Source: Wikimedia

Town of Savoy, MA

HAZARD MITIGATION PLAN

April 2021

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1.0 INTRODUCTION

The Town of Savoy prepared this Hazard Mitigation Plan (HMP) as an action strategy to reduce the impacts of natural hazards and climate change within the community and the region. The Savoy HMP was adopted by the Board of Selectmen on DATE.

1.1 What is a Hazard Mitigation Plan?

Natural hazards, such as earthquakes, hurricanes, and flooding, can result in loss of life, disruptions to everyday life, and property damage. Hazard mitigation is the effort to reduce these disruptions through community planning, policy changes, education programs, infrastructure projects, and other activities (FEMA, 2020a). Hazard mitigation planning uses a stepped process with participation of a wide range of stakeholders to:

1. Define local hazards.
2. Assess vulnerabilities and risks.
3. Review current mitigation measures.
4. Develop priority action items.

The resulting HMP and action strategy saves lives and money. For every dollar spent on federal hazard mitigation grants, an average of six dollars are saved (FEMA, 2018a). There are many additional benefits of mitigation planning. HMPs increase public awareness of natural hazards that may affect the community. They allow state, local, and tribal governments to work together and combine hazard risk reduction with other community goals and plans. HMPs focus resources and attention on the community's greatest vulnerabilities. The vulnerability assessment of an HMP documents data related to the National Flood Insurance Program (NFIP), such as repetitive loss sites, and ongoing work by the community related to floodplain management.

Figure 1. FEMA Hazard Mitigation Planning Saves Money Graphic

Source: FEMA, 2018a

By completing HMPs, municipalities also become eligible for specific federal funding and allow potential funding sources to understand a community's priorities (FEMA, 2019a). Hazard mitigation funding is available through the Federal Emergency Management Agency (FEMA). To be eligible for FEMA grants, local governments are required to prepare an HMP meeting the requirements established in the *Robert T. Stafford Disaster Relief and Emergency Assistance Act*, as amended by the *Disaster Mitigation Act of 2000*.

Table 1. FEMA Grants

FEMA Grants	Purpose
Hazard Mitigation Grant Program (HMGP)	Helps communities implement hazard mitigation measures following a Presidential Major Disaster Declaration.
Pre-Disaster Mitigation Program (PDM)	Assists in implementing a sustained pre-disaster natural hazard mitigation program, in order to reduce risk to the population and structures from future hazard events.
Public Assistance Grant Program (PA)	Provides supplemental grants so that communities can quickly respond and recover from major disasters or emergencies.
Fire Management Assistance Grant Program (FMAG)	Available for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands.

(FEMA, 2020b)

1.2 Hazard Mitigation Planning in Savoy

The Town of Savoy (the "Town") received a MEMA grant to prepare an HMP. The Town created an action strategy that considers both the impacts based on historic data and climate change protected threats, following the lead established by the Commonwealth when it adopted the first-ever Massachusetts State Hazard Mitigation and Climate Adaptation Plan (EEA and EOPSS, 2018).

The HMP used FEMA's 10-step planning process integrating the recommendations from FEMA's Local Mitigation Planning Handbook (March 2013), FEMA's Local Multi-Hazard Mitigation Planning Guidance (2008), the Local Mitigation Planning How-To Guides, and the 10-step planning process used for FEMA's CRS and Flood Mitigation Assistance programs. The table below shows how the modified 10-step process corresponds with the planning requirements of the *Disaster Mitigation Act.*

Table 2. Planning Requirements of the Disaster Mitigation Act

Disaster Mitigation Act Requirements 44CFR 201.6	Modified CRS Planning Steps
1 Organize Resources	
201.6(c)(1)	1 Organize the Planning Effort
201.6(b)(1)	2 Involve the Public
201.6(b)(2) and (3)	3 Coordinate with Other Departments and Agencies
2 Assess Risks	

