a discussion of existing capabilities is included in chapter 5, culminating in a chart of existing mitigation capabilities.

Hadley has most of the no cost or low cost hazard mitigation capabilities in place. Land use zoning, subdivision regulations and an array of specific policies and regulations that include hazard mitigation best practices, such as limitations on development in floodplains, stormwater management, tree maintenance, etc. Hadley also has appropriate staff dedicated to hazard mitigation-related work for a community its size, including a Town Administrator, an Emergency Management Director, a professionally run Department of Public Works, a full-time Building Inspector, a Planning Board with part-time planning services provided by the Pioneer Valley Planning Commission, and a Tree Warden,

and Hadley has recommended plans in place, including a Master Plan, an Open Space and Recreation Plan, and a Capitol Improvements Plan. Not only does Hadley have these capabilities in place, but they are also deployed for hazard mitigation as appropriate. The Town also has very committed and dedicated volunteers who serve on Boards and Committees and in Volunteer positions. The Town collaborates closely with surrounding communities and is party to Mutual Aid agreements through the MEMA. Hadley is also an active member community of the Pioneer Valley Planning Commission (PVPC) and can take advantage of no cost local technical assistance as needed provided by the professional planning staff at the PVPC.

Participation by the Public, Businesses, and Neighboring Communities

Two public planning sessions were held as part of the development of the Hadley plan – on May 18, 2016 and June 29 2016. Both meetings occurred after the Hazard Mitigation Committee had provided input on hazards and mitigation strategies relevant to the community. Notice of both public meetings was posted at Hadley Town Hall in compliance with the Commonwealth of Massachusetts' open meeting law. Public meeting agendas and notices can be found in Appendix B.

On May 13 the Pioneer Valley Planning Commission, in collaboration with the Town of Hadley, sent a press release to relevant media outlets to announce that there would be a first public outreach meeting about the plan on May 18. This release was sent to those media identified by the Hazard Mitigation Committee as most relevant to the development of the plan. No members of the public attended the meeting.

On June 24 PVPC sent out a press release indicating that a second public outreach meeting would take place on June 29 and also to inform the public that a draft of the Hadley Hazard Mitigation Plan had been placed on PVPC's website. A list of media organizations that were sent the second press release is included in Appendix B, which are the television stations, radio stations, and newspapers located in western Massachusetts, northern Connecticut, and southern Vermont. The screen capture of PVPC's website showing the link to the press release can be found in Appendix B. The release also indicated that hard copies were available at PVPC's offices and at Hadley Town Hall, and that all residents, businesses and other concerned parties of Hadley were encouraged to comment on the plan by e-mailing or calling staff contacts at PVPC or the Town.

The Hazard Mitigation Committee determined that the most effective outreach strategy for engaging with the public, businesses and neighboring communities was through the media, and so this was the outreach strategy employed for reaching out to all three groups of stakeholders. The press release indicated that residents of Hadley were invited to attend the event, which was also intended to include representatives of businesses in Hadley and residents of neighboring communities.

Businesses and neighboring communities were also provided with an opportunity to provide feedback through the Pioneer Valley Planning Commission. PVPC is regularly involved in land use, transportation, and environmental planning initiatives in Hadley and surrounding communities. Regular feedback received from these other initiatives was incorporated into the hazard mitigation planning process.

Additional outreach to surrounding communities occurred through the regular quarterly newsletter that PVPC sends out to its member communities about its recent activities. In these articles, adjacent municipalities were encouraged to reach out to PVPC about hazard mitigation plans by e-mailing or calling staff contacts at PVPC. These notices are included in Appendix B.

No feedback was received from the public, businesses, or neighboring communities during the planning process. Any future input received from the public, as well as any other stakeholders, will be incorporated into the plan during future regular updates. Public participation will be a critical component of the Hazard Mitigation Plan maintenance process. The Hazard Mitigation Committee will hold all future meetings in accordance with Massachusetts open meeting laws. In addition, the public will be invited to provide comments through e-mail. The comments will be reviewed by the Hazard Mitigation Committee and incorporated as appropriate.

The Pioneer Valley Planning Commission's regional scope ensured that residents and government officials throughout the Pioneer Valley saw the press release and the request for comments.

A list of media organizations that were sent the two press releases is provided in Appendix B. The list of media included television stations, radio stations, and newspapers located in western Massachusetts, northern Connecticut, and southern Vermont.

Public participation will be a critical component of the Hazard Mitigation Plan maintenance process, as discussed in Chapter 6: Plan Review, Evaluation, Implementation, and Adoption.

1.4 Local Adoption

In 2011, the Hadley Select Board agreed to collaborate with the PVPC to seek funds from FEMA (via MEMA) to update Hadley's Hazard Mitigation plan. PVPC was awarded funding in 2012. Updating Hadley's plan was part of a multi community plan update funding award. Work on Hadley's plan update began in 2015. After the plan was provisionally approved by FEMA in 2016, the Select Board adopted the updated plan on December 14, 2016.

2. COMMUNITY PROFILE

2.1 Community Setting

The Town of Hadley is a community of 5,301 residents nestled along the eastern bank of the Connecticut River bordered by Amherst on the east, Sunderland to the north, South Hadley to the south, and Northampton and Hatfield to the west (across the Connecticut River). Route 9, a major state road, bisects the community at its approximate midpoint from the Northampton line at the Coolidge Bridge and I-91 Exit 19 interchange east to the Amherst line at University Drive. Route 47 is a primary north/south travel corridor along the Connecticut River from the Sunderland town line in the north to the South Hadley line in the south near Hadley's historic Hockanum district.

The Route 9 corridor on its eastern end is the location of most of the Town's major commercial development; on the western end, there is smaller scale development and Hadley's historic Town center at the intersection with Route 47. Several of the Town's municipal structures, including the library, Town Hall, U.S. Post Office and Hopkins Academy, the Town's public high school and middle school, are located on Route 9 (known locally as Russell Street) between Route 47 (Middle Street) and the historic Town Common at West Street. This area is the heart of the community, and in addition to important municipal structures it also has historic and well-maintained residences, the Hadley Senior Center, the Farm Museum, local businesses and religious institutions. At the Route 9 intersection with Maple Street there are three large mall developments totaling more than 1 million square feet that constitute one of the largest concentrations of commercial and retail uses in the region. To the north on Route 47 is North Hadley center, a village clustering of structures that include North Hadley Hall, North Hadley Congregational Church, and historic homes located along Lake Warner and Mill River.

Hadley was founded in 1659, when a dissenting church congregation from Suffield, Connecticut came north and founded an agricultural community on the east bank of the Connecticut River. The first settlers laid out 8-acre home lots along both sides of the Town Common (West Street), with farmlands behind. By the 1670s, the Town rapidly developed northward along present-day Route 47. Lake Warner, also known as the North Hadley Mill Pond, became the site of the Hopkins Corn Mill, and many farmers and mill workers settled there.

Hadley continued to grow as an agricultural community during the 1700s, encompassing areas of present-day Amherst, Hatfield, and Sunderland. Hadley also became a center for broom and brush making, which became a thriving industry in the Town, exporting products throughout New York and New England, and as far west as Ohio. By 1840, tobacco had become a major local crop, as well as seed onions and other vegetables. In 1887, the Massachusetts Central Railroad crossed the northern half of the Town Common with a station along Railroad Street; this opened new opportunities for Hadley farmers shipping produce to regional markets. By 1900, the Connecticut Valley Street Railway had been laid out along Russell Street (present day Route 9) and a new bridge over the Connecticut River to Northampton.

During the late 1800s, because of labor shortages and a drop in land values, Hadley experienced somewhat of a decline in farming, though remained internationally known for asparagus. It was also about this time that a large number of Irish and Polish immigrants joined the earlier English immigrants in Hadley.

Today, land uses in Hadley are still largely agricultural, though increasing areas are now devoted to residential and commercial development. In fact, Hadley has the greatest number of acres in agriculture in the Pioneer Valley, with principal crops that include corn, potatoes, peppers, tobacco, and many other vegetables.

Hadley is entirely within the Connecticut River Watershed Basin. The Connecticut River, along the western border of Town, is one of the Town's major bodies of water, along with Lake Warner and the Mill River. The total land area of Hadley is approximately 15,872 acres (25 sq mi). The majority of land in Hadley is either undeveloped (30%) or agricultural (46%).

The population of Hadley continues to grow at a rate faster than the regional average. Since 2000, the Town population has increased 10% from 4,793 (U.S. Census) to 5,301 residents in 2014 (American Community Survey 2009-2013 estimate), as compared to approximately an average 4% growth for the region as a whole. The vast majority of new homes being built in Town are in single-family structures, as multi-family dwellings are not allowed by zoning. A total of 13.0% homes in Hadley are classified as affordable by the Department of Housing and Community Development (as of December 2014).

2.2 Infrastructure

Hadley's history and geography have been major factors in the development of the Town's infrastructure. Both Hadley center (along the West Street Town Common) and North Hadley center (at Lake Warner and the Mill River) were settled along the Connecticut River. Hadley was home to Native American people long before European settlers began to arrive in the 1600s and settled the town in 1659. The agricultural heritage of the community promoted the development of the clearing of the landscape, which features gentle hills to the north, the Holyoke Mountain Range to the south, and relatively flat and easily farmed floodplain areas with rich soil that is among the most fertile in the world.

Neither the early village centers nor the predominant agricultural land use required significant public infrastructure until the proliferation of the regional roadways in and through Hadley, and the introduction of large-scale commercial development along these routes. Since the 1970s, Hadley has continued to experience strains on its public services, as the number and geographic dispersal of homes has continued to increase, and the number of businesses requiring inspections and public safety services has grown dramatically.

Roads and Highways

There are 66 miles of Town-owned and maintained roads in Hadley, and 9 miles of state-owned and maintained roads. Regional transportation access from and from Hadley is provided primarily by Massachusetts State Route 9 (Russell Street), which runs east-west through the Town. At the western town line at the Calvin Coolidge Bridge, Route 9 provides access to Northampton and points north and south via Interstate 91 at Exit 19. Primary north-south regional access is provided by Route 116 in the western side of Town, as well as River Drive/Middle Street (Route 47) along the Connecticut River from the Sunderland town line in the north to the South Hadley line in the south. Commercial development has followed these transportation routes, with large businesses along the eastern segment of Route 9 as it approaches Amherst. The street network in Hadley is dominated by various local roads connected directly or indirectly with Route 116, Route 47, North Hadley Road and Route 9.

Rail

There are no active rail lines in Hadley. Passenger rail service is available at the Northampton Amtrak station on South Pleasant Street. The Vermonter operates one train per day to Washington DC via New Haven Connecticut, and one train per day to St. Albans, Vermont, via Greenfield and Brattleboro.

Public Transportation

Hadley is served by multiple routes of the Pioneer Valley Transit Authority (PVTA), as well as on-demand paratransit service. PVTA fixed bus routes serving Hadley are the B43 (Northampton to Amherst via Route 9 with stops at West Street, Middle Street and Hampshire Mall); Route 39 (Smith College to Mount Holyoke College via Route 47), and Route 33 (Amherst Center to Campus Plaza Mall/Shop & Shop). (Minuteman Route 40 service from Northampton to UMass travels through Hadley via Route 9 but does not stop within the Town.) Paratransit service is available to Hadley residents traveling to and from destinations within half a mile of a fixed bus route during the hours that the service operates. Van service is also operated by the Hadley Council on Aging for shopping and leisure trips.

Public Drinking Water Supply

Hadley has two sources of drinking water: The Mt Warner wells at the base of Mt Warner (at the end of Hawley St), and the Callahan wells, off of Route 47 south.

The Mt. Warner wells are contaminated by perchlorate, nitrates, and DCPA (Dimono-acid degredate). The Environmental Protection Agency has set a permissible level of nitrates and has listed DCPA as a candidate for regulation; and the state has established a 2 ppb limit for perchlorate. The town has closed well #2 at Mt. Warner and is currently using the water well #1 (top capacity 800,000 gpd) augmented by water from the Callahan wells low levels for summer use. The town also is trying to determine the source of the pollutants. The technology needed to treat the Callahan wells is proven and readily available. The town has no intention to abandon or ignore the Mt. Warner wells. The Mt. Warner wells will require treatment by more complex, newer methods, and it makes sense to wait until standards are set.

The Callahan wells are now the primary source of drinking water in Hadley. However, they have excessive amounts of manganese. This metal is not considered a “regulated contaminant” but does cause problems with drinking water. Manganese builds up in pipelines, pressure tanks, water heaters and water softeners and the damage results in economic costs to homeowners and businesses alike. Manganese can permanently stain clothes when you wash them and affect the flavor and taste of food and water. The Callahan wells have been treated using a chemical called Aqua-Mag, which does not take the manganese out of the water but keeps it “in solution.” However, the best way to fix the problem is to use “ultra-filtration membrane technology” which eliminates the manganese. The filter membranes also screen out viruses and bacteria without the use of chlorine, so the technology offers additional protection. A new water treatment plant came online in 2007. The Water Division of the Hadley DPW is developing an update to the 2004 master plan, evaluating future capital costs and needs.

Sewer Service

Hadley provides public wastewater treatment. The system has 800 connections serving Route 9, Route 47 and the side streets surrounding drinking water wells. Hadley accepts out of Town septage and uses

the additional income to maintain and expand the collection pipeline system without cost to the system users. The treatment plant located at 230 South Middle Street was remodeled in 1988 and is in good condition. The average daily flow to the treatment plant is 300 mgd; this represents 55% of the plant's 540 mgd capacity. No lines have been added since 1988; however, the Town is currently replacing older sewer lines which have been causing problems. In addition, several Town residents rely on septic to treat their wastewater.

Schools

The Town has two public schools: Hadley Elementary serves Pre-Kindergarten through grade 6 and the Hopkins Academy junior and senior high school serves grades 7 through 12. There is also the private Hartsbrook School, serving Pre-Kindergarten through grade 12.

Recreation

The former Boston & Maine Railroad right-of-way runs for approximately 5 miles east-west through Hadley, paralleling Route 9 between Northampton Amherst. In 1985, the right of way was purchased by the Department of Environmental Management and transformed into the Norwottuck Rail Trail, a part of the Connecticut River Greenway State Park. This facility was resurfaced and upgraded in 2015, and has become one of the most popular recreational attractions in the region.

Lake Warner (North Hadley Pond) is a privately owned water body used for fishing, kayaking and canoeing; it has two public access points.

Municipally owned recreation facilities include:

- Reservoir (fishing allowed from shore and picnic area adjacent to water)
- Playing fields at Elementary School
- Zytrka Park (Breckenridge and Huntington Roads)

2.3 Natural Resources

Hadley has natural resources that are of statewide importance; these include a historic landscape, rare and endangered species, the Mt. Holyoke range, and agriculture soils that are among the most fertile and high quality in the Commonwealth and North America. These are discussed below.

Landscape

Hadley's landscape is characterized by acres of contiguous farmland along the Connecticut River Valley. The predominantly flat landscape is only interrupted by two upland and wooded areas, the Holyoke Range and Mount Warner. Far to the south, along virtually Hadley's entire southern border lies Skinner State Park, a heavily wooded landscape in the Mt. Holyoke range that towers over the remainder of the Town. To the north lies Mount Warner, the only other major area of woodland within Hadley. These two woodlands are connected through a tenuous ribbon of trees that cling to the various streams and corridors running north to south. The remainder of the community contains some of the most valuable and productive agricultural land in Massachusetts. This cropland makes up almost 42% of Hadley's total

land area and is spread through virtually the entire community. Significant clusters of agricultural land lie along the western half of Route 9, around the Moody Bridge area, in the Great Meadows area, along portions of Route 47 and to the north along Knightly Road, among others.

Water Resources

Wetlands and bodies of water comprise approximately 936 acres of Hadley's 15,872 acres of total landmass. Water resources are essential to residents. Waterways in Hadley have had a large influence on development and recreation. The first settlers in Hadley made their homes along the Connecticut River, later, North Hadley developed as townspeople harnessed the power of Mill River to run the mill industry.

Watershed and Water Bodies

Hadley is entirely within the Connecticut River Watershed and has approximately 15 miles of river frontage along the river's west bank. There are two major tributaries to the Connecticut River within Hadley: the Mill River and Fort River. The Fort River lies to the Southwest and is fed by numerous streams with headwaters in the Holyoke Range. The Fort River provides important wildlife habitat, floodwater storage (nearly the entire length lies within the Floodplain Overlay district), and helps protect water quality (it is within the recharge area for the backup well field). Russellville Brook, a lesser tributary of the Mill River, has been identified by the Department of Environmental Management as the largest and most significant natural community found in Hadley along the Connecticut River.

Lake Warner and the Hadley Reservoir are Hadley's major bodies of water. Water rights to the 68-acre Lake Warner belong to the Kestrel Trust, a private land trust operating in Hampden, Hampshire, and Franklin counties.

Wetlands

Hadley has a range of wetland resources, including floodplain forests, forested swamp and wet meadows. Much of the wetlands lie in heavily forested areas along the Connecticut River and its tributaries. Wet meadows are more common along the Fort River near Hockanum Flat and Hadley Cove. Many wetlands and wooded swamps in Hadley were drained for agricultural use as Hadley once had many wetland areas, specifically around Lake Warner, Fort River and Mill River, along the Connecticut River riparian corridor and behind Stop and Shop. The remaining wetlands are a critical element in the habitat and stormwater management systems of the Town.

Flood Hazard Areas

The Town of Hadley has several FEMA Special Flood Hazard Areas identified. The Connecticut River, which creates the entire western boarder of the Town, sees a year swell every spring. In addition, the natural path of the river has created a large peninsula-like swath of land, the site of Hadley's earliest settlements. This peninsula is very low-lying and has the potential to be completed flooded. Other flood prone areas are along the Fort River, which consists of several large wetlands and ponds, and along Mill River, before it runs into Lake Warner.

FEMA data indicates that Hadley is a member community of the National Flood Insurance Program and has a Flood Insurance Rate Map (FIRM) date of 6/1/1978.

Forests

Portions of Hadley 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. Including Skinner State Park, Hadley boasts almost 30% of its land as forested.

2.4 Development

This section presents information about development in Hadley that is relevant to hazard mitigation planning.

Zoning

Hadley has the following base zoning districts:

Residential – R	To accommodate moderate-density, single-family residential development and complementary land uses.
Limited Business – LiB	To accommodate very-low-intensity and limited commercial and office development and other complementary land uses that serve and are generally appropriate near residential neighborhoods.
Local Business – LoB	To accommodate smaller business activity which is located at the edge of residential areas but which serves a larger trade area than the immediately surrounding residential neighborhoods.
Business – B	To accommodate a wide range of retail uses and services and commercial activities in appropriate locations along primary roads within the Town […]
Industrial – I	To accommodate a wide range of manufacturing, industrial, commercial, institution of higher learning and complementary land uses.

Hadley has the following overlay zoning districts:

Aquifer Protection	[…] protecting and preserving the surface and ground water resources of the Town from any use of land or buildings which may reduce the quality and quantity of its water resources.
Flood	Consisting of those geographical areas which by virtue of their relationship to components of the natural hydrology of the Town of Hadley have substantial importance to the protection of life and property against the hazards of floods, erosion, and pollution and in general are essential to the public health, safety, and welfare.
Wireless Communications Services	To establish a district in which wireless communications services may be provided with minimal harm to the public health, safety and general welfare by protecting the general public from impacts associated with wireless communications towers and minimizing visual impacts from wireless communications towers on Districts within Hadley
Farmland Preservation and Receiving Districts	To permanently protect farmland and agricultural soils, to protect farmland property values and provide a fair economic return to owners of property restricted from further development, to foster compact commercial and industrial development in central areas served by public infrastructure in the Town of Hadley.
Municipal	To protect the health, safety, convenience and welfare of the public by facilitating the siting of municipal uses and facilities required for the safe and efficient operation of Town government.

Village Center	A mixed-use commercial area within and adjacent to the town center promoting development in scale with the existing character of the village and encouraging new construction to be compatible with the scale of existing structures.
Senior Housing	To provide a variety of housing choices for persons who are 55 years of age and older […]

The Hadley Zoning Bylaw also establishes a Site Plan/Special Permit Approval procedure for specific uses and structures. This review allows the Special Permit Granting Authority (Planning Board) the ability to review development to ensure that the basic safety and welfare of the people of the Town are protected, and includes several specific evaluation criteria that are relevant to natural hazards.

Current Development Trends

During the past five years, Hadley has seen increased development in the following areas:

- Hadley Corner/Home Depot additional 120,000 ft of retail development
- Chinese Immersion Charter School
- Residential homes on Huntington Road
- Three large-scale solar power developments: Mill Valley Road, Huntington Road,
- Lowe's plaza with 120,000 sf store and adjacent restaurant
- Mill Valley Road commercial building
- Additional development at Hampshire and Mountain Farms Malls

It is not expected that these developments will increase the town's vulnerability to hazards.

National Flood Insurance Program (NFIP)

Hadley has been a participating member of the National Flood Insurance Program since 1974, and had the following NFIP policy and claim statistics as of 08/31/2015. (https://www.fema.gov/cis/MA.pdf)

Food Insurance Maps (FIRMs) are used for flood insurance purposes and are on file with the Hadley Planning Board. FIRMs have been effective since June 1, 1981, with no updates to Hadley or any other municipality in Hampshire County since then. PVPC has requested an update to all Hampshire County FIRMs, but has not been advised if or when these will be completed. Hadley County FIRMs were updated by FEMA as of July 21, 2014 (http://www.mass.gov/anf/docs/itd/services/massgis/nfhl-status.pdf)

As of August 31, 2015 there were 103 in-force flood insurance policies in effect in Hadley for a total of $25,146,400 worth of flood insurance coverage (http://bsa.nfipstat.fema.gov/reports/1011.htm#MAT)

As of August 31, 2015, there were a total of 15 NFIP loss claims in Hadley for which a total $96,282 was paid. (http://bsa.nfipstat.fema.gov/reports/1040.htm#25)

There is currently one structure defined as "Repetitive Loss (RL)" properties insured under the NFIP within Hadley. The "repetitive loss" property is a residential structure and is currently uninsured under the NFIP program. A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Currently there are over 122,000 RL properties nationwide.