201.6(c)(2)(i)	4 Identify the Hazards
201.6(c)(2)(ii)	5 Assess the Risks
3 Develop the Mitigation Plan	
201.6(c)(3)(i)	6 Set Goals
201.6(c)(3)(ii)	7 Review Possible Activities
201.6(c)(3)(iii)	8 Draft an Action Plan
4 Implement the Plan and Monitor Progress	
201.6(c)(5) 9 Adopt the Plan	
201.6(c)(4) 10 Implement, Evaluate, and Revise the Plan	

Source: FEMA *Local Multi-Hazard Mitigation Planning Guidance*, 2008

1.3 Planning Process Summary

To prepare for the development of this HMP, the Town convened a core team of municipal leaders to lead the process and provide local expertise. An important aspect of the natural hazard and climate change impact mitigation planning process is the discussion it promotes among community members about creating a safer, more resilient community. Developing a plan that reflects the Town's values and priorities is likely to produce greater community support and result in greater success in implementing mitigation strategies that reduce risk.

Federal regulations for HMP approval also guided the process. Most importantly, FEMA requires that stakeholders and the general public have opportunities to be involved during the planning process and in the plan's maintenance and implementation. Community members can therefore provide input that can affect the content and outcomes of the mitigation plan. The planning and outreach strategy used to develop this HP Plan had three tiers: 1) the core team, with representation from municipal leadership at the Town, 2) stakeholders who could be vulnerable to, or provide strength against, natural hazards and/or climate change, and 3) the public, who live and work in the Town. Specific outreach to neighboring communities and agencies that regulate development included direct email solicitation for feedback.

1.3.1 Core Team

The Town convened the core team to act as a steering committee for the development of the HMP Plan. The core team met on October 26, 2020 to plan for the Workshop, review public comments, develop the mitigation plan, and transition to implementation of the plan's mitigation strategies. More information on these meetings is included in Appendix A.

The core team established goals for the plan, provided information on hazards affecting the Town, identified critical infrastructure, identified key stakeholders, reviewed the status of existing mitigation measures, and developed proposed mitigation measures for this plan. Members of the core team are listed in Table 2.

Table 3. Savoy's Core Team

Name	Title
John Tynan	Chair, Select Board
Sue McGrath	Administrative Assistant
Peter J. Miner	Fire Chief
Trish Carlo	Police Chief
William Drosehn	Highway Department Superintendent

An invitation list was developed for the Local Hazard Mitigation Planning Workshop series at which key stakeholders were invited to help the Town identify hazards, vulnerabilities, strengths, and proposed actions to mitigate the impacts of natural hazards and climate change. The core team sought to include municipal leaders as well as residents, and flyers were placed in public areas and on the Town's website. The Town also suggested or made available reports, maps, and other pertinent information related to natural hazards in Savoy. These included:

- *Berkshire County Hazard Mitigation Plan*, 2015 Update, (Berkshire Regional Planning Commission, 2012)
- *Berkshire County Outdoor Recreation Plan* (Berkshire Regional Planning Commission, 2020)
- *Route 116 Scenic Byway Corridor Management Plan*, Chapter 7, Community Planning Evaluation (Franklin Regional County of Governments, 2013)
- Massachusetts Climate Change Projections (NECSC, 2018)
- Massachusetts Climate Change Adaptation Report (EEA, 2011)
- *Massachusetts State Hazard Mitigation and Climate Change Adaptation* (EEA and EOPSS, 2018)
- *Local Mitigation Plan Review Guide*, October 2011 (FEMA, 2011)
- Flood Insurance Rate Maps (FIRM) for Berkshire County, MA, (FEMA, 2010)
- National Center for Environmental Information (NOAA)
- National Water Information System (USGS)
- US Decennial Census (US Census Bureau, 2010)
- American Community Survey (US Census Bureau, 2018)

1.3.2 Stakeholder Involvement

Stakeholders were involved in the process through a series of workshops and through a survey posted on the Town's website. Participants reviewed the plan's goals and provided feedback and comments, and also provided valuable observations on areas with potential localized flooding, erosion, and other concerns and expressed concerns about local buildings and landmarks that could be impacted. This input informed the process and the plan's actions.

1.3.3 Plan Layout

This plan presents the results and input derived from the core team, town staff, and members of the public, in addition to the documentation of community features and hazard profiles. Features are assets or characteristics of the Town that may contribute to the Town's ability to respond during a hazard event.

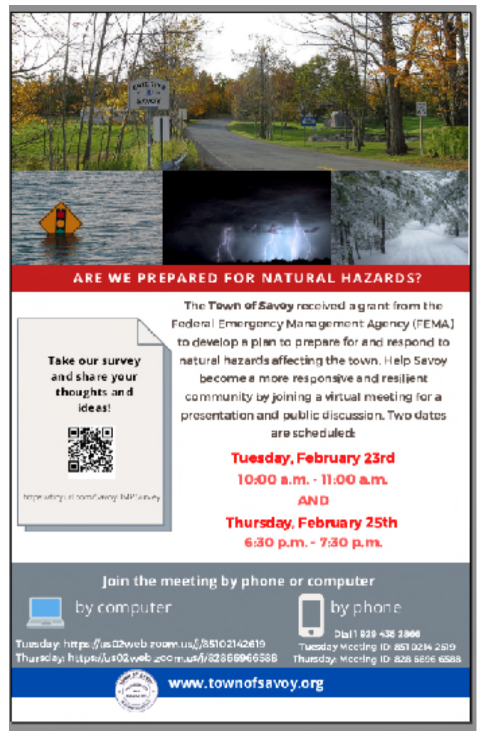


Figure 2. Flyer for Savoy's Public Meetings

1.4 Planning Timeline

The HMP process proceeded according to the timeline below. Four workshops were held in the preparation of this plan:

Kick-Off Meeting: October 26, 2020

Meeting 1: January 26, 2021

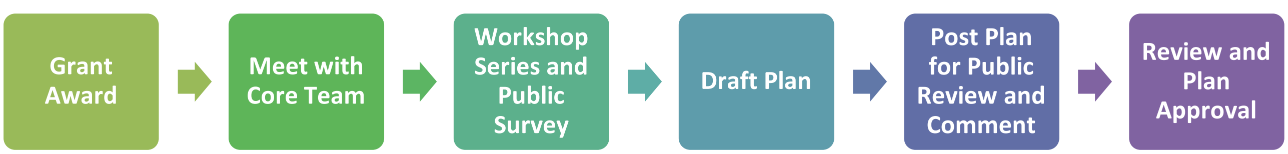
Meeting 2: January 28, 2021

Meeting 3: February 23, 2021

Meeting 4: February 25, 2021

Because of the COVID19 pandemic, meetings were advertised on the Town's website and on Facebook and were held via Zoom.

Figure 3. HMP- MVP Planning Process Timeline



2.0 HAZARD MITIGATION GOALS

The following seven goals were developed and endorsed by the core team as well as participants in the public workshop series.

1) Develop programs and mitigation measures in the high-risk areas to protect residents' health, safety, and property, business interests, cultural, recreational, and environmental resources.
    a) Protect critical infrastructure and essential services from disruption as a result of natural hazards by developing mitigation plans for critical infrastructure and the built environment and essential services, such as electric power delivery, and private drinking water supplies.
    b) Pursue funding to design and construct infrastructure improvements, such as culverts, that will protect roadways, property, and public safety.
2) Incorporate hazard mitigation measures into local plans, bylaws, regulations, and other planning tools to protect critical infrastructure and property and to encourage resilient development.
3) Plan for all phases of the emergency management cycle, including mitigation, preparation, response, and recovery.
4) Increase awareness and provide resources for hazard mitigation to businesses and residents through outreach and education, such as online fact sheets.
5) Identify funding opportunities specific to hazard mitigation projects.
6) Increase the Town's capacity for responding to a natural hazard event by centralizing municipal services and through coordination with businesses, surrounding communities, and state, regional, and federal agencies.