The Town will maintain compliance with the NFIP throughout the next 5-year hazard mitigation planning cycle by monitoring its Flood Plain Overlay District and ensuring that the district accurately reflects the 100-year floodplain and FEMA Flood Insurance Rate Map.

2.5 Classification of Water Bodies

Lake Warner and the Hadley Lower Reservoir are Hadley's major bodies of water. Water rights to the 65-acre Lake Warner belong to Kestrel Land Trust, which merged with Valley Land Fund becoming one non-profit land trust operating in Hampden, Hampshire, and Franklin counties. Public access is available just upstream of the dam next to the bridge that carries Mt. Warner Road over the pond.

Mill River and Lake Warner

The Mill River corridor is located in North Hadley and includes a variety of habitats, rich in plant and bird life, with outstanding opportunities for nature study and protection of Hadley's natural heritage, including the 65-acre Lake Warner.

Fort River

The Fort River area lies in the heart of the Pioneer Valley in Hadley, just north of the Mount Holyoke Range. It contains more than 2,000 acres of the most prized grassland fields and farmland with prime soils that support working dairy farms, row crops, hay, and prizewinning breeding programs. The Fort River is the longest free-flowing tributary to the Connecticut River in Massachusetts and is a priority focus area for the Silvio O. Conte National Fish and Wildlife Refuge.

Floodplains

Hadley has been inundated by floodwaters several times since the turn of the 20th century. A roadside sign along Route 47 marks several flood events. Perhaps the most notable was the flood of 1936. Soon after, the town enlarged an existing earthen dike to protect the Town Center. Still, the western section of the peninsula and the area along Aqua Vitae Road remain susceptible to flooding. Nearly all of Hadley Center is mapped as being in the range of a one-hundred-year flood, a storm event that has a one percent chance of occurring in any given year.

Wetlands

Hadley has a range of wetland resources, including floodplain forests, forested swamp and wet meadows. Much of the wetlands lie in heavily forested areas along the Connecticut River and its tributaries. Wet meadows are more common along the Fort River near Hockanum Flat and Hadley Cove. Many wetlands and wooded swamps in Hadley were drained for agricultural use as Hadley once had more extensive wetland areas, specifically around Lake Warner, the Fort and Mill Rivers, along the Connecticut River, and behind Stop and Shop and the Campus Plaza Mall on Route 9 at the Amherst town line.

2.6 Access Status

Access to the Connecticut River is mostly from private land and marinas. Areas of state owned land next to the river are difficult to locate and reach by land. Access to the Fort and Mill Rivers on protected land would be across APR land, and require permission from the farmers first. State owned land along the Mill River near Lake Warner is also difficult to locate and reach by land. Access to Hadley Lower Reservoir requires a town parking permit for passive recreation.

3: HAZARD IDENTIFICATION AND RISK ASSESSMENT

The following section includes a summary of disasters that have affected or could affect Hadley. Historical research, conversations with local officials and emergency management personnel, available hazard mapping and other weather-related databases were used to develop this list. Identified hazards are the following:

1. Floods
2. Severe snows and ice storms
3. Hurricanes
4. Severe thunderstorms, tornadoes, high winds, and microbursts
5. Wildfire/brushfire
6. Earthquakes
7. Dam failure
8. Drought
9. Landslides
10. Extreme temperatures
11. Other hazards

Natural Hazard Analysis Methodology

The analysis of the hazards above is organized in the following categories: Hazard Description, Location, Extent, Previous Occurrences, Probability of Future Events, Impact, and Vulnerability. A description of each of these analysis categories follows.

Hazard Description

The natural hazards identified for Hadley are: floods, severe snowstorms/ice storms, hurricanes, severe thunderstorms / wind / tornadoes, wildfire/brushfire, earthquakes, dam failure, and drought. Many of these hazards result in similar impacts to a community. For example, hurricanes, tornadoes and severe snowstorms may cause wind-related damage.

Location

Location refers to the geographic areas within the planning area that are affected by the hazard. Some hazards affect the entire planning area universally, while others apply to a specific portion, such as a floodplain or area that is susceptible to wild fires. Classifications are based on the area that would potentially be affected by the hazard, on the following scale:

Location of Occurrence, Percentage of Town Impacted by Given Natural Hazard	
Location of Occurrence	Percentage of Town Impacted
Large	More than 50% affected
Medium	10 to 50% affected
Small	Less than 10% affected

Extent

Extent describes the strength or magnitude of a hazard. Where appropriate, extent is described using an established scientific scale or measurement system. Other descriptions of extent include water depth, wind speed, and duration.

Previous Occurrences

Previous hazard events that have occurred are described. Depending on the nature of the hazard, events listed may have occurred on a local, state-wide, or regional level.

Probability of Future Events

The likelihood of a future event for each natural hazard was classified according to the following scale:

Frequency of Occurrence and Annual Probability of Given Natural Hazard	
Frequency of Occurrence	Probability of Future Events
Very High	70-100% probability in the next year
High	40-70% probability in the next year
Moderate	10-40% probability in the next year
Low	1-10% probability in the next year
Very Low	Less than 1% probability in the next year

Impact

Impact refers to the effect that a hazard may have on the people and property in the community, based on the assessment of extent described above. Impacts are classified according to the following scale:

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

Vulnerability

Based on the above metrics, a hazard index rating was determined for each hazard. The hazard index ratings are based on a scale of 1 through 5 as follows:

1 – Very high risk
2 – High risk
3 – Medium risk
4 – Low risk
5 – Very low 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.

Hazard Identification and Analysis Worksheet for Hadley

Type of Hazard	Location of Occurrence	Probability of Future Events	Impact	Hazard Risk Index Rating
Floods	Small	Very High	Limited	3 – Medium Risk
Severe Snowstorms / Ice Storms	Large	High	Limited	2– High Risk
Hurricanes	Large	Low	Limited	3 – Medium Risk
Severe Thunderstorms Wind/Microburst	Medium	Very High	Limited	3 – Medium Risk
Tornado	Small	Low	Limited/Critical	3-Medium Risk
Wildfires / Brushfires	Small	Low	Minor	4 –Low Risk
Earthquakes	Large	Very Low	Critical	5 - Very Low Risk
Dam Failure (only 1) Dike System Failure	Small Medium	Very Low Low	Minor Limited	5 - Very Low Risk 4 - Low Risk
Drought	Large	Low	Minor	4- Low Risk
Landslides	Small	Low	Limited	4 - Low Risk
Extreme Temperatures	Large	Low	Limited	5 – Very Low Risk

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).

3.1 Floods

Hazard Description

There are three major types of storms that can generate flooding in Hadley:

Continental storms, which are typically low-pressure systems that can be either slow or fast moving. These storms originate from the west and occur throughout the year.

Coastal storms, also known as nor'easters, usually occur in late summer or early fall and originate from the south. The most severe coastal storms, hurricanes, occasionally reach Massachusetts and generate very large amounts of rainfall.

Thunderstorms, which form on warm, humid summer days and cause locally significant rainfall, usually over the course of several hours. These storms can form quickly and are more difficult to predict than continental and coastal storms.

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

Location

There are approximately 2,412 acres of land within the FEMA mapped 100-year floodplain (FEMA codes A and A1) and 690 acres of land within the 500-year floodplain within the Town of Hadley. Key locations of known and recurring flooding are described below.

Aqua Vitae Road[1]

The primary land use in this area is agriculture as well as low density residential. Approximately thirty (30) structures could be affected by a flood incident. 100% damage to 100% of the structures, estimated cost of repairing or replacing to be $9,354,000. Cost for repairing or replacing any dams or bridges, power lines, telephone lines, and contents of structures are not included.

- A washout of one section of the road and extensive flooding occurred during the October 9, 2005 Connecticut River Flood. An earthen berm was constructed at the intersection of Aqua Vitae Road and Bay Road to prevent flood waters from crossing Bay Road.

[1] Number of structures determined through the use of aerial photography

- In 1984 there was a large sink hole on Aqua Vitae Road. It required many large axle trucks of dirt and gravel to fill in the hole.
- Annual potential for flooding in floodplain from both spring runoff and heavy summer/fall rains.
- Potential for damage/repair to road surface.

Bay Road

Approximately fifty (50) structures could be affected by a flood incident. 100% damage to 100% of the structures, estimated cost of repairing or replacing to be $13,521,750. Cost for repairing or replacing any dams or bridges, power lines, telephone lines, and contents of structures are not included.

- Portions of Bay Road are within the 100-year floodplain associated with the Connecticut River, Fort River and Harts Brook.
- Annual potential for flooding in floodplain from both spring runoff and heavy summer/fall rains.
- Potential for damage/repair to road surface.

Honey Pot Road

The primary land use in this area is agriculture as well as low density residential. Approximately ten (10) structures could be affected by a flood incident. 100% damage to 100% of the structures, estimated cost of repairing or replacing to be $2,704,350. Cost for repairing or replacing any dams or bridges, power lines, telephone lines, and contents of structures are not included.

- A washout of 3 ½ feet in depth occurred during the October 9, 2005 Connecticut River Flood.
- Annual potential for flooding in floodplain from both spring runoff and heavy summer/fall rains.
- Potential for damage/repair to road surface.

Mountain Road

Most of Mountain Road is just outside the FEMA mapped 100-year base flood but floods on a regular basis due to both spring runoff and heavy summer/fall rains. Approximately two structures, including a pump station, could be affected by a flood incident. 100% damage to 100% of the structures, estimated cost of repairing or replacing to be $236,800. Cost for repairing or replacing any dams or bridges, power lines, telephone lines, and contents of structures are not included.

- A portion of Mountain Road is within a FEMA mapped 100-year flood zone.
- A washout and landslide, approximately 200’ in length, depth about 20’, as well as numerous washouts on other portions of road over 1,500’ in length occurred during the October 9, 2005 Connecticut River Flood.
- In the summers, many people park recreational trailers along the Connecticut River, which poses an issue with summer flooding potential.

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

Moody Bridge Road

Approximately two structures could be affected by a flood incident. 100% damage to 100% of the structures, estimated cost of repairing or replacing to be $236,800. Cost for repairing or replacing any dams or bridges, power lines, telephone lines, and contents of structures are not included.

- Moody Bridge Road is not within a FEMA mapped 100-year flood zone with the exception of that portion that crosses Harts Brook.
- Numerous washouts occurred during the October 9, 2005 Connecticut River Flood.
- Annual potential for flooding in floodplain from both spring runoff and heavy summer/fall rains.
- Potential for damage/repair to road surface.

Extent

The Hazard Mitigation Committee indicated that all locations of localized flooding can receive high water marks of up to several feet during sufficiently large rainstorms. Water levels in Hadley's rivers, streams, and wetlands rise and fall seasonally and during high rainfall events. High water levels are typical in spring, due to snowmelt and ground thaw. This is the period when flood hazards are normally expected. Low water levels occur in summer due to high evaporation and plant uptake (transpiration). At any time, heavy rainfall may create conditions that raise water levels in rivers and streams above bank full stage, which then overflow adjacent lands.

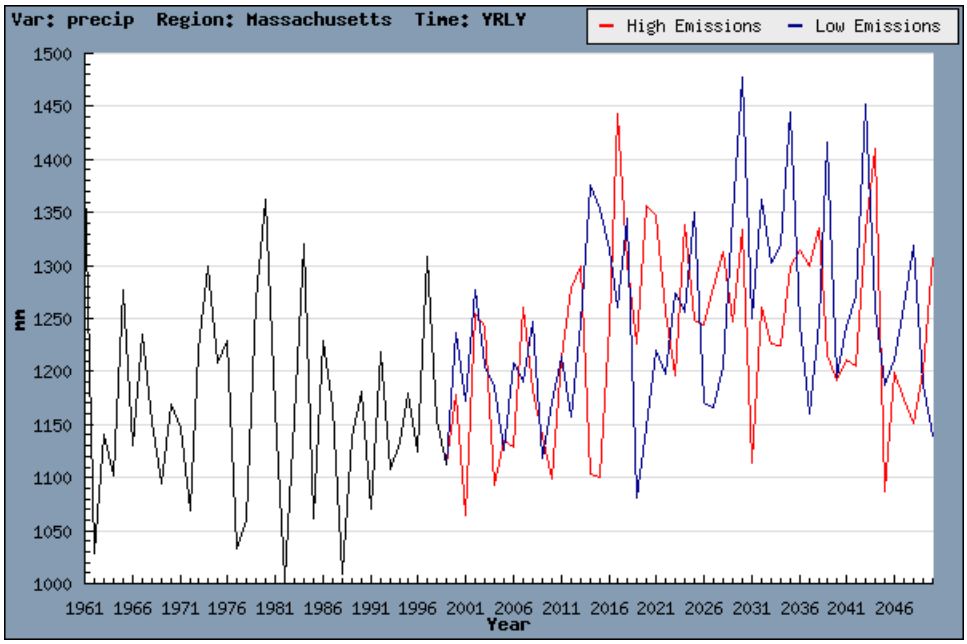
Floods can be classified as one of two types: flash floods and general floods.

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

General floods may last for several days or weeks and are caused by precipitation over a longer time period in a particular river basin. 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).

The average annual precipitation for Hadley and surrounding areas in western Massachusetts is 46 inches. This is likely to increase. Rainfall has increased approximately 10% during the past 50 years, and is expected to continue increasing (see figure below).

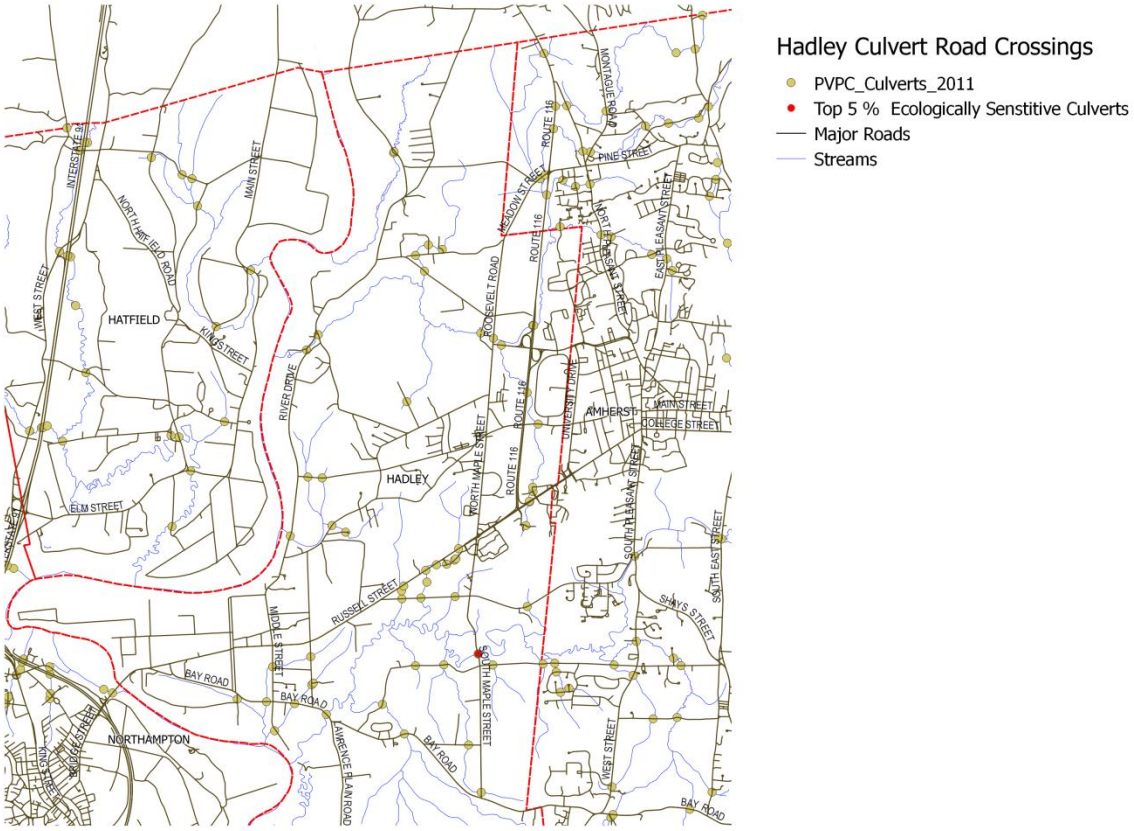
Massachusetts Rainfall 1961-2050



Source: NECIA

Related to the flood-prone areas identified above are the locations of 53 culvert road crossings in Hadley, which are shown on the map below.

Hadley Culvert Road Crossings (53)



Source: University of Massachusetts Stream Continuity Project 2011
<https://streamcontinuity.org/index.htm>

Previous Occurrences

The Hazard Mitigation Workgroup identified the locations listed under the "location" section as where previous occurrences of localized flash flooding have occurred. Hadley has experienced many small flooding events over the last decade. Generally, these small floods have had minor impacts, temporarily impacting roads.

The National Weather Service monitors flood crests for the Connecticut River at the nearest NWS station, which is located directly opposite the Hadley west bank in Northampton, Massachusetts. The NWS flood classifications and definitions are:

> **Action Stage**, the stage which, when reached by a rising stream, represents the level where the NWS or a partner/user needs to take some type of mitigation action in preparation for possible significant hydrologic activity. The type of action taken varies for each gage location. Gage data should be closely monitored by any affected people if the stage is above action stage.

Minor Flooding, defined to have minimal or no property damage, but possibly some public threat. A Flood Advisory product is issued to advise the public of flood events that are expected not to exceed the minor flood category. Examples of conditions that would be considered minor flooding include:

- water over banks and in yards
- no building flooded, but some water may be under buildings built on stilts (elevated)
- personal property in low lying areas needs to be moved or it will get wet
- water overtopping roads, but not very deep or fast flowing
- water in campgrounds or on bike paths
- inconvenience or nuisance flooding
- small part of the airstrip flooded, and aircraft can still land
- one or two homes in the lowest parts of the community may be cut off or get a little water in the crawl spaces or homes themselves if they are not elevated

Moderate Flooding, defined to have some inundation of structures and roads near the stream. Some evacuations of people and/or transfer of property to higher elevations may be necessary. A Flood Warning is issued if moderate flooding is expected during the event. Examples of conditions that would be considered moderate flooding include:

- several buildings flooded with minor or moderate damage
- various types of infrastructure rendered temporarily useless (i.e. fuel tanks cannot be reached due to high water, roads flooded that have no alternates, generator station flooded)
- elders and those living in the lowest parts of the village are evacuated to higher ground
- access to the airstrip is cut off or requires a boat
- water over the road is deep enough to make driving unsafe
- gravel roads likely eroded due to current moving over them
- widespread flooding, but not deep enough to float ice chunks through the community
- water deep enough to make life difficult, normal life is disrupted and some hardship is endured
- airstrip closed
- travel is most likely restricted to boats

Major Flooding, defined to have extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations are necessary. A Flood Warning is issued if major flooding is expected during the event. Examples of conditions that would be considered major flooding include:

- many buildings flooded, some with substantial damage or destruction
- infrastructure destroyed or rendered useless for an extended period of time
- multiple homes are flooded or moved off foundations
- everyone in threatened area is asked to evacuate
- National Guard units assist in evacuation efforts
- erosion problems are extreme
- the airstrip, fuel tanks, and the generator station are likely flooded
- loss of transportation access, communication, power and/or fuel spills are likely

- fuel tanks may float and spill and possibly float downstream
- ice chunks floating though the community that could cause structural damage
- high damage estimates and high degree of danger to residents

The major flood stage for the Connecticut River at the Northampton station is 120 feet, which has been reached three times since 1935. The moderate flood stage is 115 feet, which has been reached 16 times since 1935. The minor flood stage is 112 feet, which has been reached 60 times since 1935. The action stage is 110 feet, which has been reached 11 times since 1935.