3.0 COMMUNITY PROFILE, LAND USE, AND DEVELOPMENT TRENDS

Figure 4. Entrance to Savoy.
Source: Wikimedia

3.1 Community Profile

Savoy was originally part of the Massachusetts Colony as part of "Northern Berkshire Township #6," which originally included the present-day towns of Adams, North Adams, Cheshire, and Lanesborough. The town was officially incorporated in 1797 and was supposedly named for the land's resemblance to the Duchy of Savoy in France. The town began with a grazing agrarian industry before several lumber mills took off in town. Today, the town is mostly a quiet rural community, known for its traditional New England scenery and natural beauty.

The town has a total land area of approximately 36 square miles, of which 35.8 square miles is land and 0.19 square miles is water. Savoy is located among the Berkshire Hills, with much of the town being dominated by Savoy Mountain State Forest, as well as parts of Mohawk Trail State Forest, Windsor State Forest, and Kenneth Dubuque Memorial State Forest. The Cold River, a branch of the Deerfield River, forms a portion of the town's norther border and feeds several brooks that passes through the town. There are several tributaries of the Westfield River that also flow through the southern portion of town.

Savoy is located along the eastern border of Berkshire County and shares a border with Franklin County and Hampshire County. The town is border to the north by Florida, Charlemont, Hawly, to the east by Plainfield, to the south by Windsor, and to the west by Adams. Savoy is located 17 miles from Pittsfield, 49 miles from Springfield, and approximately 120 miles from Boston.

A short portion of Route 2, also known as the Mohawk Trail, crosses through the northeast border of town. In the southern portion of town, Route 116 and Route 8A meet near the center of town and continue as one road towards the southeast corner of town. There are no railroad lines through town, the nearest being the freight line which passes through the neighboring town of Florida. The nearest regional bus service is in North Adams, as well as the closest small airport.

Savoy employs the open town meeting form of government and is led by a Board of Selectmen. The town has its own fire, police, and public works departments. The town operates the Savoy Hollow Library, which is connected to the regional library network. The town operates an elementary school, the Emma L. Miller Memorial Elementary School, but has an agreement with the Town of Florida to send middle school students to the Gabriel Abbott Memorial School and an agreement with the Adams-Cheshire Regional School district to send high school students to Hoosac Valley High School. There are also several private, parochial, charter, and vocational schools located nearby in Adams and North Adams. The nearest colleges are Berkshire Community College in Pittsfield, Massachusetts College of Liberal Arts in North Adams, and the University of Massachusetts Amherst in Amherst.

In 2019, the population was just 680 people (U.S. Census Bureau, 2019), which is approximately a 2% population decrease from 2010 (U.S. Census Bureau).

Table 4. Population Demographics

2018	Savoy	Massachusetts
Population	680	6,902,149
Under the Age 18	15%	20%
Over Age 65	20%	17%
Bachelor's degree or higher	12%	42%
Median household income	$58,125	$79,835
Poverty Rate	7.1%	11%
With a Disability	10%	8%
Limited English-Speaking Skills	3%	6%
Housing Units	364	2,864,989
Renter-Occupancy Rate	8%	38%

Burdened by Housing Costs	41%	50%

(US Census Bureau, 2019)

3.2 Land Use

Table 6. Land Use Breakdown

	Acres	Percentage of Total Land
Forest	20,664	89.7
Residential	399	1.7
Commercial/Industrial	14	0.1
Agricultural	506	2.2
Wetland and Water	1,124	4.9
Other	339	1.5
Total	23,048	100

Source: MASSGIS, 2010

3.3 Recent and Potential Development

As indicated in Table 6, Savoy is 90% forested, with less than 2% residential and commercial development. The development of individual residential housing lots rather than subdivisions is a trend that is likely to continue. At this point, ground-mounted solar arrays have the most potential for large-scale development, and an application for a 2 megawatt solar installation was submitted in 2017 but ultimately was not developed. Medium and large ground mounted-solar installations are those that are established for off-site consumption and require a special permit from the Special Permit Granting Authority (SPGA). The SPGA reviews for potential impacts of the installation to emergency services, farmland, and erosion impacts, and impacts to wildlife habitat. A 12.5 megawatt wind turbine project was proposed in 2017, reviving older approvals from the Town, but was delayed because of environmental approvals. Subsequently, voters removed turbines from the zoning bylaw.

3.4 Critical Facilities and Vulnerable Populations

Critical facilities were identified and mapped in GIS based on the confirmed physical location/address by the Town of Savoy. Each was then overlaid with the identified and mappable hazard zones (FEMA Flood Zones). For purposes of this analysis, it was assumed that the physical location of a critical facility within a hazard area (completely or partially) means that it is exposed and potentially vulnerable to that specific hazard; however, it is recognized that more site-specific evaluations may be required to confirm this assumption. As can be seen on the Critical Facilities Map (See Appendix B) and Table 16, Savoy does have critical facilities located within a flood zone, including the Savoy Fire Department and Route 8A.

The most vulnerable populations are the elderly, children, and people with certain medical conditions, such as heart issues. As indicated in Table 5, Savoy has a slightly lower population under the age of 18 in comparison with Massachusetts, and a slightly higher percentage of residents over the age of 65 and people with disabilities than the state overall. Vulnerability can also occur when people cannot access needed help in an emergency because of limited access to English, or because of lower incomes and mobility. While Savoy's income is much lower than the state average, the town has a lower housing cost burden and fewer renters. The population with limited English is also lower than in Massachusetts overall. Savoy does not have any Environmental Justice areas, or concentrations of low-income residents.

3.4.1 Schools

Savoy's only school in town is the Emma L. Miller Elementary School (Savoy Elementary) at 26 Chapel Road, which houses students from pre-kindergarten through the 6th grade. Approximately 60 students attend the elementary school. Older students attend Adams Memorial School in Adams and Hoosac Valley Middle and High School in Cheshire for public schools. Berkshire County also includes a number of private schools.

3.4.2 Seniors

As noted above, Savoy's senior population (over the age of 65) is slightly higher than the state at 20%. Savoy does not have a senior center in town. The Savoy Council on Aging is currently housed in the Town Hall, but efforts are being made to coordinate regionally.

3.4.3 Special Populations

Although 10% of the population of Savoy has a disability, the town does not have group homes or assisted living facilities for special populations. Residents who depend on electrical equipment for their health can register with Eversource Energy and the Emergency Operations Center to notification of power outages and to receive assistance with a generator if necessary.

4.0 HAZARD PROFILES, RISK ASSESSMENT, & VULNERABILITIES

Each hazard profile contains information on the areas vulnerable to the hazard, documentation of historic events, and a risk and vulnerability assessment. The risk and vulnerability assessment examines both the frequency and severity of hazards and their potential impact to the Town of Savoy. Each hazard risk and vulnerability assessment use previous occurrences. The vulnerability analysis looks at various factors in the community, such as existing and future buildings, infrastructure, and critical facilities. In some cases, an estimate of the potential dollar loss to vulnerable structures is available. Land uses and development trends were of particular interest in the flood vulnerability assessment.

The hazard profiles were updated with information from the *2013 Massachusetts State Hazard Mitigation Plan* (MEMA and DCR, 2013); the *2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan* (SHMCAP) (EEA and EOPSS, 2018) and additional research and assessment. The core team, other town staff, and public input provided local accounts of each hazard. A Geographic Information System (GIS) assessment was conducted to analyze the potential impact of flooding in Savoy on current and future development. FEMA's Hazus software was used to model potential damage of hurricanes.