Historical Crests of the Connecticut River in Northampton/Hadley Station

3/19/36	129.4 ft	Major flooding
9/22/38	125 ft	Major flooding
5/31/84	120.8 ft	Major flooding
4/6/60	119.9 ft	Moderate flooding
1/1/49	118.6 ft	Moderate flooding
4/1/87	118 ft	Moderate flooding
3/23/48	117.7 ft	Moderate flooding
3/29/53	117.6 ft	Moderate flooding
8/30/11	117.16 ft	Moderate flooding
5/5/40	117 ft	Moderate flooding
10/9/05	116.3 ft	Moderate flooding
3/15/77	116.2 ft	Moderate flooding
6/3/52	116 ft	Moderate flooding
4/3/76	115.7 ft	Moderate flooding
4/23/69	115.5 ft	Moderate flooding
4/1/51	115.4 ft	Moderate flooding
4/24/58	115.3 ft	Moderate flooding
3/24/68	115.2 ft	Moderate flooding
5/1/56	115 ft	Moderate flooding
7/2/73	114.9 ft	Minor flooding
4/7/52	114.8 ft	Minor flooding
4/19/82	114.8 ft	Minor flooding
3/27/79	114.6 ft	Minor flooding
4/4/05	114.6 ft	Minor flooding
3/19/73	114.6 ft	Minor flooding
4/17/96	114.6 ft	Minor flooding
4/1/98	114.6 ft	Minor flooding
4/17/07	114.5 ft	Minor flooding
12/16/83	114.5 ft	Minor flooding
4/18/94	114.4 ft	Minor flooding
4/13/47	114.4 ft	Minor flooding
4/5/59	114.3 ft	Minor flooding
4/24/01	114.3 ft	Minor flooding
12/22/73	114.2 ft	Minor flooding
5/14/96	114.2 ft	Minor flooding
2/26/81	114.2 ft	Minor flooding
4/2/62	114.1 ft	Minor flooding
4/2/04	114 ft	Minor flooding
4/2/77	114 ft	Minor flooding
3/18/90	113.9 ft	Minor flooding
5/6/72	113.9 ft	Minor flooding
1/19/06	113.7 ft	Minor flooding
4/8/84	113.7 ft	Minor flooding
3/22/45	113.5 ft	Minor flooding
4/1/86	113.5 ft	Minor flooding
4/1/93	113.5 ft	Minor flooding
4/14/11	113.46 ft	Minor flooding
11/30/59	113.4 ft	Minor flooding
3/29/76	113.4 ft	Minor flooding
4/17/93	113.4 ft	Minor flooding
4/21/72	113.3 ft	Minor flooding
10/30/03	113.2 ft	Minor flooding
4/17/14	113.12 ft	Minor flooding
3/31/03	113 ft	Minor flooding
10/27/05	113 ft	Minor flooding
1/10/98	112.9 ft	Minor flooding
4/15/08	112.9 ft	Minor flooding
4/18/11	112.8 ft	Minor flooding
4/17/55	112.8 ft	Minor flooding
3/31/10	112.8 ft	Minor flooding
9/8/11	112.7 ft	Minor flooding
4/6/50	112.7 ft	Minor flooding
9/8/11	112.7 ft	Minor flooding
10/21/75	112.6 ft	Minor flooding
4/4/67	112.5 ft	Minor flooding
5/26/79	112.5 ft	Minor flooding
5/7/89	112.5 ft	Minor flooding
4/16/64	112.4 ft	Minor flooding
4/8/89	112.4 ft	Minor flooding
1/28/96	112.4 ft	Minor flooding
12/19/00	112.4 ft	Minor flooding
4/4/63	112.4 ft	Minor flooding
5/5/71	112.2 ft	Minor flooding
4/6/74	112.2 ft	Minor flooding
3/24/10	112.2 ft	Minor flooding
4/26/70	112.1 ft	Minor flooding
8/20/55	112 ft	Minor flooding
4/11/80	112 ft	Minor flooding

4/19/54	112 ft	Minor flooding
12/13/08	111.9 ft	Action Stage
4/5/90	111.8 ft	Action Stage
4/6/00	111.8 ft	Action Stage
5/21/06	111.8 ft	Action Stage
12/1/59	111.8 ft	Action Stage
4/17/02	111.7 ft	Action Stage
12/26/90	111.7 ft	Action Stage
4/30/88	111.6 ft	Action Stage
5/5/83	111.6 ft	Action Stage
4/4/73	111.6 ft	Action Stage
12/26/03	111.5 ft	Action Stage

Source: National Weather Service

Probability of Future Events

Based upon previous data, there is a very high probability (more than 70% in any given year) of flash flooding or general flooding occurring in Hadley.

Flooding frequencies for the various floodplains in Hadley are defined by FEMA as the following:

10-year floodplain – 10% chance of flooding in any given year
25-year floodplain – 2.5% chance of flooding in any given year
100-year floodplain – 1% chance of flooding in any given year
500-year floodplain – 0.2% chance of flooding in any given year

Climate scientists predict that in the next few decades, climate change will increase the frequency and intensity of all storms that can cause flooding. Currently, floods are the most costly natural hazard in the United States, and climate change will only increase this damage. More information about the effect of Climate Change can be found in the Pioneer Valley Planning Commission's Climate Action Plan, available at www.sustainableknowledgecorridor.org.

The Massachusetts State Climate Change Adaptation Report has additional information about the impact of climate change and can be accessed at www.mass.gov/eea/air-water-climate-change/climate-change/climate-change-adaptation-report.html.

Since 1948, incidents of extreme rainfall events (large amounts of rain in a short period of time) in the U.S. have increased 30%. But New England states have experienced a far greater increase than the national average. In Massachusetts, the increase is 81%; upstream on the Connecticut River, New Hampshire is up 115% and Vermont is up 84%. (Source: Environment America Research & Policy Center, 2012). Extreme rainfall is a cause of flooding, which is a major concern of this plan.

Impact

The value of all residential structures in the Town of Hadley is $611,874,600 as of 2015. The mean value of a home in Hadley in 2016 is approximately $311,800 and the average household size is 2.41 people. The data below was calculated using FEMA's Understanding Your Risks: Identifying Hazards and Estimating Losses, August 2001. In addition, the Committee completed the Vulnerability Assessment Worksheets which provided more data to estimate the potential losses.

There are approximately 2,412 acres of land within the FEMA mapped 100-year floodplain and 690 acres of land within the 500-year floodplain within the Town of Hadley. According to the Community Information System (CIS) of FEMA, there were 331, 1-4 family structures and 74 "other" structures located within the Special Flood Hazard Area (SFHA) in Hadley as of July 14, 2005, the most current records in the CIS for the Town of Hadley, totaling approximately $111,182,900 of damage, and 798 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.

Vulnerability

Based on the above analysis, Hadley has a hazard index rating between "**3 – medium risk**" of flooding.

The presence of the Connecticut River, other streams and undersized culverts make localized flooding in Hadley very likely. There are a number of structures located within the 100-year flood plan that were built before the town's initial FIRM was created. These structures are most vulnerable to flooding that could occur. While most of the town's critical facilities are not located within the flood hazard area, a number of bridges and pumping stations are. Damage to the bridges could impede evacuation efforts in the event of a natural hazard. Particularly vulnerable are Route 47 North and Route 116.

3.2 Severe Snowstorms and Ice Storms

Hazard Description

Snow is characterized as frozen precipitation in the form of six-sided ice crystal. In order for snow to occur, temperatures in the atmosphere (from ground level to cloud level) must be at or below freezing. The strongest form of a severe snow storm is a blizzard. Blizzards are characterized by frequent wind gusts above 35 miles per hour, limited to no visibility due to falling snow and extreme cold that lasts longer than three hours.

Ice storms are liquid rain that falls and freezes upon contact with cold objects. There must be an ice build-up of greater than ¼ inch for it to be considered an ice storm. When more than a ½ inch of ice build-up is forecasted a winter storm warning can be triggered.

Severe winter storms can pose a significant risk to property and human life. The rain, freezing rain, ice, snow, cold temperatures and wind associated with these storms can cause the following hazards:

- Disrupted power and phone service
- Unsafe roadways and increased traffic accidents
- Infrastructure and other property are also at risk from severe winter storms and the associated flooding that can occur following heavy snow melt.
- Tree damage and fallen branches that cause utility line damage and roadway blockages
- Damage to telecommunications structures
- Reduced ability of emergency officials to respond promptly to medical emergencies or fires.

Location

The entire Town of Hadley is susceptible to severe snowstorms. Because these storms occur regionally, they would impact the entire town, with more than 50% of land area affected.

The Town has had snow-related problems with the following roadways:

- Portions of the north side of Knightly Road.
- Northwest corner of the intersection of Knightly Road/Roosevelt Road.
- Northwest corner of the intersection of Mount Warner Road/Roosevelt Road.
- Southwest corner of the intersection of Mount Warner Road/North Maple Street.
- Portions of the north side of Huntington Road.
- Portions of the north side of Rocky Hill Road.
- West side of South Maple Street.
- Portions of the east side of Lawrence Plain Road (Route 47).

Extent

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.

Northeast Snowfall Impact Scale Categories		
Category	NESIS Value	Description
1	1—2.49	Notable
2	2.5—3.99	Significant
3	4—5.99	Major
4	6—9.99	Crippling
5	10.0+	Extreme

Source: http://www.ncdc.noaa.gov/snow-and-ice/rsi/nesis

Previous Occurrences

The Pioneer Valley generally experiences at least one or two severe winter storms each year with varying degrees of severity. Severe winter storms typically occur during January and February; however, they can occur from late September through late April.

Based on data available from the National Oceanic and Atmospheric Administration, there are 47 winter storms since 1958 that have registered on the NESIS scale. Of these, approximately 26 storms resulted in snow falls in the Pioneer Valley of at least 10 inches. These storms are listed in the table on the next page, in chronological order.

Winter Storms Producing Over 10 inches of Snow in the Pioneer Valley, 1958-2015			
Date	NESIS Value	NASIS Category	NESIS Classification
1958-02-14	6.25	4	Crippling
1958-03-18	3.51	2	Significant
1960-03-02	8.77	4	Crippling
1960-12-11	4.53	3	Major
1961-01-18	4.04	3	Major
1961-02-02	7.06	4	Crippling
1964-01-11	6.91	4	Crippling
1966-01-29	5.93	3	Major
1966-12-23	3.81	2	Significant
1967-02-05	3.50	2	Significant
1969-02-08	3.51	2	Significant
1969-02-22	4.29	3	Major
1969-12-25	6.29	4	Crippling
1972-02-18	4.77	3	Major
1978-01-19	6.53	4	Crippling
1978-02-05	5.78	3	Major
1982-04-06	3.35	2	Significant
1983-02-10	6.25	4	Crippling
1987-01-21	5.40	3	Major
1993-03-12	13.20	5	Extreme
1994-02-08	5.39	3	Major
1995-02-02	1.43	1	Notable
1996-01-06	11.78	5	Extreme
1997-03-31	2.29	1	Notable
2000-01-24	2.52	2	Significant
2000-12-30	2.37	1	Notable
2003-02-15	7.50	4	Crippling
2005-01-21	6.80	4	Crippling
2006-02-12	4.10	3	Major
2007-02-12	5.63	3	Major
2007-03-15	2.54	2	Significant
2009-03-01	1.59	1	Notable
2010-02-23	5.46	3	Major
2010-12-24	4.92	3	Major
2011-01-09	5.31	3	Major
2011-01-26	2.17	1	Notable
2011-02-01	5.30	3	Major
2011-10-29	1.75	1	Notable
2013-02-07	4.35	3	Major
2013-03-04	3.05	2	Significant
2013-12-13	2.95	2	Significant
2013-12-30	3.31	2	Significant
2014-02-11	5.28	3	Major
2014-11-26	1.56	1	Notable
2014-12-09	1.49	1	Notable
2015-01-25	2.62	2	Significant
2015-01-29	5.42	3	Major
2015-02-08	1.32	1	Notable

Source: http://www.ncdc.noaa.gov/snow-and-ice/rsi/nesis

Probability of Future Events

Based upon the availability of records for Hampshire County, the likelihood that a severe snow storm will hit Hadley in any given year is greater than 50%.

Research on climate change indicates that there is great potential for stronger, more frequent storms as the global temperature increases. More information about the effect of Climate Change can be found in the Pioneer Valley Planning Commission's Climate Action Plan, available at www.sustainableknowledgecorridor.org.

The Massachusetts State Climate Change Adaptation Report has additional information about the impact of climate change and can be accessed at www.mass.gov/eea/air-water-climate-change/climate-change/climate-change-adaptation-report.html.

Impact

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all residential property in town, $935,709,078, is used. An estimated 20% of damage would occur to 10% of structures, resulting in a total of $4,678,545 worth of damage. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above assessment, Hadley faces a hazard index rating of "**2 - high risk**" from severe snowstorms and ice storms.

No critical facilities or evacuation routes are considered significantly vulnerable to severe winter weather. Snow and ice build up on roads can, however, make winter travel difficult for residents.

3.3 Hurricanes and Tropical Storms

Hazard Description

Hurricanes are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and with a diameter ranging from 10 to 30 miles. The primary damaging forces associated with hurricanes are high-level sustained winds and heavy precipitation. Hurricanes are violent rainstorms with strong winds that can reach speeds of up to 200 miles per hour and which generate 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. In Western Massachusetts, which is 80 to 100 miles inland from the Atlantic Coast, hurricanes may degrade to tropical storms by the time they reach the region; nonetheless, impacts in some cases are similar to hurricanes.

Location

Because of the hazard's regional nature, all of Hadley is at risk from hurricanes, meaning the location of occurrence is "large." Ridge tops are more susceptible to wind damage. Areas susceptible to flooding are also likely to be affected by the heavy rainfall that typically accompanies hurricanes and tropical storms. Areas susceptible to flooding are also likely to be affected by heavy rainfall.

Extent

As an incipient hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour, the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Hurricane Wind Scale, which rates hurricane wind intensity on a scale of 1 to 5, with 5 being the most intense.

Saffir-Simpson Scale	
Category	Maximum Sustained Wind Speed (MPH)
1	74–95 mph
2	96–110 mph
3	111–129 mph
4	130–156 mph
5	157+ mph

Source: National Hurricane Center, 2012

Previous Occurrences

Hurricanes and tropical storms that have affected Hadley are shown below. ("Super Storm Sandy" in 2012 was not considered a hurricane or tropical storm, as it did not meet the meteorological criteria for having a warmer temperature at its core; nonetheless, the storm was significant in Hadley.)

Major Hurricanes and Storms Affecting Hadley		
Hurricane/Storm Name	Year	Saffir/Simpson Category (when reached MA)
Great Hurricane of 1938	1938	3
Great Atlantic Hurricane	1944	1
Carol	1954	3
Edna	1954	1
Diane	1955	Tropical Storm
Donna	1960	Unclear, 1 or 2
Groundhog Day Gale	1976	Not Applicable
Gloria	1985	1
Bob	1991	2
Floyd	1999	Tropical Storm
Irene	2011	Tropical Storm
Sandy	2012	Super Storm

Source: National Weather Service

Probability of Future Events

Hadley's location in Western Massachusetts reduces the risk of extremely high winds that are associated with hurricanes, although it can experience some high wind events. Based upon past occurrences, it is reasonable to say that there is a "low" probability of hurricanes in Hadley in any given year.

Impact

A description of the damages that could occur due to a hurricane is described by the Saffir-Simpson scale, as shown below.

Hurricane Damage Classifications			
Storm Category	Damage Level	Description of Damages	Wind Speed (MPH)
1	MINIMAL Very dangerous winds will produce some damage	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. An example of a Category 1 hurricane is Hurricane Dolly (2008).	74-95
2	MODERATE Extremely dangerous winds will cause extensive damage	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. An example of a Category 2 hurricane is Hurricane Francis in 2004.	96-110
3	EXTENSIVE Devastating damage will occur	Some structural damage to small residences and utility buildings, with a minor amount of curtain wall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. An example of a Category 3 hurricane is Hurricane Ivan (2004).	111-129
4	EXTREME Catastrophic damage will occur	More extensive curtain wall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. An example of a Category 4 hurricane is Hurricane Charley (2004).	130-156
5	CATASTROPHIC Catastrophic damage will occur	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. An example of a Category 5 hurricane is Hurricane Andrew (1992).	157+

Source: "Saffir/Simpson Hurricane Scale" NOAA National Climatic Data Center https://www.ncdc.noaa.gov

Note: The Saffir Scale uses "5" as its most severe category; this is the inverse of the Hazard Index Ratings used in this plan, in which "1" is the most severe.

The 1938 and 1985 hurricanes were major events and caused wind damage and flooding statewide. There is potential for disruption of power and phone line services, structural damage to buildings, and flooding of evacuation routes.

Using a total a value of all structures in town of $935,709,078 and an estimated wind damage of 5% of all structures with 10% damage to each structure, an estimated $4,678,545 of damage would occur. Estimated flood damage to 10% of the structures with 20% damage to each structure would result in $18,714,181 of damage. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above analysis, Hadley faces a hazard index rating of "**3 - medium risk**" from hurricanes.

The high winds and flooding due to rainfall in a hurricane could cause damage within the town. Areas identified as particularly vulnerable to flooding would likely also be vulnerable to hurricanes if large amounts of rainfall were to be present.

3.4 Severe Thunderstorms, High Winds, and Microbursts

Hazard Description

A thunderstorm is a storm with lightning and thunder produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain, and sometimes hail. Effective January 5, 2010, the NWS modified the hail size criterion to classify a thunderstorm as 'severe' when it produces damaging wind gusts in excess of 58 mph (50 knots), hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Wind is air in motion relative to surface of the earth. For non-tropical events over land, the NWS issues a Wind Advisory (sustained winds of 31 to 39 mph for at least 1 hour or any gusts 46 to 57 mph) or a High Wind Warning (sustained winds 40+ mph or any gusts 58+ mph). For non-tropical events over water, the NWS issues a small craft advisory (sustained winds 25-33 knots), a gale warning (sustained winds 34-47 knots), a storm warning (sustained winds 48 to 63 knots), or a hurricane force wind warning (sustained winds 64+ knots). For tropical systems, the NWS issues a tropical storm warning for any areas (inland or coastal) that are expecting sustained winds from 39 to 73 mph. A hurricane warning is issued for any areas (inland or coastal) that are expecting sustained winds of 74 mph. Effects from high winds can include downed trees and/or power lines and damage to roofs, windows, etc. High winds can cause scattered power outages. High winds are also a hazard for the boating, shipping, and aviation industry sectors.

Microbursts are sudden down bursts of air that funnel air directly down until it hits the ground and disperses outwards. Microbursts most commonly occur during strong thunderstorms. The scale and suddenness of microbursts make them difficult to predict with certainty, but it is possible to forecast the conditions that make microbursts much more likely. The high winds associated with microbursts can knock over full grown trees, damage buildings and are especially problematic for aircrafts.

Location

As per the Massachusetts Hazard Mitigation Plan, the entire town is at risk of high winds, severe thunderstorms, and tornadoes. The plan also identifies Hadley and the surrounding communities as having a high frequency of tornados occurrence within Massachusetts. However, the actual area affected by thunderstorms, wind, or microburst is "small," with less than 10% of the town affected.

Extent

An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. Southern New England typically experiences 10 to 15 days per year with severe thunderstorms. Thunderstorms can cause hail, wind, and flooding.

Microbursts are typically less than three miles across. They can last anywhere from a few seconds to several minutes. Microbursts cause damaging winds up to 170 miles per hour in strength and can be accompanied by precipitation.

Previous Occurrences

Because thunderstorms and wind affect the town regularly on an annual basis, there are not significant records available for these events. As per the Massachusetts Hazard Mitigation Plan, there are approximately 10 to 30 days of thunderstorm activity in the state each year.

A powerful microburst affected the nearby city of Easthampton on October 8th, 2014 which involved winds up to 100 miles per hour. The microburst began on the west side of Mount Tom and moved southwest to northeast along the edge of the range, causing significant damage to, and loss of, trees. Several homes lost power; some of these and others were damaged.

Probability of Future Events

As per the Massachusetts Hazard Mitigation Plan, there are approximately 10 to 30 days of thunderstorm activity in the state each year.

Microbursts and tornadoes are not uncommon in the region, and they are expected to become more frequent and more violent as the earth's atmosphere warms, due to predictions of climate change from global warming.

Impact

Overall, Hadley faces a "limited" impact from severe thunderstorms, winds, or microbursts with 10% or less of the town affected

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all property in town, $935,709,078 is used. An estimated 100% of damage would occur to 1% of structures, resulting in a total of $9,357,090 worth of damage and 55 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above assessment, Hadley has a hazard index rating of "**3 – medium risk**" of thunderstorms, wind, and tornadoes.

All areas of the town are vulnerable to destruction caused by severe thunderstorms, wind and microbursts. The town's communication and energy infrastructure is particularly vulnerable to high winds that frequently accompany severe thunderstorms. The vulnerabilities associated with flooding could be present if substantial rain accompanies the severe thunderstorms.

3.5 Tornadoes

Hazard Description

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. Within Massachusetts, tornadoes have occurred most frequently in Worcester County and in communities west of Worcester, including towns in eastern Hampshire County. 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.).

Location

As per the Massachusetts Hazard Mitigation Plan, the entire town is at risk of tornadoes. The plan also identifies Hadley and the surrounding communities as having a high frequency of tornados occurrence within Massachusetts. However, the actual area affected by tornadoes is "small," with less than 10% of the town affected.

Extent

Tornadoes are measured using the enhanced F-Scale, shown with the following categories and corresponding descriptions of damage:

Enhanced Fujita Scale Levels and Descriptions of Damage			
EF-Scale Number	Intensity Phrase	3-Second Gust (MPH)	Type of Damage Done
EF0	Gale	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	Moderate	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	Significant	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	Severe	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	Devastating	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

Previous Occurrences

There are typically 1 to 3 tornadoes somewhere in southern New England per year. Most occur in the late afternoon and evening hours, when the heating is the greatest. The most common months are June, July, and August, but the Great Barrington tornado (1995) occurred in May and the Windsor Locks, CT tornado (1979) occurred in October. In 2011, a tornado ranked F3 (Severe Damage) on the Fujita Scale of Tornado Intensity, blew through West Springfield, Westfield, Springfield, Monson, Wilbraham, Brimfield, Sturbridge, and Southbridge. The tornado and related storm killed 3 people and resulted in hundreds of injuries across the state. No known tornado has tracked directly through Hadley.

Tornadoes are not uncommon in the region, and they are expected to become more frequent and more violent as the earth's atmosphere warms, due to predictions of climate change from global warming.

Probability of Future Events

One measure of tornado activity is the tornado index value. It is calculated based on historical tornado events data using USA.com algorithms. It is an indicator of the tornado level in a region. A higher tornado index value means a higher chance of tornado events. Data was used for Hampshire County to determine the Tornado Index Value as shown in the table below.

Tornado Index for Hampshire County	
Hampshire County	125.73
Massachusetts	87.60
United States	136.45

Source: www.usa.com/hampshire-county-ma-natural-disasters-extremes.htm

Based upon the available historical record, as well as Hadley's location in a high-density cluster of state-wide tornado activity, it is reasonable to estimate that there is a low frequency of tornado occurrence in Hadley in any given year.

As per the Massachusetts Hazard Mitigation Plan, there are approximately 10 to 30 days of thunderstorm activity in the state each year.

Impact

Overall, Hadley faces a "limited" impact from severe thunderstorms, winds, or tornadoes, with 10% or less of the town affected. The potential for locally catastrophic damage is a factor in any tornado event. In Hadley, a tornado that hit the residential areas would leave much more damage than a tornado with a travel path that ran along the agricultural areas. Most buildings in the Town of Hadley have not been built to Zone 1, Design Wind Speed Codes. The first edition of the Massachusetts State Building Code went into effect on January 1, 1975, with most of the Town's housing built before this date.

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all property in town, $935,709,078 is used. An estimated 100% of damage would occur to 1% of structures, resulting in a total of $9,357,090 worth of damage and 55 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above assessment, Hadley has a hazard index rating of "**3 – medium risk**" of tornadoes.

All areas of the town are vulnerable to destruction caused by tornadoes. The town's communication and energy infrastructure is particularly vulnerable to high winds that frequently accompany tornadoes.

3.5 Wildfire/Brushfire

Hazard Description

Wildfires are typically larger fires, involving full-sized trees as well as meadows and scrublands. Brushfires are uncontrolled fires that occur in meadows and scrublands, but do not involve full-sized trees. Both wildfires fires and brushfires can consume homes, other buildings and/or agricultural resources. FEMA has classifications for 3 different classes of wildfires:

- **Surface fires** are the most common type of wild land fire and burn slowly along the floor of a forest, killing or damaging trees
- **Ground fires** burn on or below the forest floor and are usually started by lightening
- **Crown fires** move quickly by jumping along the tops of trees. A crown fire may spread rapidly, especially under windy conditions

The wildfire season in Massachusetts usually begins in late March and typically culminates in early June, corresponding with the driest live fuel periods of the year. April is historically the month in which wildfire danger is the highest. However, wildfires can occur every month of the year. Drought, snow pack, and local weather conditions can expand the length of the fire season. The early and late shoulders of the fire season usually are associated with human-caused fires.

Location

Hampden and Hampshire County have approximately 469,587 acres of forested land, which accounts for 62% of total land area.

The following areas have been identified as potential wildfire areas in Hadley:

Area East of Mount Warner Road
Moderate risk exists for potential wildfire incidents in this central portion of Town. There are approximately 10 structures in this area that could be affected by a wildfire incident. 100% damage to 100% of the structures, estimated cost of repairing or replacing to be $3,359,000. Cost for repairing or replacing any power lines, telephone lines, and contents of structures are not included.

Skinner State Park and Chmura Road
This was identified as the area having the greatest potential for wildfires and brush fires. There are approximately 30 structures in this area that could be affected by a wildfire/brush fire incident. 100% damage to 100% of the structures, estimated cost of repairing or replacing to be $10,077,000. Cost for repairing or replacing any power lines, telephone lines, and contents of structures are not included.

Extent

Wildfires can cause widespread damage to the areas that they affect. They can spread very rapidly, depending on local wind speeds and be very difficult to get under control. Fires can last for several hours up to several days. In terms of land acreage, approximately 30% of Hadley is forestland, mostly fragmented and interrupted by swaths of agricultural fields. A large wildfire in Hadley could cause serious damage to the town's land mass 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.

As described in the next section describing previous occurrences of wildfire, there have not been any major wildfires recorded in Hadley. However, based on other major wildfires that have occurred in western Massachusetts, it is estimated that such a fire would likely destroy around 50 to 500 acres of forested area.

The overall extent of wildfires is shown in the table below:

Extent of Wildfires

Rating	Basic Description	Detailed Description
CLASS 1: Low Danger (L) Color Code: **Green**	Fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
CLASS 2: Moderate Danger (M) Color Code: **Blue**	Fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
CLASS 3: High Danger (H) Color Code: **Yellow**	Fires start easily and spread at a rapid rate	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.
CLASS 4: Very High Danger (VH) Color Code: **Orange**	Fires start very easily and spread at a very fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
CLASS 5: Extreme (E) Color Code: **Red**	Fire situation is explosive and can result in extensive property damage	Fires under extreme conditions start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Previous Occurrences

During the past 100 years, there have not been many wildfires occurring in the Pioneer Valley. However, several have occurred during the past 20 years, as shown in the list below:

1995 – Russell, 500 acres burned on Mt. Tekoa

2000 – South Hadley, 310 acres burned over 14 days in the Litihia Springs Watershed

2001 – Ware, 400 acres burned

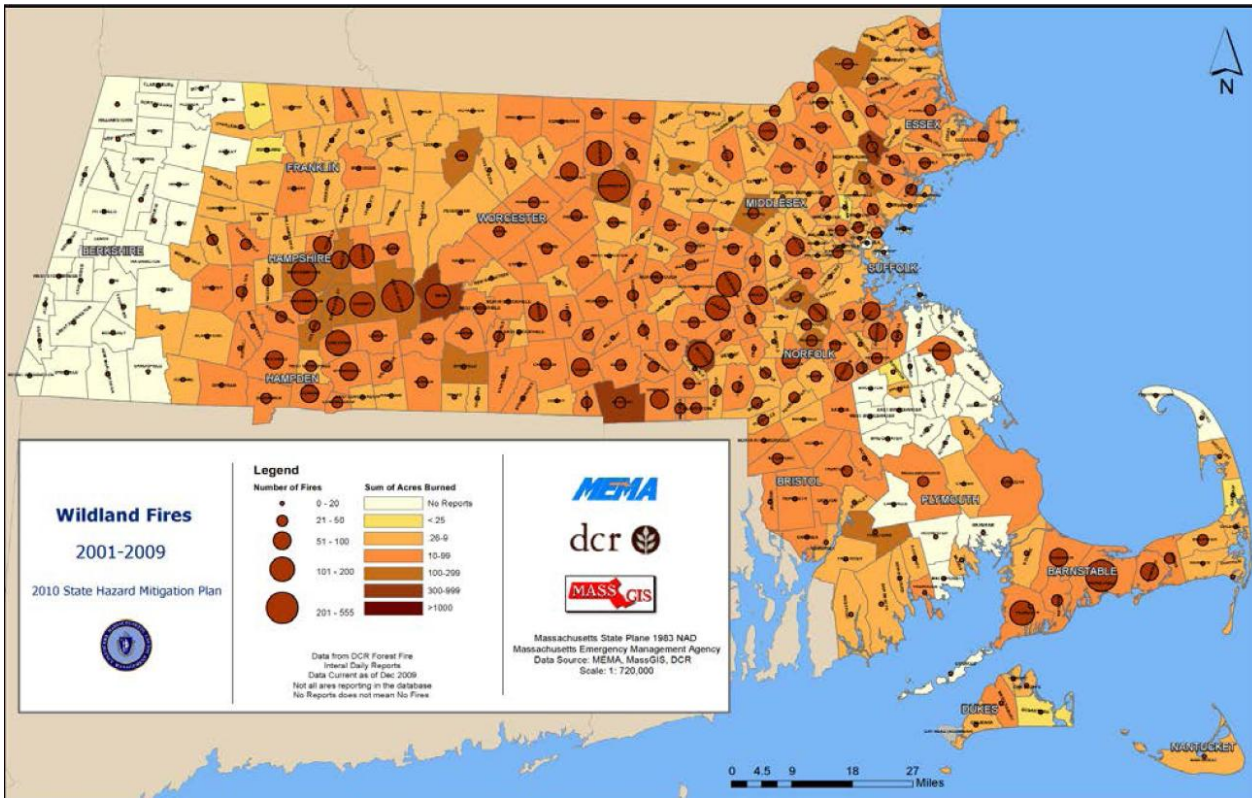
2010 – Russell, 320 acres burned on Mt. Tekoa

2012 – Eastern Hampden County, dry conditions and wind gusts created a brush fire in Brimfield, and burned 50 acres

According to the Hadley Fire Department, there are approximately 12 unauthorized burns or brushfires in town on an annual basis. As a point of comparison, 262 burn permits were issued in 2015.

Wildland Fires in Massachusetts, 2001-2009

Wildland Fires in Massachusetts, 2001-2009



Source: Massachusetts Hazard Mitigation Plan

Probability of Future Events

In accordance with the Massachusetts Hazard Mitigation Plan, the Hadley Hazard Mitigation Committee found it is difficult to predict the likelihood of wildfires in a probabilistic manner because the number of variables involved. However, based on previous occurrences, the Committee determined the probability of future events to be "low" (1% to 10% probability in the next year).

Climate scenarios project summer increases in summer temperature averages of 2ºC and 5ºC (3.6ºF to 9.0ºF) and precipitation decreases of up to 15%. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called "fertilization effect"—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown.

Climate change is also predicted to bring increased wind damage from major storms, as well as new types of pests to the region. Both increased wind and the introduction of new pests could potentially create more debris in wooded areas and result in a larger risk of fires.

Impact

Wildfires can result in widespread damage to the natural environment, the built environment and can cause injuries and death. Hadley faces a "minor" Impact from wildfires, with limited damages anticipated in such an event.

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all property in town, $935,709,078, is used. An estimated 100% of damage would occur to 1% of structures, resulting in a total of $9,357,090 worth of damage and 55 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Both wildfires and brushfires can consume homes, other buildings and/or agricultural resources. The impact of wildfires and brushfires are as follows:

- Impact to benefits that people receive from the environment, such as food/water and the regulation of floods and drought
- Impact on local heritage, through the destruction of natural features
- Impact to the economy, due to damage to property and income from land following a wildfire
- Impact through the destruction of people and property

Vulnerability

Based on the above assessment, Hadley faces a hazard index rating of "**4 - low risk**" for wildfires.

The forested areas of Hadley, most east of Mount Warner Road, are most vulnerable to the impacts of wildfires and brushfires. Much of Hadley's critical infrastructure is located in this area. There are, however, water tanks on Mount Warner Road that would be vulnerable. Damage to these could impact the town's back-up drinking water supply.

3.6 Earthquakes

Hazard Description

An earthquake is a sudden, rapid shaking of the ground that is caused by the breaking and shifting of rock beneath the Earth's surface. Earthquakes can occur suddenly, without warning, at any time of the year. New England experiences an average of 30 to 40 earthquakes each year although most are not noticed by people.[2] 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.[3]

Location

Because of the regional nature of this hazard, the entire town (more than 50% of land area) is equally susceptible to earthquakes.

Extent

The magnitude of an earthquake is measured using the Richter Scale, which measures the energy of an earthquake by determining the size of the greatest vibrations recorded on the seismogram. On this scale, one step up in magnitude (from 5.0 to 6.0, for example) increases the energy more than 30 times. The intensity of an earthquake is measured using the Modified Mercalli Scale. This scale quantifies the effects of an earthquake on the Earth's surface, humans, objects of nature, and man-made structures on a scale of I through XII, with I denoting a weak earthquake and XII denoting a earthquake that causes almost complete destruction.

Richter Scale Magnitudes and Effects	
Magnitude	**Effects**
< 3.5	Generally not felt, but recorded.
3.5 - 5.4	Often felt, but rarely causes damage.
5.4 - 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 - 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 - 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or >	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: FEMA

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

Modified Mercalli Intensity Scale for and Effects			
Scale	**Intensity**	**Description Of Effects**	**Corresponding Richter Scale Magnitude**
I	Instrumental	Detected only on seismographs.	
II	Feeble	Some people feel it.	< 4.2
III	Slight	Felt by people resting; like a truck rumbling by.	
IV	Moderate	Felt by people walking.	
V	Slightly Strong	Sleepers awake; church bells ring.	< 4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves.	< 5.4
VII	Very Strong	Mild alarm; walls crack; plaster falls.	< 6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged.	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open.	< 6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread.	< 7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards.	< 8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves.	> 8.1

Previous Occurrences

The most recent earthquakes to affect New England are shown in the table below. There is no record of any damage in the Town of Hadley as a result of these earthquakes.

Largest Earthquakes Affecting the Region, 1924 – 2012		
Location	Date	Magnitude
Ossipee, NH	December 20, 1940	5.5
Ossipee, NH	December 24, 1940	5.5
Dover-Foxcroft, ME	December 28, 1947	4.5
Kingston, RI	June 10, 1951	4.6
Portland, ME	April 26, 1957	4.7
Middlebury, VT	April 10, 1962	4.2
Near NH Quebec Border, NH	June 15, 1973	4.8
West of Laconia, NH	Jan. 19, 1982	4.5
Plattsburg, NY	April 20, 2002	5.1
Bar Harbor, NH	October 3, 2006	4.2
Hollis Center, ME	October 16, 2012	4.6

Source: Northeast States Emergency Consortium website, www.nesec.org/hazards/earthquakes.cfm

New England States Record of Historic Earthquakes		
State	Years of Record	Number Of Earthquakes
Connecticut	1668 - 2007	137
Maine	1766 - 2007	544
Massachusetts	1668 - 2007	355
New Hampshire	1638 - 2007	360
Rhode Island	1776 - 2007	38
Vermont	1843 - 2007	73
New York	1840 - 2007	755
Total Number of Earthquakes within the New England states between 1638 and 1989 is 2262.		

Source: Northeast States Emergency Consortium website, *www.nesec.org/hazards/earthquakes.cfm*

Probability of Future Events

One measure of earthquake activity is the Earthquake Index Value. It is calculated based on historical earthquake events data using USA.com algorithms. It is an indicator of the earthquake activity level in a region. A higher earthquake index value means a higher chance of earthquake events. Data was used for Hampshire County to determine the Earthquake Index Value as shown in the table below.

Earthquake Index for Hampshire County	
Hampshire County	0.17
Massachusetts	0.70
United States	1.81

Based upon existing records, there is a **"very low**" chance of earthquakes in Hadley with between a 1% and 2% chance of an earthquake occurring in any given year.

Impact

Most earthquake related property damage and deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the extent and duration of the shaking. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock, and liquefaction.

Massachusetts introduced earthquake design requirements into their building code in 1975 and improved building code for seismic reasons in the 1980s. 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 the 1980s 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.

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all property in town, $935,709,078 is used.

An estimated 100% of damage would occur to 20% of structures, resulting in a total of $187,141,815 worth of damage and 1,098 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on this analysis, Hadley faces a hazard index rating of "**5-very low risk**" from earthquakes.

The entire town is at risk of earthquakes. Older buildings are more vulnerable because their construction pre-dates building codes that included seismic considerations. Bridges are also generally vulnerable to the impacts of an earthquake. Damage to bridges could impede travel or evacuation efforts.

3.7 Dam Failure and Dike System Failure

Hazard Description

Dams, levees, and their associated impoundments provide many benefits to a community, such as water supply, recreation, hydroelectric power generation, and flood control. However, they also pose a potential risk to lives and property. Dam or levee 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 rapidly. Most dam or levee failures occur when floodwaters above overtop and erode the material components of the dam. Often dam or levee breaches lead to catastrophic consequences as the water rushes in a torrent downstream flooding an area engineers refer to as an "inundation area." The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area.

Many dams in Massachusetts were built during the 19th Century without the benefit of modern engineering design and construction oversight. Dams of this age can fail because of structural problems due to age and/or lack of proper maintenance, as well as from structural damage caused by an earthquake or flooding.

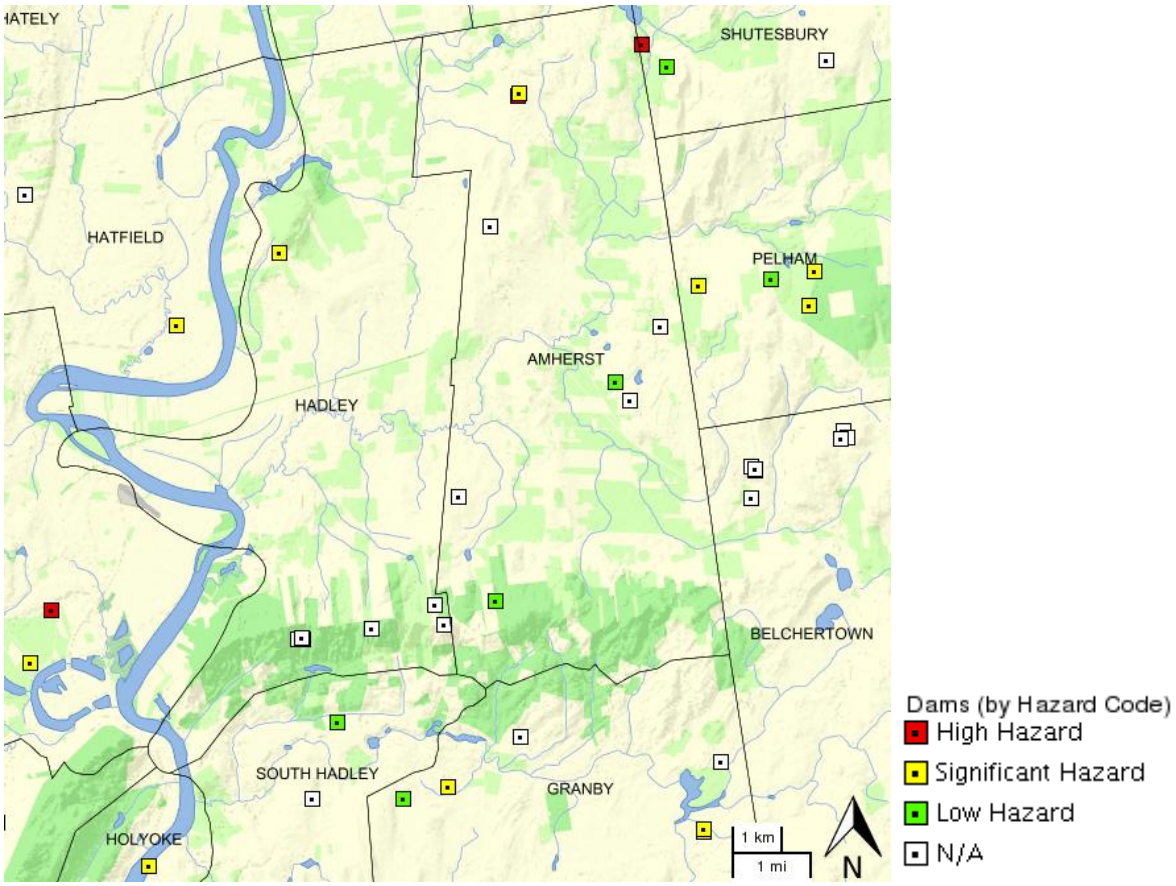
The Massachusetts Department of Conservation and Recreation Office of Dam Safety is the agency responsible for regulating dams in the state (M.G.L. Chapter 253, Section 44 and the implementing regulations 302 CMR 10.00). To be regulated, these dams are in excess of 6 feet in height (regardless of storage capacity) and have more than 15 acre feet of storage capacity (regardless of height). Dam safety regulations enacted in 2005 transferred significant responsibilities for dams from the State of Massachusetts to dam owners, including the responsibility to conduct dam inspections.

Location

Hadley has seven dams located on private and public land.

Dams in Hadley		
Dam	**Ownership**	**Hazard Level**
Lake Warner Dam	Kestrel Trust/Friends of Lake Warner	Significant
Shingle Mill Brook Dam	Town of Hadley	Low
B & M Upper Pond Dam (earthen)	No Record for Privately Owned Non Jurisdictional Dam	Low
B & M Middle Pond Dam (earthen)	No Record for Privately Owned Non Jurisdictional Dam	Low
B & M Lower Pond Dam (earthen)	No Record for Privately Owned Non Jurisdictional Dam	Low
Harts Brook Lower Dam	Town of Hadley	Low
Harts Brook Upper Reservoir Dam	Town of Hadley	Low

It is also important to consider and plan for the potential critical failure of dams upstream in the Town of Amherst. Amherst contains one *High Hazard* dam upstream, Factory Hollow Dam.



The town of Hadley has an extensive dike system along the Connecticut River. The system was constructed in response to flooding in 1936 caused by the Great New England Hurricane. The dike system prevents much of the low-lying land along the Connecticut River from flooding. In 2009, a crack was found in the section of the dike system and was repaired. During the repairs, this section of the dike collapsed, but caused no damage to the town, and was subsequently rebuilt. This prompted a thorough analysis of the condition of the dike system including subsurface testing and recertification of the system through FEMA, which should be completed in 2017.

Extent

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.

Dams in Massachusetts are assessed according to their risk to life and property. The state has three hazard classifications for dams:

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

- **Significant Hazard:** 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.

Previous Occurrences

To date, there have been no catastrophic dam failures in Hadley.

In 2009, portion of town-owned dike measuring approximately 100 feet along the Hadley side of the Connecticut River west of the intersection of West Street and North Lane collapsed into the river during a reconstruction project. The levee was subsequently repaired and restored without incident.

Probability of Future Events

As Hadley's dams age, and if maintenance is deferred, the likelihood of a dam failure will increase, but, currently the frequency of dam failures is very low with a less than 1% chance of a dam failing in any given year.

As described in the Massachusetts Hazard Mitigation Plan, dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams are already seeing increases in stream flows from earlier releases from dams. Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Dike systems, like dams, are much more vulnerable to failure as they age. A failure would mean that they are unable to provide the flood control protection they were designed for. The probability of Hadley's dike system failing is low (1-10% chance of failure).

Impact

The town faces a critical impact in the event of a dam or dike failure, with up to 25% of Hadley affected. To approximate the potential impact to property and people that could be affected by this hazard, the total value of all property in town, $935,709,078 is used.