4.1 Statewide Overview of Hazards

4.1.1 Massachusetts State Hazard Mitigation and Climate Adaptation

The *2013 Massachusetts State Hazard Mitigation Plan* (MEMA and DCR, 2013) and the *2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan* (SHMCAP) (EEA and EOPSS, 2018) examined the natural hazards that have the potential to impact the Commonwealth. These plans summarize the frequency and severity of hazards of greatest concern. The frequency classification ranges from very low to high. Severity classifications are listed as a range from minor severity to catastrophic. The

Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency

- *Very low frequency*: events that occur less frequently than once in 100 years (less than 1% per year)
- *Low frequency*: events that occur from once in 50 years to once in 100 years (1% to 2% per year)
- *Medium frequency*: events that occur from once in 5 years to once in 50 years (2% to 20% per year)
- *High frequency*: events that occur more frequently than once in 5 years (greater than 20% per year)

Severity

- *Minor:* Limited and scattered property damage; limited damage to public infrastructure and essential services not interrupted; limited injuries or fatalities.
- *Serious:* Scattered major property damage; some minor infrastructure damage; essential services are briefly interrupted; some injuries and/or fatalities.
- *Extensive:* Widespread major property damage; major public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and/or fatalities.
- *Catastrophic:* Property and public infrastructure destroyed; essential services stopped; numerous injuries and fatalities.

box below gives further definitions of the frequency and severity characterizations. The figures on the following pages display the severity of hazard risk in Savoy.

Table 13. Massachusetts Hazard Risk Summary

Hazard	Frequency	Severity
Inland Flooding	High (1 flood disaster declaration event every 3 years; 43 floods per year of lesser magnitude)	Serious to Catastrophic
Dam failures	Very Low	Extensive to Catastrophic
Coastal Hazards	High (6 events per year over past 10 years)	Serious to Extensive
Tsunami	Very Low (1 event every 39 years on East Coast, 0 in MA)	Extensive to Catastrophic
Hurricane/ Tropical Storm	High (1 storm every other year)	Serious to Catastrophic
High Wind	High (43.5 events per year)	Minor to Extensive
Tornadoes	High (1.7 events per year)	Serious to Extensive
Thunderstorms	High (20 to 30 events per year)	Minor to Extensive
Nor'easter	High (1 to 4 events per year)	Minor to Extensive
Snow and Blizzard	High (1 per year)	Minor to Extensive
Ice Storms	High (1.5 per year)	Minor to Extensive

Table 13. Massachusetts Hazard Risk Summary

Hazard	Frequency	Severity
Earthquake	Very Low (10-15% change of a magnitude 5.0+ every 10 years in New England)	Minor to Catastrophic
Landslide	Low (1 every 2 years in Western MA)	Minor to Extensive
Brush Fires	High (at least 1 per year)	Minor to Extensive
Extreme Temperatures	High (1.5 cold weather and 2 hot weather events per year)	Minor to Serious
Drought	High (8% chance of “Watch” level drought per month [recent droughts in 2016 and 1960s])	Minor to Serious

Source: MEMA and DCR, 2013; EEA and EOPSS, 2018

Not all hazards included in the *2018 State Hazard Mitigation and Climate Adaptation Plan* or the *2013 Massachusetts State Hazard Mitigation Plan* apply to Savoy. Given Savoy’s inland location, coastal hazards and tsunamis are unlikely to affect the town directly. Given the type of fires that have occurred in Savoy’s history, and the current Wildfire Potential Maps developed by the U.S. Forest Service, wildfires are less likely than brushfires. It is assumed that all of Savoy and its critical facilities are susceptible during the occurrence of events such as earthquakes, high-wind events, hurricanes, winter storms, temperature extremes and snow and ice. Flood risk is elevated in the vicinity of the flood zones. Landslides are most likely in areas with more unstable soil types.

4.1.2 Federally Declared Disasters in Massachusetts

Tracking historic hazards and federally declared disasters that have occurred in Massachusetts, and more specifically Berkshire County, helps planners understand the possible extent and frequency of hazards. Massachusetts has experienced multiple type of hazards, including flooding, blizzards, and hurricanes. Since 1991, there have been 22 storms in Massachusetts that resulted in federal or state disaster declarations. Seven of these disaster declarations occurred in