An estimated 100% of damage would occur to 20% of structures, resulting in a total of $187,141,815 worth of damage and 1,098 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on this analysis, Hadley faces a hazard index rating of "**5 -very low risk**" for dam failure and "4-low risk" for dike failures.

There are no areas of the town that are particularly vulnerable to dam failures. Additionally, there is no critical infrastructure located in areas that would be impacted by the failure of any of Hadley's dams.

If the Connecticut River Dike System in Hadley were to fail, much of the western portion of Hadley would be vulnerable to the flooding the system works to prevent. The small portion of the dam that was compromised in 2009, for example, plays a critical role in protecting a number of the town's historic structures, the town common and cemetery. While most of the town's critical facilities are not located within these flood prone areas, a number of bridges and pumping stations are. Damage to the bridges could impede evacuation efforts in the event of a natural hazard. Particularly vulnerable are Route 47 North and Route 116.

3.8 Drought

Hazard Description

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. 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.

Location

Because of this hazard's regional nature, a drought would impact the entire town.

Extent

The severity of a drought would determine the scale of the event and would vary among town residents depending on whether the residents' water supply is derived from a private well or the public water system.

The U.S. Drought Monitor also records information on historical drought occurrence. Unfortunately, data could only be found at the state level. The U.S. Drought Monitor categorizes drought on a D0-D4 scale as shown below.

U.S. Drought Monitor		
Classification	Category	Description
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies

Source: US Drought Monitor, http://droughtmonitor.unl.edu/classify.htm

Previous Occurrences

In Massachusetts, six major droughts have occurred statewide since 1930.[4] 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. The following table indicates previous occurrences of drought since 2000, based on the US Drought Monitor:

Annual Drought Status	
Year	**Maximum Severity**
2000	No drought
2001	D2 conditions in 21% of the state
2002	D2 conditions in 99% of the state
2003	No drought
2004	D0 conditions in 44% of the state
2005	D1 conditions in 7% of the state
2006	D0 conditions in 98% of the state
2007	D1 conditions in 71% of the state
2008	D0 conditions in 57% of the state

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

2009	D0 conditions in 44% of the state
2010	D1 conditions in 27% of the state
2011	D0 conditions in 0.01% of the state
2012	D2 conditions in 51% of the state
2013	D1 conditions in 60% of the state
2014	D1 conditions in 54% of the state
2015	D1 conditions in 100% of the state

Source: U.S. Drought Monitor <http://droughtmonitor.unl.edu/>

Hadley has not been impacted by any previous droughts in the state.

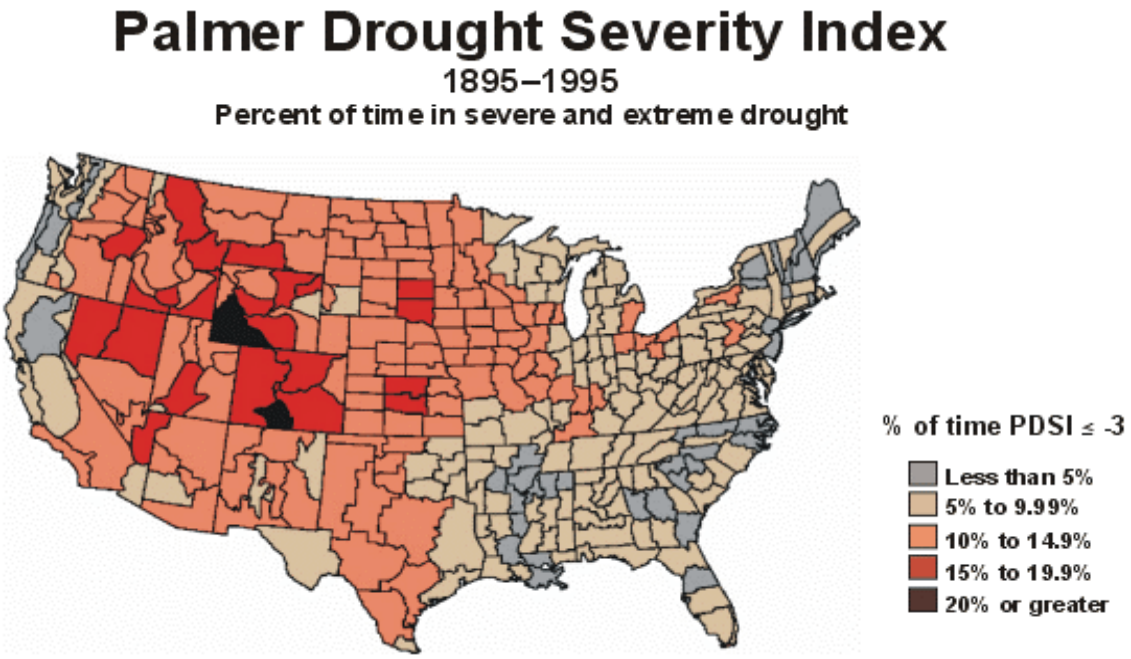
Probability of Future Events

In Hadley, as in the rest of the state, drought occurs at a rate of between 1% and 10% in a single given year.

Based on past events and current criteria outlined in the Massachusetts Drought Management Plan, it appears that western Massachusetts may be more vulnerable than eastern Massachusetts to severe drought conditions. However, many factors, such as water supply sources, population, economic factors (i.e., agriculture based economy), and infrastructure, may affect the severity and length of a drought event.

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.[5] 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.

[5] National Drought Mitigation Center – http://drought.unl.edu



Impact

Due to the water richness of Western Massachusetts, Hadley is unlikely to be adversely affected by anything other than a major, extended drought. While such a drought would require water saving measures to be implemented, there would be no foreseeable damage to structures or loss of life resulting from the hazard.

Vulnerability

Based on the above assessment, Hadley faces a hazard index rating of **"4 - low risk**" of drought.

While an extended drought would require the town to implement water saving measures, there are no areas, structures or populations that would be especially vulnerable.

3.9 Landslides

Hazard Description

Landslides have not previously been identified as a hazard for the Town of Hadley. However, the anticipated in the increase in the number of heavy precipitation events in the region potentially increases the risk for landslides, especially in areas with steep slopes. In addition, on October 8, 2014 a powerful microburst in Easthampton on Mount Tom along Mountain Road/Route 141 stripped the mountainside of many trees and damaged the vegetated slopes, thus greatly increasing the risk of landslide. Therefore, landslides are being considered as part of this plan.

The following description of landslides is excerpted from the Massachusetts Hazard Mitigation Plan, p. 12-1:

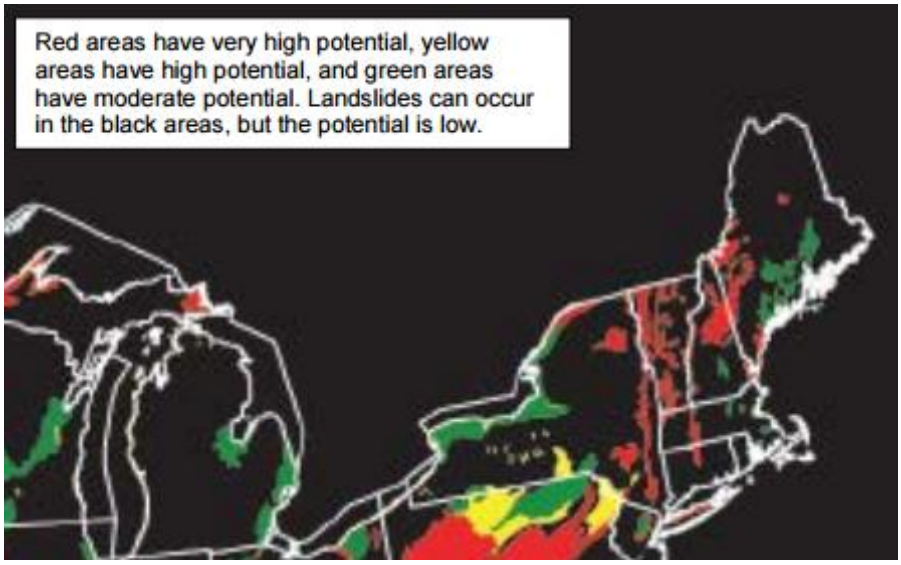
The term “landslide” includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors (USGS, 2013). According to the Massachusetts state geologist, Steve Mabee, slope saturation by water is a primary cause of landslides in the Commonwealth. This effect can be in the form of intense rainfall, snowmelt, changes in groundwater level, and water level changes along coastlines, earth dams, and the banks of lakes, rivers, and reservoirs. Water added to a slope can not only add weight to the slope, which increases the driving force, but can increase the pore pressure in fractures and soil pores, which decreases the internal strength of the earth materials needed to resist the driving forces.

Landslides in Massachusetts can be divided into four general groups: 1) construction related, 2) over steepened slopes caused by undercutting due to flooding or wave action, 3) adverse geologic conditions, and 4) slope saturation. Construction related failures occur predominantly in road cuts excavated into glacial till where topsoil has been placed on top of the till. This juxtaposition of materials with different permeability often causes a failure plane to develop along the interface between the two materials resulting in sliding following heavy rains. […] Other construction related failures occur in utility trenches excavated in materials that have very low cohesive strength and associated high water table (usually within a few feet of the surface). The clays often formed in the deepest parts of many of the glacial lakes that existed in Massachusetts following the last glaciation. Some of the major glacial lakes are Bascom, Hitchcock [which encompassed the area of present-day Hadley], Nashua, Sudbury, Concord, and Merrimack. (Mabee, 2010).

Location

The entire U.S. experiences landslides, with 36 states having moderate to highly severe landslide hazards. Expansion of urban and recreational developments into hillside areas leads to more people being threatened by landslides each year. The figure below shows landslide potential mapped by the USGS for the eastern U.S. Landslides are common throughout the Appalachian region and New England. The greatest eastern hazard is from sliding of clay-rich soils. Based on the U.S. data set for landslides, it appears that areas along the Connecticut River in western Massachusetts, and the greater Boston area have the highest risk to landslide. The figure below, excerpted from the Massachusetts Hazard Mitigation Plan, illustrates the landslide incidence and susceptibility zones in Massachusetts. Note a band of red, indicating “high” risk, along the Connecticut River Valley through Western Massachusetts.

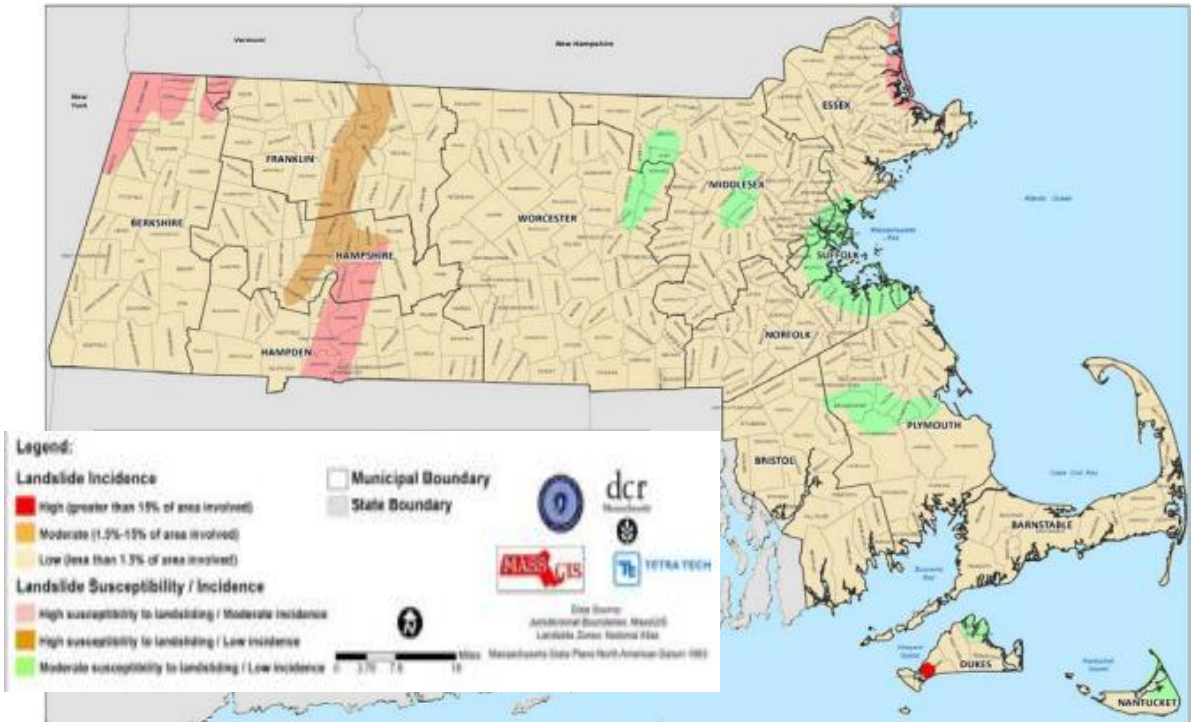
Landslide Incidence and Susceptibility Map U.S. Northeast



Source: http://geology.com/usgs/landslides/

The figure below illustrates the landslide incidence and susceptibility zones in Massachusetts. Note that almost the entirety of Hadley is within the brown band of "moderate" landslide incidence and susceptibility that passes through Hatfield and Northampton.

Landslide Incidence and Susceptibility Zones 2013 Massachusetts



Source: Massachusetts Department of Conservation Resources

Extent

To determine the extent of a landslide hazard, the affected areas need to be identified and the probability of the landslide occurring within some time period needs to be assessed. Natural variables that contribute to the overall extent of potential landslide activity in any particular area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. As a result, the landslide hazard is often represented by landslide incidence and/or susceptibility, defined below:

> Landslide incidence is the number of landslides that have occurred in a given geographic area. High incidence means greater than 15% of a given area has been involved in landslides; medium incidence means that 1.5% to 15% of an area has been involved; and low incidence means that less than 1.5% of an area has been involved.

Landslide susceptibility is defined as the probable degree of response of geologic formations to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. It can be assumed that unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced numerous landslides in the past. Landslide susceptibility depends on slope angle and the geologic material underlying the slope. Landslide susceptibility only identifies areas potentially affected and does not imply a time frame when a landslide might occur. "High," "Medium," and "Low" susceptibility are delimited by the same percentages used for classifying the incidence of landslides. Landslides destroy property and infrastructure and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion.

Previous Occurrences

Hadley has no record of previous landslides.

Probability of Future Events

Increasing short-term heavy precipitation events will increase the risk of landslides in Hadley. There is a "low" probability or a 1 to 10% chance of a landslide happening in the next year.

Impact

Homes located on lots with significant slopes (i.e., 10% or greater) are at greater risk of impacts from landslides. The impact of a landslide in Hadley would be limited with between 10 and 25% of structures in the town damage.

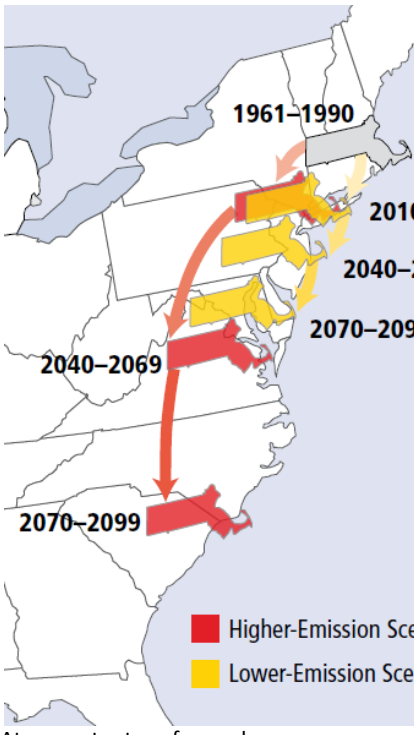
Vulnerability

Based on the above assessment, Hadley has a hazard index rating of **"4 –low risk"** from landslides.

Structures built on or at the bottom of significant slopes are most vulnerable to landslides.

3.10 Extreme Temperatures

Greater variation and extremes in local atmospheric temperatures due to global changes in climate are now among the natural hazards that this plan anticipates. Hadley is likely to experience more instances of extreme and sustained heat and cold. And, because warmer air holds more moisture, higher temperatures will also bring wetter winters, more severe storms, and more frequent flooding. Locally, there will also be more single-day records highs, and more total days with highs above 90 degrees, and more heat waves with 3 or more days above 90 degrees. More extreme temperatures throughout Western Massachusetts and New England mean that there will be more floods, droughts, and tornados. There will also be more Atlantic hurricanes and nor'easters. Anticipated increases in extreme local temperatures is directly related to many of the previously described vulnerabilities, as well as increasing the risk of heat-related disease and injury, especially among senior citizens and residents unable to afford air conditioning.



At current rates of greenhouse gas accumulation and temperature increases, the climate of Massachusetts will become similar to those of present-day New Jersey or Virginia by 2040-2069, depending on future GHG emissions. *Source: NECIA 2006*

Anticipated Climatic Variation

In Western Massachusetts, annual precipitation is expected to increase by 14% by the end of the 21st century. However, most of this precipitation increase will come during the winter months – as much as 30% more than today – while summertime precipitation will actually decrease slightly. Also, most of the added winter precipitation is expected to be in the form of rain, rather than snow. This will mean a continuation of the current regional trend of a decreasing snowfall totals, as well as the number of days with snow cover on the ground, but more precipitation overall. The increased amount of strong precipitation events and overall increase in rainfall, combined with the aging stormwater infrastructure in the region, will likely result in more flooding in the region.

Anticipated Climatic Variations for Massachusetts Due to Climate Change

Category	Current (1961-1990 avg.)	Predicted Change 2040-2069	Predicted Change 2070-2099
Average Annual Temperature (°F)	46°	50°to 51°	51° to 56°
Average Winter Temperature (°F)	23°	25.5° to 27°	31° to 35°
Average Summer Temperature (°F)	68°	69.5° to 71.5°	74° to 82°
Days over 90 °F	5 to 20 days	-	30 to 60 days
Days over 100 °F	0 to 2 days	-	3 to 28 days
Annual Precipitation	41 inches	43 to 44 inches	44 to 47 inches
Winter Precipitation	8 inches	8.5 to 9 inches	9 to 10.4 inches
Summer Precipitation	11 inches	10.9 to 10.7 inches	10.9 to 11 inches

Sources: Massachusetts Climate Adaptation Report 2011, NECIA

Increased temperatures will likely have the following projected impacts to people, property, and the local economy:

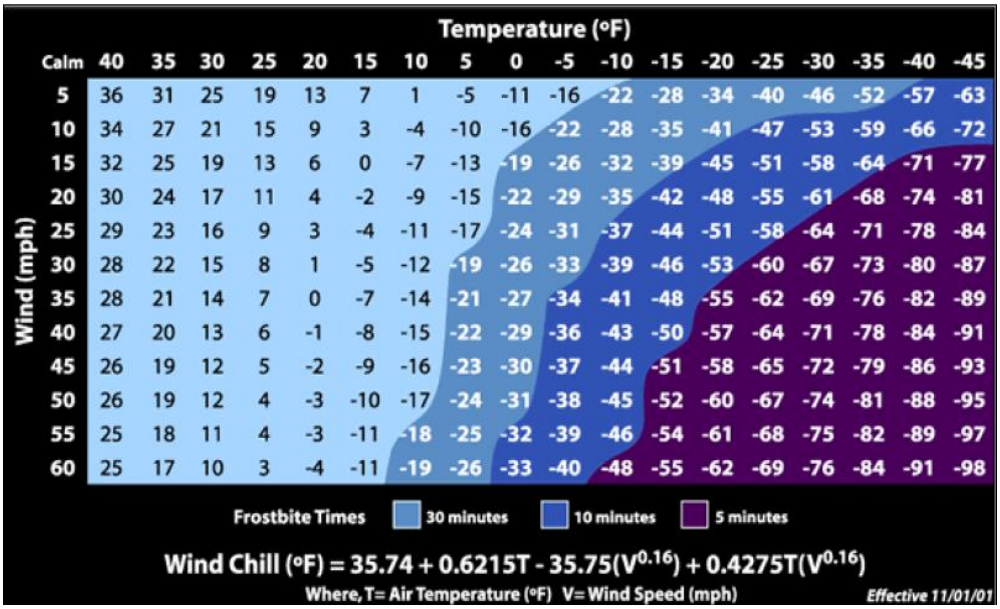
- There will be greater stress on special populations, such as senior citizens and economically disadvantaged people, without access to air conditioning during heat waves. The Board of Health has already initiated education and outreach to seniors in Hadley to advise them of strategies for keeping their homes and themselves cooler during heat waves.
- Increased temperatures and changes in growing seasons for various crops will put stress on current food production and require farming operations to adjust by planting new varieties of crops. There are several farms in Hadley that will likely be affected.
- Livestock will be at greater risk from extreme and extended heat. There are five dairy farms that will likely need to adapt to increased heat, as well as horse farms and an alpaca farm.
- Maple sugaring businesses are at risk due to changes in spring temperature patterns needed for successful sap collection. There are four maple sugaring operations in Hadley that will likely be affected.
- Increased energy usage in order to cool buildings in the summer and long-term electrical needs will increase.

Extent

As per the Massachusetts Hazard Mitigation Plan, the extent (severity or magnitude) of extreme cold temperatures are generally measured through the Wind Chill Temperature Index. Wind Chill Temperature is the temperature that people and animals feel when outside and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. The chart shows three shaded areas of frostbite danger. Each shaded area shows how long a person can be exposed before frostbite develops. In Massachusetts, a wind chill warning is issued by the NWS Taunton Forecast Office when the Wind Chill Temperature Index, based on sustained wind, is –25ºF or lower for at least three hours.

Extreme temperatures would affect the whole community.

Wind Chills



For extremely hot temperatures, the heat index scale is used, which combines relative humidity with actual air temperature to determine the risk to humans. The NWS issues a Heat Advisory when the Heat Index is forecast to reach 100-104 degrees F for 2 or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105+ degrees F for 2 or more hours. The following chart indicates the relationship between heat index and relative humidity:

Heat Index

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke or Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

Previous Occurrences

Using the NOAA National Centers for Environmental Information data base--one day of extreme cold/wind chill was recorded in the last 365 days, and no incidents of extreme heat have been recorded in Hampshire County in the last year.

The following are some of the lowest temperatures recorded in parts of Massachusetts for the period from 1895 to present (Source: NOAA, www.ncdc.noaa.gov.):

- Blue Hills, MA- –21°F
- Boston, MA- –12°F
- Worcester, MA- –19°F

The following are some of the highest temperatures recorded for the period from 1895 to present (Source: NOAA, www.ncdc.noaa.gov.):

- Blue Hills, MA - 101°F
- Boston, MA - 102°F
- Worcester, MA - 96°F

Probability of Future Events

The probability of future extreme heat and extreme cold is considered to be "low," or between 1 and 10 percent in any given year.

Impact

Extreme cold and extreme heat are dangerous situations that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat or air conditioning or some other way to stay cool.

Because of the relatively wealthy status of residents in Hadley, its geography--being close to a range of services and well served by public transit, combined with the services provided by the Council on Aging, who monitor older residents who may be more susceptible to suffering the impact of extreme temperatures, the impact of extreme heat or cold in Hadley is considered to be "minor," with no property damage and very limited affect on humans.

Vulnerability

Hadley's vulnerability from extreme heat and cold is considered to be, "5 – Very Low Risk”

Structures and infrastructure within the town are not at risk for damage due to extreme temperatures, but populations that are not prepared to contend with these temperature extremes could be most vulnerable.

3.11 Other Hazards

In addition to the hazards identified in previous sections, the Hazard Mitigation Committee reviewed the full list of hazards listed in the Massachusetts Hazard Mitigation Plan. Coastal flooding, coastal erosion, urban fires, and tsunamis, which are considered in the statewide hazard mitigation plan were determined to be not relevant to Hadley.

4. CRITICAL FACILITIES

4.1 Facility Classification

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 community residents and property
- Would create a secondary disaster if a hazard were to impact it

The Critical Facilities List for the Town of Hadley has been identified utilizing a Critical Facilities List provided by the State Hazard Mitigation Officer. Hadley's Hazard Mitigation Workgroup has broken up this list of facilities into three categories:

- Facilities needed for emergency response in the event of a hazard event.
- Facilities identified as non-essential and not required in an emergency response event, but which are considered essential for the everyday operation of the Town.
- Facilities or institutions that include special populations which would need additional attention in the event of a hazard event.

The critical facilities and evacuation routes potentially affected by hazard areas are identified following this list. The Past and Potential Hazards/Critical Facilities Map (Appendix C) also identifies these facilities.

Category 1 – Emergency Response Services

The City 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**

   Hadley Public Safety Complex – 15 East Street

   Alternate EOC – North Hadley Fire Station, 237 River Drive

   Trailer for Mobile EOC

2. **Fire Station**

   Hadley Public Safety Complex – 15 East Street

   North Hadley Fire Station – 237 River Drive (Route 47)

3. **Police Station**

   Hadley Public Safety Complex – 15 East Street

4. **Highway Garage**

   Department of Public Works, Highway Department – 230 South Middle Street

5. **Water Department**

   Department of Public Works, Water Department – 230 South Middle Street

   Callahan Drinking Water Filtration Plant- 129 Bay Road

6. **Waste Water Treatment Plants**

   Department of Public Works, Waste Water Treatment Plant – 230 South Middle Street

   University of Massachusetts Waste Water Treatment Plant – Mullins Way

7. **Mass Care Shelters and Reception Centers**

   Hadley Elementary School – 21 River Drive (Route 47), Capacity = 400 (Red Cross Certificate)

   Sunbridges Care/Rehab. For Nancy at Elaine Manor – 20 N. Maple Street, Capacity = 300

   Pioneer Valley Chinese Immersion Charter School – 317 Russell Street (Route 9), Capacity = 1,400

   American Legion – 271 Russell Street (Route 9), Capacity = 150 (Not Handicapped accessible)

   North Hadley Fire Station – 237 River Drive (Route 47), Capacity = 200

   Senior Center- 46 Middle Street

   Hopkins Academy- 131 Russell Street

8. **Water Storage Facilities**

   Water Tanks - Mount Warner Road

   Water Tank – Mount Holyoke (Route 47 @ Laurel Drive)

9. **Primary Evacuation Routes**

Russell Street (Route 9)

River Drive (Route 47)

Route 116

10. Bridges Located on Evacuation Routes

Calvin Coolidge Bridge over Route 9

Bridge over a brook under Route 9 near the Home Depot site

Bridge over the Fort River on Route 47

Bridge over the Mill River on Route 47 in North Hadley Village

Bridge over Russellville Brook on Route 47 in North Hadley

Bridge over the Mill River on Route 116

Bridge over wetland area on Route 116 east of Stadium Drive

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 Hadley.

1. Hospitals

Cooley Dickenson Hospital – 30 Locust Street, Northampton

AEIOU Critical Care—University Drive, Amherst

2. Public Water Supply

The Town's primary source of water is located at the Callahan well field on Bay Road, which has two wells.

A secondary source is at the base of Mount Warner off of Town Well Road, which has two gravel-developed wells.

3. Pumping Stations

<u>Drinking water:</u>

Pumping Station - 129 Bay Road

<u>Waste water:</u>

Pumping Station - Bay Road/Middle Street

Pumping Station - Bay Road/West Street

Pumping Station - Mill Valley Road

Pumping Station - Hawley Road

Pumping Station – Area of 106 Mount Warner Road

Pumping Station – Route 47 (Hibbard Lane)

Pumping Station - Route 47 (Klimoski)

Pumping Station – Route 47 (Stockbridge Road)

Pumping Station – Venture Way

Pumping Station – Westgate Drive

Pumping Station - Winfield Drive

5. Transfer Station

Located at the end of North Branch Road

6. Utilities

Eversource, 55 Russell Street (Route 9)

7. Communications (Cell Towers)

Cell Tower at Stop & Shop site on Route 9 near Amherst Town Line

Skinner State Park Mountain House Communications Tower

Public Safety Complex—15 East Street

8. Alternate Transportation Pickup Points

Hooker School – 46 Middle Street

Hopkins Academy – 131 Russell Street (Route 9)

North Hadley Hall – 239 River Road (Route 47)

9. Transportation Resources

Town of Hadley Schools (Public Buses), Number of Vehicles = 3 47-passenger buses and 2 smaller special needs buses

Executive Limo (Limousine Services), Number of Vehicles = 6

Checkers Taxi-Cab Service (Taxi Services), 217 Mount Tom Road, Northampton

Goutlet (Trucking – Non-Construction), 41 South Maple Street

Karl's Excavating (Trucking – Non-Construction), 327 River Drive (Route 47)

10. Mortuary Facilities

Amherst Funeral Home, 151 Amity Street

Douglas Funeral Home, 87 N. Pleasant Street, Amherst

11. Emergency Food Storage/Goods Warehousing

Hopkins Academy – 131 Russell Street (Route 9)

Hadley Senior Center – 46 Middle Street

Hadley Elementary School – 21 River Drive (Route 47)

Stop and Shop – 456 Russell Street

Big Y--175 University Drive

Whole Foods -- 327 Russell Road

12. Problem Culverts (Localized Flooding)

Numerous locations throughout Town, see *Critical Facilities Map* at the back of this plan.

DPW is starting a culvert inspection/maintenance program

Category 3 – Facilities/Populations to Protect

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

1. Health and Medical Facilities

Shady Lawn Rest Home – 132 Middle Street

Sunbridges Care/Rehab. For Nancy at Elaine Manor – 20 N. Maple Street

2. Group Home or Adult Day Care

Numerous locations throughout Town – see Critical Facilities Map located in back of Plan

3. Special Institutions

Commonwealth Community Services – 29 East Street

Commonwealth Community Services – 212 River Drive (Route 47)

Pioneer Valley Charter – 135 Russell Street (Route 9)

Service Network of Northampton – 52 Roosevelt Street

Thayer Care – 49 Middle Street

4. Nursing or Rest Home

Sunbridges Care/Rehab. For Nancy at Elaine Manor – 20 N. Maple Street

Shady Lawn Rest Home – 90 Middle Street

5. Daycare or Nursery

Numerous locations throughout Town – see Critical Facilities Map located in back of Plan

6. Schools

Hadley Elementary School – 21 River Street

Hopkins Academy (Public Middle School and High School) – 131 Russell Street

Hartsbrook School #1 (Private School) – 193 Bay Road

Pioneer Valley Chinese Immersion Charter School- 317 Russell Street

7. Historic Buildings/Sites

Hadley Center Historic District (added 1977 to the National Register of Historic Places – District #77000185): Middle and Russell Streets.

Hockanum Rural Historic District (added 1993 to the National Register of Historic Places – District #93001474): Area surrounding Hockanum Road from Hockanum Cemetery to the NE corner of Skinner State Park.

North Hadley Historic District (added 1993 to the National Register of Historic Places – Building #93001475): Roughly, area along River Drive from Stockwell Road to Stockbridge Street, including French, Meadow and Mt. Warner Streets.

8. Large Employment Centers

Commercial corridor along Route 9, particularly near the Amherst Town Line

Critical Facilities and Evacuation Routes Potentially Affected by Hazard Areas			
Hazard Type	**Hazard Area**	**Critical Facilities Affected**	**Evacuation Routes Affected**
Flooding	100-year Floodplain along Connecticut River Shoreline	Route 47 Bridge over Russellville Brook in North Hadley	Route 47 North
		- N. Maple Street Bridge over Mill River at N. Hadley Road	None
		- Route 116 Bridge over Mill River north of N. Hadley Road	Route 116
		- Bay Road Bridge over Fort River north of Bay Road	None
	Aqua Vitae Road	- Bay Road Bridge over Harts Brook in East Hadley	None
		- Mitch's Drive Bridge over Fort River in South Hadley	None
		- Pumping station: Bay Road/West Street	None
		- Pumping station: 129 Bay Road	None
		- Public Well @ Bay Road/Lawrence Plain Road.	None
Severe snowstorms / ice Storms	Entire Town	N/A	N/A
Hurricanes	N/A	N/A	N/A

Severe thunderstorms / wind / tornadoes	N/A	N/A	N/A
Wildfires / brushfires	Area East of Mount Warner Road	Water Tanks - Mount Warner Road	N/A
Earthquakes	N/A	N/A	N/A
Dam failures	N/A	N/A	N/A
Drought	N/A	N/A	N/A

5. MITIGATION CAPABILITIES/STRATEGIES

One of the steps of this Hazard Mitigation Plan update process is to evaluate all of the Town's existing policies and practices related to natural hazards and identify potential gaps in protection. Hadley's local Hazard Mitigation Committee worked with PVPC to complete the FEMA Capability Assessment worksheet, included in Appendix D.

Hadley has most of the no cost or low cost hazard mitigation capabilities in place. Land use zoning, subdivision regulations and an array of specific policies and regulations that include hazard mitigation best practices, such as limitations on development in floodplains, stormwater management, tree maintenance, etc. Hadley also has appropriate staff dedication to hazard mitigation-related work for a community its size, including members of the Select Board who served on the local Hazard Mitigation committee, an Emergency Management Director, a professionally run Department of Public Works, a part-time Building Inspector, and a Tree Warden, and Hadley has plans in place, including an Open Space and Recreation Plan, and a Comprehensive Emergency Management Plan.

The Town also has very committed and dedicated volunteers who serve on Boards and Committees and in Volunteer positions. The Town collaborates closely with surrounding communities and is party to Mutual Aid agreements through MEMA. Hadley is also an active member community of the Pioneer Valley Planning Commission (PVPC) and can take advantage of no cost local technical assistance as needed provided by the professional planning staff at the PVPC.

Hadley's most obvious hazard mitigation need is for federal funds to implement prioritized actions. While Hadley is a well-managed fiscally sound Town, it is not a wealthy community and with state constraints on municipalities raising their own funds, Hadley has very limited financial resources to invest in costly hazard mitigation measures. Hadley is, however, committed to locally matching all HMGP grants received.

After reviewing existing policies and the hazard identification and assessment, the Town Hazard Mitigation Committee developed a set of hazard mitigation strategies it would like to implement.

The Town of Hadley has developed the following goal to serve as a framework for mitigation of the hazards identified in this plan.

Goal Statement

To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to the following hazards: flooding, severe snowstorms/ice storms, severe thunderstorms, hurricanes, tornadoes, wildfires/brushfires, earthquakes, dam failures, and drought.

5.1 Overview of Mitigation Strategies by Hazard

An overview of the general concepts underlying mitigation strategies for each of the hazards identified in this plan is as follows:

Flooding

The key factors in flooding are the water capacity of water bodies and waterways, the regulation of waterways by flood control structures, and the preservation of flood storage areas and wetlands. As more land is developed, more flood storage is demanded of the town's water bodies and waterways. The Town currently addresses this problem with a variety of mitigation tools and strategies. Flood-related regulations and strategies are included in the Town's general bylaws, zoning by-law, and subdivision regulations. Infrastructure like dams and culverts are in place to manage the flow of water.

Severe Snowstorms / Ice Storms

Winter storms can be especially challenging for emergency management personnel. 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. Even though the storm has usually been forecast, there is no certain way for predicting its length, size or severity. Therefore, mitigation strategies must focus on preparedness prior to a severe snow/ice storm.
The Town's current mitigation tools and strategies focus on preparedness, with many regulations and standards established based on safety during storm events. To the extent that some of the damages from a winter storm can be caused by flooding, flood protection mitigation measures also assist with severe snowstorms and ice storms.

Hurricanes

Hurricanes provide the most lead warning time of all identified hazards, 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). Even with significant warning, hurricanes can do significant damage – both due to flooding and severe wind.

The flooding associated with hurricanes can be a major source of damage to buildings, infrastructure and a potential threat to human lives. Flood protection measures can thus also be considered hurricane mitigation measures. The high winds that often accompany hurricanes can also damage buildings and infrastructure, similar to tornadoes and other strong wind events.

Severe Thunderstorms / Winds / Tornadoes

Most damage from tornadoes and severe thunderstorms come 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, making strict adherence to building codes a primary mitigation strategy. In addition,

current land development regulations, such as restrictions on the height of telecommunications towers, can also help prevent wind damages.

Wildfires / Brushfires

Wildfire and brushfire mitigation strategies involve educating people about how to prevent fires from starting, as well as controlling burns within the town.

Earthquakes

Although there are five mapped seismological faults in Massachusetts, there is no discernible 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 for which to plan.

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.

Dam Failure

Dam failure is a highly infrequent occurrence, but a severe incident could prove catastrophic. In addition, dam failure most often coincides with flooding, so its impacts can be multiplied, as the additional water has nowhere to flow. The only mitigation measures currently in place are the state regulations governing the construction, inspection, and maintenance of dams. This is managed through the Office of Dam Safety at the Department of Conservation and Recreation.

Drought

Although Massachusetts does not face extreme droughts like many other places in the country, it is susceptible to dry spells and drought. Drought can most likely be effectively mitigated in regions like the Pioneer Valley if measures are put into place, such as ensuring that groundwater is recharged.

Extreme Temperatures

Extreme temperatures were not identified as a hazard in Hadley in the 2008 Hazard Mitigation plan. The Town is aware of increasing extreme temperatures and has included this hazard in their plan, even though there have been no major occurrences in the Town.

5.2 Existing Capabilities/Strategies

The Town of Hadley has a list of existing mitigation capabilities and strategies that were in place prior to the development of the first Hazard Mitigation Plan in 2007, as well as a set of prioritized mitigation strategies to be pursued in the future. Strategies that were previously completed prior to 2007, or completed between 2007 and 2014, are listed below and noted under the "effectiveness" column. Strategies that were completed since the last version of the plan are listed in bold.

Flooding

The key factors in flooding are the water capacity of water bodies and waterways, the regulation of waterways by flood control structures, and the preservation of flood storage areas and wetlands. As more land is developed, more flood storage is demanded of the city's water bodies and waterways. The town currently addresses this problem with a variety of mitigation tools and strategies. Flood-related regulations and strategies are included in the town's zoning ordinance, and subdivision regulations. Infrastructure like dams and culverts are in place to manage the flow of water.

Management Plans

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

- Identify areas in the community that are flood prone and define methods to minimize the risk. Review National Flood Insurance Maps.
- Disseminate emergency public information and instructions concerning flood preparedness and safety.
- Community leaders should ensure that Hadley continues to be enrolled in the National Flood Insurance Program.
- Strict adherence should be paid to land use and building codes, (e.g. Wetlands Protection Act), and new construction should not be built in flood-prone areas.
- Ensure that flood control works are in good operating condition at all times.
- Natural water storage areas should be preserved.
- Maintain plans for managing all flood emergency response activities including addressing potentially hazardous dams.

Subdivision Rules and Regulations

Hadley's most recent draft of its Subdivision Rules and Regulations which govern the subdivision of land were adopted for the purpose of regulating the planning, design, and construction of new development in order to ensure public safety, general welfare, and environmental mitigation. The Subdivision Rules and Regulations contain several provisions that mitigate the potential for, and impact of, flooding.

Hadley Zoning Ordinance

Hadley has adopted several land use regulations that serve to limit or regulate development in floodplains, to manage stormwater runoff, and to protect groundwater and wetland resources, the latter of which often provide important flood storage capacity.

Existing Mitigation Capabilities				
Capability	**Action Type**	**Description**	**Hazards Mitigated**	**Effectiveness**
Flood Control Structures	Capital Construction	There are seven dams in Hadley	Flooding	Effective
Aquifer Protection District Overlay	Zoning bylaws	Areas delineated as primary recharge areas for groundwater aquifers, and watershed areas for reservoirs are protected by strict use regulations	Flooding	Effective
Floodplain District Overlay	Zoning bylaws	Areas delineated as part of the 100-year floodplain are protected by strict use regulations	Flooding	Effective
Wetlands Regulations	Zoning bylaws	Proposed development where wetlands are located must meet minimum upland acreage requirements	Flooding	Effective
Submission Requirements	Subdivision regulations	Subdivisions must meet requirements of Wetlands Protection Act as well as Floodplain Overlay District Subdivisions within the Floodplain District are governed by additional regulations	Flooding	Effective
Design Standards	Subdivision regulations	Requirements for sufficient drainage and protection of natural features	Flooding	Effective
River and Stream Protection	Subdivision regulations	Required enforcement of standards established by the Wetlands Protection Act.	Flooding	Effective
Hadley Master Plan and Open Space and Recreation Plan	Planning document	Identifies potential issues for Hadley's water supply needs in the future Inventories natural features and promotes natural resource preservation in the Town, including areas in the floodplain; such as wetlands aquifer recharge areas, farms and open space, rivers, streams and brooks.	Floods Severe Thunderstorm Hurricanes Tornadoes Wildfire / Brushfire Earthquakes Dam Failure	Effective

Existing Mitigation Capabilities				
Capability	**Action Type**	**Description**	**Hazards Mitigated**	**Effectiveness**
Participation in the National Flood Insurance Program	Operational Strategy	As of 2016, there were 102 homeowners with flood insurance policies	Flooding	Effective
Design Standards for Roads	Subdivision regulations	Standards include street grade regulations (6-10% maximum)	Severe Snowstorms/ Ice Storms	Effective
State Building Code	State regulation	The Town of Hadley has adopted the Massachusetts State Building Code which promotes construction of buildings that can withstand hazards to a certain degree	Floods Severe Snowstorms / Ice Storms Severe Thunderstorm Hurricanes Tornadoes Wildfire / Brushfire Earthquakes Dam Failure	Effective
Height Restrictions	Zoning bylaws	The Town restricts height of development based on the use and zoning district	Flooding Severe Thunderstorm Hurricanes Tornadoes	Effective
Utilities	Subdivision regulations	Electric, cable, communications, and gas utility lines are to be placed underground	Severe Snowstorms / Ice Storms Severe Thunderstorms Hurricanes Tornadoes	Effective

Existing Mitigation Capabilities				
Capability	**Action Type**	**Description**	**Hazards Mitigated**	**Effectiveness**
Shelters	Operational strategy	There are 5 shelters identified in the Hadley CEM Plan	Floods Severe Snowstorms / Ice Storms Severe Thunderstorm Hurricanes Tornadoes Wildfire / Brushfire Earthquakes Dam Failure Drought	Effective
Burn Permits	Regulation	Residents can obtain burn permits from the Hadley Fire Department which provides information on safe burn practices	Wildfire / Brushfire	Effective
Subdivision Review Fire Safety	Subdivision regulations	The Fire Department is involved in the review of subdivision plans	Wildfire / Brushfire	Effective
Public Education / Outreach	Operational strategy	The Fire Department has an ongoing educational program in the schools	Wildfire / Brushfire	Effective
New Dam Construction Permits	Regulation	State law requires a permit for the construction of any dam	Flooding Dam Failure	Effective
Dam Inspections	Operational strategy	DCR has an inspection schedule that is based on the hazard rating of the dam (low, medium, high hazard)	Flooding Dam Failure	Effective
Evacuation Plans	Operational strategy	Comprehensive evacuation plans are required for High Hazard Dams and ensure the safety of citizens in the event of a dam failure	Flooding Dam Failure	Effective

Status of strategies from 2008 plan

PRIORITY	MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	POTENTIAL FUNDING SOURCE(S)	EST. COST	STATUS 2016
High	Establish an Emergency Management Planning Committee	Board of Selectmen, EMD	2007	Town Staff/Volunteers	N/A	DONE
Low	Add Flood Prevention and Mitigation to the Purpose of the Subdivision Rules and Regulations	Planning Board	2007	Planning Board Assistance (PBA) Program	N/A	DONE
Medium	Implement Standards in the Subdivision Rules and Regulations to Require Temporary and Permanent Erosion Control Measures	Planning Board	2007	Planning Board Assistance (PBA) Program	N/A	DONE
Medium	Amend Section 4.3.4 – Environmental Impact Statement - of the Hadley Subdivision Regulations by adding Requirements to Identify Potential Flooding Impacts and Mitigation Measures	Planning Board	2007	Planning Board Assistance (PBA) Program	N/A	DONE
High	Establish a Community Emergency Response Team (CERT)	EMD, Hadley TRIAD SALT Council	2008	Town Staff/Volunteers	N/A	Not yet-carry forward
Low	Develop a Preliminary Project Proposal and Cost Estimate for Updating Current 911 System including Feasibility of Reverse 911	Board of Selectmen, Police & Fire Departments, Hampshire Regional Emergency Planning Committee	2008	Town Staff/Volunteers	N/A	DONE
Medium	Amend the Special Permit and Site Plan Approval Provision of the Hadley Zoning Bylaw to include more Specific Requirements to Address Flood Related Issues	Conservation Commission, Planning Board	2008	Planning Board Assistance (PBA) Program	N/A	DONE
High	Prepare a Priority List for the Replacement of Undersized Culverts throughout Town	Board of Selectmen, Highway Department	2008	HMGP	tbd	In process
Medium	Evaluate whether to become a part of FEMA's Community Rating System	Board of Selectmen, EMD	2009	Town Staff	N/A	Not yet-Carry Forward
Medium	Identify Existing Shelters that are Earthquake Resistant as well as Outside of Dam Inundation Areas	Building Inspector, EMD	2009	Town Staff	N/A	DONE

PRIORITY	MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	POTENTIAL FUNDING SOURCE(S)	EST. COST	STATUS 2016
Medium	Inventory Supplies at Existing Shelters and Develop a Needs List and Storage Requirements	Emergency Management Planning Committee, School Facilities Manager	2009	Town Staff/Volunteers	N/A	DONE
High	Ensure that all Shelters have Sufficient back-up Utility Service in the Event of a Primary Power Failure	Building Inspector, EMD	2009	??	??	DONE
Medium	Prepare a Water Conservation Plan	Board of Selectmen, Conservation Commission	2009	Smart Growth Technical Assistance Grant Program	$7,500	DONE
Medium	Develop a Beaver Management Strategy	Board of Health, Fire Department, Highway Department	2009	Town Staff	N/A	DONE
Medium	Develop a Plan for Providing Access to Water, Information, Shelter, and Food Stores for Special Needs Populations in Town in the Event of a Severe Winter Storm	Hadley TRIAD SALT Council	2009	Town Staff/Volunteers	N/A	DONE
High	Identify all Pre-FIRM Structures throughout Town that need to be Elevated above the Base-Flood Elevation	Building Inspector, Fire Department	2010	Town Staff	N/A	IN PROCESS
Medium	Participate in the Creation of a Regional Debris Management Plan	Board of Selectmen, Planning Board, EMD	2010	Western Region Homeland Security Advisory Council Funding	To be Determined	Carry forward - will participate if it happens
Medium	Establish a Program to Identify and Clean up Properties within Flood Zones with Junk and Hazardous Materials	Building Inspector, Board of Health	2010	Town Staff	N/A	In progress, 1 site cleaned, still need program/process
Low	Establish and Action Plan that Addresses Chlorine Releases at EPA Tier II Locations	Hampshire Regional Emergency Planning Committee	2010	Town Staff/Volunteers	N/A	DONE
Medium	Establish a Plan to Prioritize and Acquire Undeveloped Properties within Flood Zones throughout Town	Board of Selectmen, Conservation Commission	2011	HMGP	To be Determined	DONE
High	Conduct a Study to Identify the Appropriate Flood Control Structures/Measures to Prevent Flooding of the North Lane and Honey Pot Road Areas	Board of Selectmen, Highway Department	2011	HMGP	To be Determined	Underway--multi-year study

Action Strategies

Through this planning process, the Town of Hadley Hazard Mitigation Committee has worked to analyze actions and/or projects that the Town considered to reduce the impacts of hazards identified in the risk assessment, and identified the actions and/or projects that the jurisdiction intends to implement. Several of the action items previously identified in the 2007 Hazard Mitigation Plan are currently continuing, either because they require more time to secure funding or their construction process is ongoing. In addition, the Hazard Mitigation Workgroup identified several new strategies that are also being pursued. These new strategies are based on experience with currently implemented strategies, as well as the hazard identification and risk assessment in this plan. The strategies identified in this plan are believed by the local Hazard Mitigation Committee to be the ones needed in Hadley to address the vulnerabilities in this plan.

The prioritization process used in this plan update is different from the prioritization process used previously and produced a different hierarchy of projects.

Prioritization Methodology

The Hadley Hazard Mitigation Planning Workgroup reviewed and prioritized a list of previously identified and new mitigation strategies using the following criteria:

Application to multiple hazards – Strategies are given a higher priority if they assist in the mitigation of several natural hazards.

Time required for completion – Projects that are faster to implement, either due to the nature of the permitting process or other regulatory procedures, or because of the time it takes to secure funding, are given higher priority.

Estimated benefit – Strategies which would provide the highest degree of reduction in loss of property and life are given a higher priority. This estimate is based on the Hazard Identification and Analysis Chapter, particularly with regard to how much of each hazard's impact would be mitigated.

Cost effectiveness – in order to maximize the effect of mitigation efforts using limited funds, priority is given to low-cost strategies. For example, regular tree maintenance is a relatively low-cost operational strategy that can significantly reduce the length of time of power outages during a winter storm. Strategies that have identified potential funding streams, such as the Hazard Mitigation Grant Program, are also given higher priority.

Eligibility Under Hazard Mitigation Grant Program – The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Funding is made available through FEMA by the Massachusetts Emergency Management Agency. Municipalities apply for grants to fund specific mitigation projects under MEMA requirements

The following categories are used to define the priority of each mitigation strategy:

Low – Strategies that would not have a significant benefit to property or people, address only one or two hazards, or would require funding and time resources that are impractical

Medium – Strategies that would have some benefit to people and property and are somewhat cost effective at reducing damage to property and people

High – Strategies that provide mitigation of several hazards and have a large benefit that warrants their cost and time to complete

Very High – extremely beneficial projects that will greatly contribute to mitigation of multiple hazards and the protection of people and property. These projects are also given a numeric ranking within the category.

Cost Estimates

Each of the following implementation strategies is provided with a cost estimate. Projects that already have secured funding are noted as such. Where precise financial estimates are not currently available, categories were used with the following assigned dollar ranges:

Low – cost less than $50,000
Medium – cost between $50,000 – $100,000
High – cost over $100,000

Cost estimates take into account the following resources:

- Town staff time for grant application and administration (at a rate of $25 per hour)
- Consultant design and construction cost (based on estimates for projects obtained from town and general knowledge of previous work in town)
- Town staff time for construction, maintenance, and operation activities (at a rate of $25 per hour)

Project Timeline

Each strategy is provided with an estimated length of time it will take for implementation. Where funding has been secured for the project, a specific future date is provided for when completion will occur. However, some projects do not currently have funding and thus it is difficult to know exactly when they will be completed. For these projects, an estimate is provided for the amount of time it will take to complete the project once funding becomes available.

Mitigation Action	Status	Action Type	Description	Hazards Mitigated	Responsible Entity	Timeframe	Funding source	Cost
Establish a Community Emergency Response Team (CERT)	New	Response	The local Haz Mit committee believes the Town would benefit from such an organized response approach.	All Hazards	EMD, Hadley TRIAD SALT Council	1/2018	Municipal	Low
Evaluate whether to become a part of FEMA's Community Rating System	New	Regulatory, programmatic	Only one community in the region is participating, Northampton, but given Hadley's location, the Town is committed to researching the feasibility of participating	All Hazards	Town Administrator, SelectBoard	1/2018	Municipal	Low (for research-could be med for actual participation)
Systematically assess and replace as needed under-sized or non-working culverts due to increased severe and unpredictable weather events	In process	Operational	Continue work on Priority List for the Replacement of Undersized Culverts throughout Town	Flood-related hazards-Tornado, severe thunderstorm, hurricane	DPW	1/2018	Municipal for assessment--HMGP with local match for replacement	Low-assess High-replace
Identify all Pre-FIRM Structures throughout Town that need to be Elevated above the Base-Flood Elevation	In process	Operational	Work with property owners and FEMA to identify structures to elevate.	Flood-related hazards-Tornado, severe thunderstorm, hurricane	DPW	1/2020	Municipal-ID HMGP-Elevation	Low-assess High-Elevate
Participate in the Creation of a Regional Debris Management Plan	New	Plan	The Homeland Security Adv Council may fund this in Hampshire county	All Hazards	DPW	3 months from when launched	WRHSAC	Low
Establish a Program to Identify and Clean up Properties within Flood Zones with Junk and Hazardous Materials	In process	Operational	The local Haz Mit committee is concerned about hazardous materials in the river as well as danger to residents if materials are carried away by flooding water	Flood-related hazards-Tornado, severe thunderstorm, hurricane	SelectBoard, BOH, SelectBoard	1/2020	Municipal	Low
Drainage and Sewer Comprehensive Assessment Action Plan	New	Plan ==> implementation	A comprehensive assessment action plan for drainage and sewer is needed for the Route 9 corridor.	All flood-related hazards	DPW	9/2021	State revolving fund (SRF)/ Municipal Sewer and Water rates	Med.

Mitigation Action	Status	Action Type	Description	Hazards Mitigated	Responsible Entity	Timeframe	Funding source	Cost
Continued education regarding dam and flood-borne diseases (Zika, etc.)	New	Outreach/ education	BOH will integrate information on Zika and other insect-borne diseases into their outreach & education	Flood-related	Board of Health	4/2018	Town Money	Low
Improve Household Disaster Preparedness connecting residents with FEMA and CDC and other resources	New	Outreach/ education	Assist residents with emergency household preparedness and the ability to shelter in place and understand municipal disaster preparedness plans	All Hazards	EMD/Board of Health	8/2018	Town Money	Low
Require review of town drought initiative and revise as needed	New	Local Planning and Regs	Plan for drought events in the area, including but not limited to considering irrigation planning and identifying secondary sources of water	Drought	Town Administrator and Selectboard	10/2021	State SRF or Massworks	Low
Consider creation of local funding mechanisms such as stormwater utility to fund MS4 compliance	New	Local Planning and Regs	The Federal government has an unfunded mandate that municipalities such as Hadley comply with new stormwater Management Standards--this would fund this mandate	All Hazards	Town Administrator and Selectboard	10/2021	DLTA	Low
Review zoning having to do with flood plain development--esp permits granted on Honey Pot Road, Aqua Vitae Road	New	Local Planning and Regs	Members of the local hazard mitigation committee are concerned about potential flooding.	Flood-related hazards-Tornado, severe thunderstorm, hurricane	Planning Board	10/2017	DLTA	Low
Develop a plan to build up earth to elevate the generator at West Street pump stations	New	Operational	Local Haz Mit committee believes elevation will mitigate risk	Flood-related hazards-Tornado, severe thunderstorm, hurricane	DPW	9 months from funding	HMGP with local match	Medium

Mitigation Action	Status	Action Type	Description	Hazards Mitigated	Responsible Entity	Timeframe	Funding source	Cost
Stormwater management plan	New	Planning, regulatory	Develop a stormwater management plan to reduce Stormwater Runoff in conformance with EPA MS4 stormwater permit	Flood-related hazards-Tornado, severe thunderstorm, hurricane	DPW	NOI 9/2017 and done in 10 yrs-9/2027	300-600k	High
Call for an Insurances Services Organization (ISO) inspection on fire side	New	Assessment, programmatic	The ISO will assess the Town's practices with respect to fire prevention	Fire	Fire Department	7/2017	Municipal	Low
Work with FEMA to get an update to the 1978 FIRM	New	Assessment, regulatory	FEMA has been reporting that the FIRMs would be updated, but Hadley has still not received their updated maps.	Flood-related hazards-Tornado, severe thunderstorm, hurricane	DPW	7/2017	FEMA with local staff stime	Low
Design and implement regular Maintenance for Drainage Systems and Flood Control Structures	New	Operational	Regular maintenance will help drainage systems and flood control structures continue to function properly.	Flood-related hazards-Tornado, severe thunderstorm, hurricane	DPW	12/2019	Town funds	Medium
Create a Hazardous Materials Response Plan	New	Operational	In response to gas tanker spill along Route 9	Hazardous materials	DPW, Police, Fire	12/2018	Municipal, possible WRHSAC to exercise plan	Low
Develop a comprehensive home preparedness outreach booklet	New	Preparedness	Currently a number of municipal services provide information to residents on emergency preparedness and response and the local Haz Mit committee would like to organize this information	All Hazards	COA, Schools, Town Mgr	12/2017	Municipal, DLTA	Low
Consider Firewise Participation	New	Programmatic ,certification	Firewise certification will assure residents and other stakeholders that the Fire Dept is following best practices	Fire	Fire Department	10/2021	Municipal	Low

Mitigation Action	Status	Action Type	Description	Hazards Mitigated	Responsible Entity	Timeframe	Funding source	Cost
Monitor Mitigation Plan Implementation	New	Planning, evaluation	Monitor mitigation plan implementation to ensure that mitigation actions are being completed	Al hazards	Emergency Management Director	1 yr from FEMA approval and annually thereafter	Municipal	Low
Install quick-connect emergency generation hook-ups for critical facilities	New	Operational	In particular the school building and primary EOD	All hazards	Town Administrator	8/2021	HMGP	Med.
Roof Replacement	New	Operational	The DPW needs a new roof on one of their buildings.	All hazards	DPW	1/2018	Local Taxation	200,000

6. PLAN REVIEW, ADOPTION, IMPLEMENTATION, MONITORING AND EVALUATION

6.1 Plan Review and Adoption

Upon completion of the draft Hazard Mitigation Plan, a public meeting was held by the town staff and the Pioneer Valley Planning Commission to present and request comments from town officials and residents. The Hazard Mitigation Plan was then submitted to the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency for their review. Upon receiving conditional approval of the plan by FEMA, the plan was presented to the Town's Select Board and adopted.

6.2 Plan Implementation

The implementation of this plan began upon its formal adoption by the Town 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 Town's Hazard Mitigation Committee will oversee the implementation of the plan.

Hadley has a series of planning and regulatory capabilities that prevent and reduce the impacts of hazards. Many of these are assessed in the tables in Chapter 5. Existing plans, studies, reports and municipal documents were incorporated throughout the planning process. This included a review and incorporation of significant information from the following key documents:

- ***Hadley Master Plan*** - used to identify Community's priorities and sync hazard mitigation strategies with planned actions.
- ***Hadley Capital Improvements Plan***
- ***Hadley Comprehensive Emergency Management Plan*** - used to identify critical infrastructure, current emergency operations, and special needs populations
- ***Hadley Open Space and Recreation Plan -*** used to identify existing hazard mitigation strategies, already proposed mitigation strategies, natural resources, and critical infrastructure
- ***Hadley Zoning Bylaw and Subdivision Regulations*** - used to identify existing mitigation strategies
- ***Massachusetts' State Hazard Mitigation Plan*** - used to ensure consistency with state identification of mitigation strategies, critical infrastructure, and hazards

- **Our Next Future: An Action Plan for Building a Smart, Sustainable, and Resilient Pioneer Valley -** used for data, information, context and strategies, including the eight elements plans:
    1. Climate Action and Clean Energy
    2. Food Security
    3. Sustainable Transportation
    4. Environment
    5. Green Infrastructure
    6. Housing
    7. Brownfields
    8. Land Use

After this plan has been approved by both FEMA and the local government, links to the plan will be emailed to all Town staff, boards, and committees, with a reminder to review the plan periodically and work to incorporate its contents, especially the action plan, into other planning processes and documents. In addition, during annual monitoring meetings for the Hazard Mitigation Plan implementation process, the Hazard Mitigation Committee will review whether any of these plans are in the process of being updated. If so, the Hazard Mitigation Committee will remind people working on these plans, policies, etc. of the Hazard Mitigation plan, and urge them to incorporate the Hazard Mitigation Plan into their efforts.

The Hazard Mitigation Plan will also be incorporated into updates of the Town's Comprehensive Emergency Management Plan.

While it is the understanding of the Hadley Hazard Mitigation committee that the previous Hazard Mitigation plan has been integrated into other planning mechanisms in the Town, the Hazard Mitigation committee did not track this work. The committee is committed to doing so going forward.

6.3 Plan Monitoring and Evaluation

Monitoring is tracking the implementation of the plan over time. Evaluating is assessing the effectiveness of the plan at achieving its purpose and goals. Updating means reviewing and revising the plan at least once every five years.

The Town's Emergency Management Director will call meetings of all responsible parties to review plan progress an annual basis in each of the following years:, 2016, 2017, 2018, 2019, and 2020 and 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. Responsible parties identified for specific mitigation actions will be asked to submit their reports in advance of the meeting. Meetings will entail the following actions:

- Review previous hazard events to discuss and evaluate the effectiveness of current mitigation measures

- Assess how the mitigation strategies of the plan can be integrated with other Town plans and operational procedures, including the Zoning Bylaw and Emergency Management Plan

- Review and evaluate progress toward implementation of the current mitigation plan based on reports from responsible parties

- Update and 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. All changes to the plan will be tracked by saving the plan with new dates when updated or amended. The committee will review and update the Hazard Mitigation Plan every five years.

The following questions will serve as the criteria that is used to evaluate the plan:

Plan Mission and Goal

- Is the Plan's stated goal and mission still accurate and up to date, reflecting any changes to local hazard mitigation activities?

- Are there any changes or improvements that can be made to the goal and mission?

Hazard Identification and Risk Assessment

- Have there been any new occurrences of hazard events since the plan was last reviewed? If so, these hazards should be incorporated into the Hazard Identification and Risk Assessment.

- Have any new occurrences of hazards varied from previous occurrences in terms of their extent or impact? If so, the stated impact, extent, probability of future occurrence, or overall assessment of risk and vulnerability should be edited to reflect these changes.

- Is there any new data available from local, state, or Federal sources about the impact of previous hazard events, or any new data for the probability of future occurrences? If so, this information should be incorporated into the plan.

Existing Mitigation Strategies

- Are the current strategies effectively mitigating the effect of any recent hazard events?
- Has there been any damage to property since the plan was last reviewed?
- How could the existing mitigation strategies be improved upon to reduce the impact from recent occurrences of hazards? If there are improvements, these should be incorporated into the plan.

Proposed Mitigation Strategies

- What progress has been accomplished for each of the previously identified proposed mitigation strategies?
- How have any recently completed mitigation strategies affected the Town's vulnerability and impact from hazards that have occurred since the strategy was completed?
- Should the criteria for prioritizing the proposed mitigation strategies be altered in any way?
- Should the priority given to individual mitigation strategies be changed, based on any recent changes to financial and staffing resources, or recent hazard events?

Review of the Plan and Integration with Other Planning Documents

- Is the current process for reviewing the Hazard Mitigation Plan effective? Could it be improved?
- Are there any Town plans in the process of being updated that should have the content of this Hazard Mitigation Plan incorporated into them?
- How can the current Hazard Mitigation Plan be better integrated with other Town planning tools and operational procedures, including the zoning bylaw, the Comprehensive Emergency Management Plan, and the Capital Improvement Plan?

Public participation will be a critical component of the Hazard Mitigation Plan maintenance process. The Hazard Mitigation Committee will hold all meetings in accordance with Massachusetts open meeting laws and the public invited to attend, as well as comment via e-mail or phone. The public will be notified of any changes to the Plan via the meeting notices board at Town Hall, and copies of the revised Plan will be made available to the public at Town Hall.

7. 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 (SRPED.....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
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
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
National Oceanic and Atmospheric Administration: National Weather Service.....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) .....MA Emergency Management Agency
406 Public Assistance and Hazard Mitigation .....MA 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) .....MA Emergency Management Agency
Emergency Generators Program by NESEC‡ .....MA Emergency Management Agency
Emergency Watershed Protection (EWP) Program.....USDA, Natural Resources Conservation Service Flood Mitigation Assistance Program (FMAP).....MA Emergency Management Agency
Flood Plain Management Services (FPMS).....US Army Corps of Engineers
Mitigation Assistance Planning (MAP).....MA Emergency Management Agency
Mutual Aid for Public Work.....Western Massachusetts Regional Homeland Security Advisory Council
National Flood Insurance Program (NFIP) † .....MA Emergency Management Agency
Power of Prevention Grant by NESEC‡ .....MA 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) Internet Resources

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/dis aster/	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/g eog/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
The Tornado Project Online	http://www.tornadoroject.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.iiaa.iix.com/ndcmap.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

Media organizations receiving press releases announcing public meetings

Media Organization	Address	Town	State	Zip
African American Point of View	688 Boston Road	Springfield	MA	01119
Agawam Advertiser News	23 Southwick Street	Feeding Hills	MA	01030
Amherst Bulletin	115 Conz Street	Northampton	MA	01060
Belchertown Sentinel	1 Main Street	Belchertown	MA	01007
Berkshire Eagle	75 South Church Street	Pittsfield	MA	01202
Brattleboro Reformer	62 Black Mountain Rd.	Brattleboro	VT	05301
CBS 3 Springfield	One Monarch Place	Springfield	MA	01144
Chicopee Register	380 Union Street	West Springfield	MA	01089
CommonWealth Magazine	18 Tremont Street	Boston	MA	02108
Country Journal	5 Main Street	Huntington	MA	01050
Daily Hampshire Gazette	115 Conz Street	Northampton	MA	01060
El Sol Latino	P.O. Box 572	Amherst	MA	01004
Going Green	PO Box 1367	Greenfield	MA	01302
Hilltown Families	P.O. Box 98	West Chesterfield	MA	01084
Holyoke Sun	138 College Street	South Hadley	MA	01075
Journal Register	24 Water Street	Palmer	MA	01069
La Voz Hispana	133 Maple Street #201	Springfield	MA	01105
Ludlow Register	24 Water Street	Palmer	MA	01069
Massachusetts Municipal Association	One Winthrop Street	Boston	MA	02110
Quaboag Current	80 Main Street	Ware	MA	01082
Recorder	14 Hope Street	Greenfield	MA	01302
Reminder	280 N. Main Street	East Longmeadow	MA	01028
Southwick Suffield News	23 Southwick Street	Feeding Hills	MA	01030
State House News Service	State House	Boston	MA	02133
Tantasqua Town Common	80 Main Street	Ware	MA	01082
The Longmeadow News	62 School Street	Westfield	MA	01085
The Republican	1860 Main Street	Springfield	MA	01102
The Westfield News	62 School Street	Westfield	MA	01085
Town Reminder	138 College Street	South Hadley	MA	01075
Urban Compass	83 Girard Avenue	Hartford	CT	06105
Valley Advocate	115 Conz Street	Northampton	MA	01061
Vocero Hispano	335 Chandler Street	Worcester	MA	01602
WAMC Northeast Public Radio	1215 Wilbraham Road	Springfield	MA	01119
Ware River News	80 Main Street	Ware	MA	01082
West Springfield Record	P.O. Box 357	West Springfield	MA	01098
WFCR-Public Radio	131 County Circle	Amherst	MA	01003
WGBY-Public TV	44 Hampden Street	Springfield	MA	01103
WGGB ABC40/FOX 6 News	1300 Liberty Street	Springfield	MA	01104
WHMP-FM	15 Hampton Avenue	Northampton	MA	01060
Wilbraham-Hampden Times	2341 Boston Road	Wilbraham	MA	01095
Worcester Telegram & Gazette	20 Franklin Street	Worcester	MA	01615
WRNX/WHYN/WPKR Radio	1331 Main Street	Springfield	MA	01103
WWLP-TV 22	PO Box 2210	Springfield	MA	01102

In addition to media releases publicizing the planning process and inviting input, PVPC assured that surrounding communities were aware of Hadley's work updating their plan by informing the members of the Commission that oversees PVPC's work through articles in the quarterly newspaper published by the PVPC and also by presenting at meetings of the Executive Committee. The PVPC "Regional Reporter" is emailed to all 43 cities and towns in the Pioneer Valley and also to Businesses, Chambers of Commerce, Educational Institutions and Developers.

Hadley Hazard Mitigation Committee
Meeting #1 Agenda

Hadley Public Safety Building
May 6, 2016 9:00- 11:00 p.m.

1. Introductions/Administrative
    a. affirm local Hazard Committee membership

2. Overview of Hazard Mitigation Planning Process

    a. Background on Hazard Mitigation Planning

    b. Planning process and requirements
        i. 3-5 committee meetings
        ii. 2 public outreach meetings
        iii. MEMA / FEMA review and conditional approval
        iv. Select Board adoption
        v. FEMA final approval

    c. Schedule for committee and public outreach meetings

3. Review of Chapter 1: Planning Process

4. Review of Chapter 2: Local Profile

5. Review of Chapter 3: Hazard Identification and Risk Assessment

6. Homework:
    a. review Capability Assessment worksheet and come prepared to complete
    b. for Chapter 4--Critical Facilities: review map and mark up with corrections as needed
    c. for Chapter 5--Mitigation Strategies: reflect on last 5 years and review strategy chart from previous plan (handout); come prepared to provide input on status of prioritized strategies as well as suggestions for new strategies.

Hadley Hazard Mitigation Committee
Meeting #2 Agenda
May 13, 2016
Town Hall
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1. Introductions/Administrative
    a. affirm local Hazard Committee membership

2. Capability Assessment--using FEMA worksheet

3. Assess Status of Recommendations included in 2008 plan

4. Review and provide any missing information Chapter 1: Planning Process

5. Review and provide any missing information Chapter 2: Local Profile

6. Review and provide any missing information Chapter 3: Hazard Identification and Risk Assessment

7. Homework:
    a. for Chapter 4--Critical Facilities: review map and mark up with corrections as needed

    Planning process and requirements
        i. 3-5 committee meetings
        ii. 2 public outreach meetings
        iii. MEMA / FEMA review and conditional approval
        iv. Select Board adoption
        v. FEMA final approval

Hadley Hazard Mitigation Committee
Meeting #3 Agenda

Town Hall
May 20 2016 1:00-3:00 p.m.

1. Finalize Capability Assessment as needed

2. Finalize status report of strategies from 2008 plan

3. Complete review and edits to Chapters 1-3

4. Revise Chapter 4--critical facilities as needed and review and finalize Map

5. Start process of identifying new strategies-time permitting

    Planning process and requirements
        i. 3-5 committee meetings
        ii. 2 public outreach meetings
        iii. MEMA / FEMA review and conditional approval
        iv. Select Board adoption
        v. FEMA final approval

Hadley Hazard Mitigation Committee
Meeting #4 Agenda

Town Hall
June 13 2016 1:00-3:00 p.m.

1. Review Final Map

2. Affirm or revise as needed existing Mitigation Capabilities Table

3. Work on Prioritized Action Plan

4. Prep for Second Public Meeting

Planning process and requirements

i. 3-5 committee meetings
ii. 2 public outreach meetings
iii. MEMA / FEMA review and conditional approval
iv. Select Board adoption
v. FEMA final approval

Hadley Hazard Mitigation Committee
Meeting #5 Agenda

Town Hall
June 17 2016 1:00-3:00 p.m.

1. Discuss how to respond to Public comments

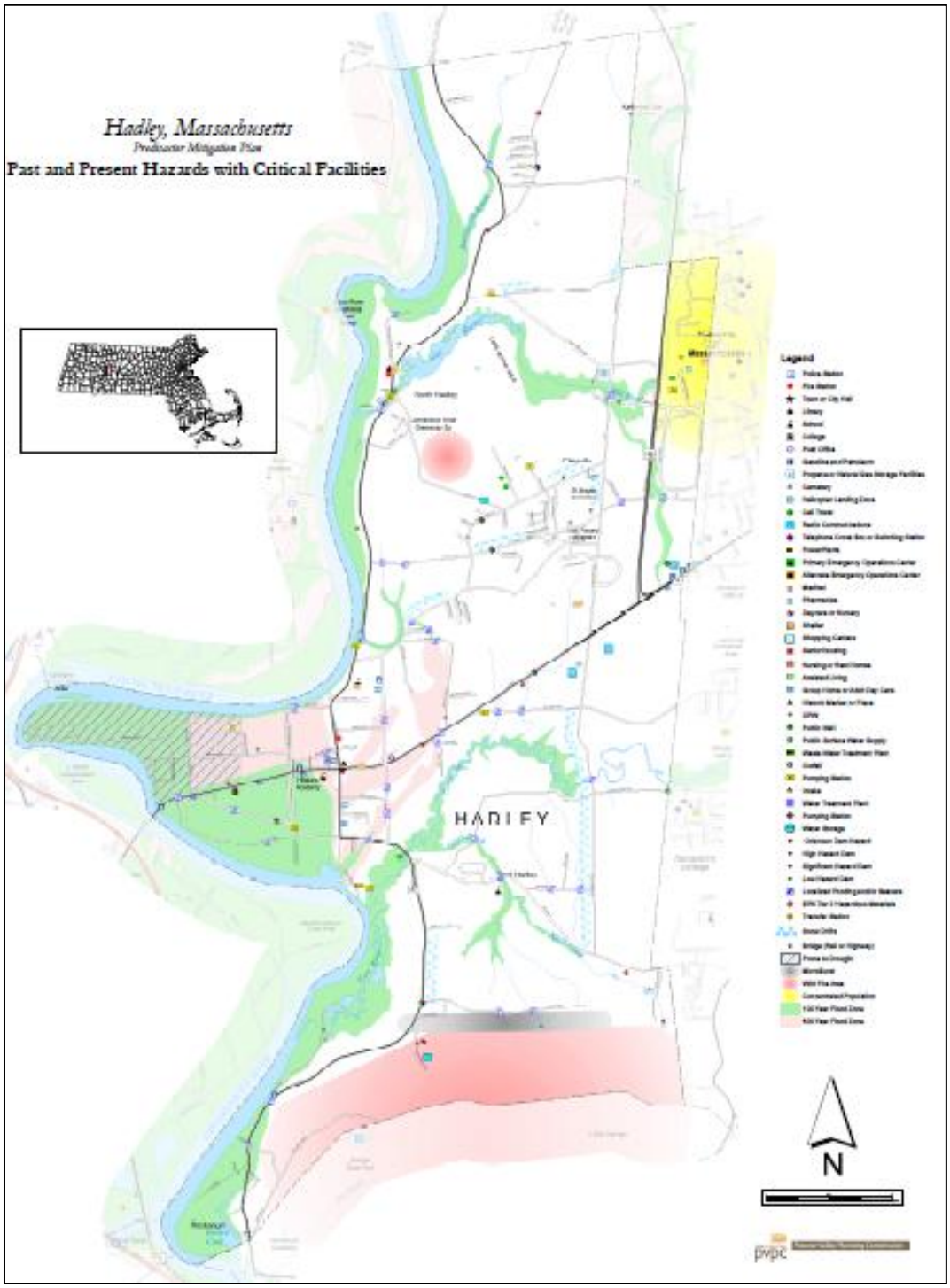
2. Finalize Prioritized Action Plan

3. Prepare for Submission

Planning process and requirements

i. 3-5 committee meetings
ii. 2 public outreach meetings
iii. MEMA / FEMA review and conditional approval
iv. Select Board adoption
v. FEMA final approval

Appendix C – Past and Potential Hazards/Critical Facilities Map



Appendix D – Capabilities Assessment

Capability Assessment Worksheet

Jurisdiction: Hadley

Local mitigation capabilities are existing authorities, policies, programs, and resources that reduce hazard impacts or that could be used to implement hazard mitigation activities. Please complete the tables and questions in the worksheet as completely as possible. Complete one worksheet for each jurisdiction.

Planning and Regulatory

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. Please indicate which of the following your jurisdiction has in place.

Plans	**Yes/No Yr**	**Does the plan address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?**
Comprehensive/Master Plan	y	Master Plan refers to Hazard Mitigation plan to address hazards
Capital Improvements Plan	y	Y, y, y
Economic Development Plan	N	
Local Emergency Operations Plan	y	y-CEMP is integrated in to Haz Mit plan
Continuity of Operations Plan	y	y-exercised it recently, y-it does id needs
Transportation Plan	y	RTP, not local
Stormwater Management Plan	y	MS4 workshop on 5/9/16; In process of update to comply with new permit- active July 2017.
Community Wildfire Protection Plan	N	
Other special plans (e.g. brownfields, redevelopment, disaster recovery, coastal zone management, climate change adaptation)	y	Freeboard tells them height of dike versus high water

Building Code, Permitting, and Inspections	**Y/N**	**Are codes adequately enforced?**
Building Code	y	**Version/Year:** State code is up to date
Building Code Effectiveness Grading Schedule (BCEGS) Score	n/a	Score: State law—muni's comply with state law
Fire Department ISO Rating	y	Rating: 9- Fire Protection

Site plan review requirements	y	Y

Land Use Planning & Ordinances	**Y/N**	**Is the ordinance an effective measure for reducing hazard impacts?** **Is the ordinance adequately administered and enforced?**
Zoning Ordinance	y	Y, y
Subdivision ordinance	y	Y, y
Floodplain ordinance	y	Y, y
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	y	Slope requirement
Flood insurance rate maps	y	Y
Acquisition of land use for open space and public recreation uses	y	Lead the Commonwealth with respect to more acres in APR than any other municipality. CPA is active to acquire land; partnering with Federal government on Silvio Conte; last scenic byway in Commonwealth
Other		y-leader in renewable energy with 19,000 kw/yr

How can these capabilities be expanded and improved to reduce risk?	
Reducing risk—biggest need is work force; equipment and staffing is an issue. Risk analysis is essential. Want to do a sub-surface investigation of the Ct River. $103,000 is pending for work planned in capital improvement plan.	

Administrative & Technical

Identify whether your community has the following administrative and technical capabilities. These include staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. For smaller jurisdictions without local staff resources, if there are public resources at the next higher level of government that provide technical assistance, indicate so in your comments.

Administration	**Y/N**	**Describe capability** **Is coordination effective?**
Planning Board	y	Y
Mitigation Planning Committee	y	y-appointed by SelectBoard
Maintenance programs to reduce risk (e.g. tree trimming, clearing drainage systems)	y	Tree Warden, annual plan, and system to clear drains—working to systematize -use vacuum truck
Mutual aid agreements	y	State agreement, Police, Fire, Board of Health

Staff	**Y/N** **FT/PT**	**Is staffing adequate to enforce regulations?** **Is staff trained on hazards and mitigation?** **Is coordination between agencies and staff effective?**
Chief Building Official	Y FT	Y, Y, Y
Floodplain Administrator	N	
Emergency Manager	y	Y, but could always use more staff-applied for a SAFER grant for more fire fighters to free up EMD for management
Community Planner	Y PT	Engage PVPC Senior Planner Larry Smith through Planning Board Assistance(PBA) program for part-time planning services
Civil Engineer	N	
GIS Coordinator	Y	Town Assessor is using GIS
Other	y	Host REPC for Hampshire Co and very active; schools and Town work very closely for back-up communication, reunification & evacuation planning and sheltering; COA engaged with warming centers; BOH participates in Hampshire Co EMC.

Technical	**Y/N**	**Describe capability** **Has capability been used to assess/mitigate risk in the past?**
Warning systems/services (Reverse 911, outdoor warning signals)	y	Code Red (over 2500), before used ConnectCTY
Hazard data and information	y	Previous plan, use NWS and webEOC, mostly historical data on CT River storm center
Grant writing	y	Staff has been successful and PVPC assists as needed
Hazus analysis	N	
Other		

How can these capabilities be expanded and improved to reduce risk?	
Schools use One Call so Town has a back-up, working on improved relationships with UMASS because so many students live in Hadley, planning to participate in Mullins Ctr emerg prep event	

Financial

Identify whether your jurisdiction has access to or is eligible to use the following funding resources for hazard mitigation.

Funding Resource	**Access Eligibility Y/N**	**Has the funding resource been used in the past and for what type of activities? Could the resource be used to fund future mitigation actions?**
Capital Improvements Project funding	Y	Y-Freeboard survey-top of dike versus flood waters
Authority to levy taxes for specific purposes	Y	Y-subsurface analysis of dike for integrity
Fees for water, sewer, gas or electric services	Y	Water, sewer, no gas electric
Impact fees for new development	Y	Used for waste water treatment plant, maybe compliance with NPDES?
Storm water utility fee	N	Maybe-if required by MS4
Incur debt through general obligation bonds and/or special tax bonds	Y	Y-freeboard survey
Community development block grants	Y	Y-housing rehab for low/mod income families-not Haz mit
Other federal funding programs	Y	SAFER-assistance for firefighter, PPE & breathing equipment, HMP from Hampshire REPC USDOT Haz Mat response
State funding programs	Y	Many—SAFE, DFS, HMP from MEMA, Ch 90-transportation and some culvert work, MassWorks
Other	Y	State$$ allocation thanks to State Rep for Emergency Trailer, capital grant for variable message board

How can these capabilities be expanded and improved to reduce risk?	
Russelville brook culvert in TIP—to develop access to north end of town if the road is out. SRF-clean water; Police and schools also receive some other federal funds.	

Education & Outreach

Identify education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information.

Program/Organization	Y/N	Describe program/organization and how it relates to disaster resilience and mitigation
Local citizens groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Y	Friends of Lake Warner-maintaining dam—under order to repair or else
Ongoing public education or information program (e.g. responsible water use, fire safety, household preparedness, environmental education)	Y	Fire and COA/Sr Ctr-household emergency preparedness, go bags
Natural disaster or safety related school programs	Y	Fire dept comes into schools
StormReady certification	N	
Firewise Communities certification	N	
Public-private partnership initiatives addressing disaster-related issues	Y	MOUs with area businesses for resources as needed, Nursing Home for inoculations
Other		Con Comm gives out an educational brochure to residents living near water

How can these capabilities be expanded and improved to reduce risk?	
Always thinking—COA-how to get all seniors better organized. Actively working to get 911 indicator forms into dispatch-home bound, oxygen, limited ability—Eversource mandated to provide info on priority customers. Only 4 listed. Special form for Winfield Sr. Community. UMASS has large MRC available to Town. Annually 6-8 UMASS Nursing students who assist with: Coop Plan, Re-unification plan, at no cost to Town, also have assisted with walk through for Emergency Dispensing site. Town also working to upgrade GIS system with information that would be helpful to public. DPW is installing software for staff/vehicles for resource management purposes. Developing work order system process which will improve risk management (ie. Will know status of all critical systems.)	

Safe Growth Audit

Use this worksheet to identify gaps in your community's growth guidance instruments and improvements that could be made to reduce vulnerability to future development

Comprehensive Plan	**Y**	**N**
Land Use		
1. Does the future land use map clearly identify natural hazard areas?	Y	
2. Do the land use policies discourage development or redevelopment within natural hazard areas?	Y	
3. Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?	Y	
Cluster development and economic development is incentivized in targeted areas.		
Transportation		
1. Does the transportation plan limit access to hazard areas?		
No plan, other than regional RTP.		
2. Is transportation policy used to guide growth to safe locations?	Y	
3. Are movement systems designed to function under disaster conditions (e.g. evacuation)?		
Need to check with PVTA. Hadley Lane has their own internal evacuation plans. Town assures all roads are maintained to current standards. Town and 5 Colleges have developed coordinated release schedule in the event of disasters so the roads are congested as little as possible.		
Environmental Management		
1. Are environmental systems that protect development from hazards identified and mapped?	Y	
Con Comm-setbacks for developments, map of 61B lands and other conservation areas, forests in 61B		
2. Do environmental policies maintain and restore protective ecosystems?	Y	
3. Do environmental policies provide incentives to development that is located outside protective ecosystems?	N	
Public Safety		
1. Are the goals and policies of the comprehensive plan related to those of the FEMA Local Hazard Mitigation Plan?	Y	
2. Is safety explicitly included in the plan's growth and development policies?	Y	
3. Does the monitoring and implementation section of the plan cover safe growth objectives?	Y	
Zoning Ordinance		

1. Does the zoning ordinance conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas?	Y	
2. Does the ordinance contain natural hazard overlay zones that set conditions for land use within such zones?	Y	
Floodplain/historic/wireless/aquifer protection		
3. Do re-zoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use?		
Re-zoning only. PB does not look at safety. Aquifer protection district		
4. Does the ordinance prohibit development within, or filling or, wetlands, floodways, and floodplains?	Y	
Subdivision Regulations		
1. Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?	N	
Subdivisions in or near flood prone areas are required to show that it was designed in a way to mitigate flood damage.		
2. Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources?	N	
Looking at now?		
3. Do the regulations allow density transfers where hazard areas exist?		
TDR, but not because of hazards, but could be applied to fund acquisition of open space to mitigate impacts		
Capital Improvement Program and Infrastructure Policies		
1. Does the capital improvement program limit expenditures on projects that would encourage development in areas vulnerable to natural hazards.	Y	
2. Do infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards?	y	
"We're not going to extend service to the floodplain…"		
3. Does the capital improvement program provide funding for hazard mitigation projects identified in the FEMA Mitigation Policy?	Y	
Other		
1. Do small area or corridor plans recognize the need to avoid or mitigate natural hazards?	y	
Rte 9 Corridor plan does consider the Ct River		
2. Does the building code contain provisions to strengthen or elevate construction to withstand hazard forces?	Y	
Seismic is built into the Building code. IECC		
3. Do economic development or redevelopment strategies include provisions for mitigation of natural hazards?	Y	
4. Is there an adopted evacuation and shelter plan to deal with emergencies from natural hazards?	Y	
CEMP		

Appendix E– 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
EMA	Emergency Management Agency
RACES	Radio Amateur Civil Emergency Service
WMECO	Western Massachusetts Electric Company
HAZMAT	Hazardous Materials

CERTIFICATE OF ADOPTION

Town of Hadley, MASSACHUSETTS

SELECT BOARD

A RESOLUTION ADOPTING THE TOWN OF HADLEY HAZARD MITIGATION PLAN UPDATE

WHEREAS, the Town of Hadley established a Committee to update the Hadley Hazard Mitigation plan; and

WHEREAS, the Town of Hadley participated in the update of the Town of Hadley Hazard Mitigation Plan;

and WHEREAS, the Town of Hadley Hazard Mitigation Plan Update contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Hadley, and

WHEREAS, a duly-noticed public meeting was held by the Select Board on December 14, 2016 for the public and municipality to review prior to consideration of this resolution; and

WHEREAS, the Town of Hadley authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Town of Hadley Select Board formally approves and adopts the Town of Hadley Hazard Mitigation Plan Update, in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED this fourteenth day of December 2016.

Molly Keegan Molly A. Keegan, Chair

Joyce A. Chunglo

Gerald T. Devine

John C. Waskewicz, II

Donald J. Pipczynski

ATTEST: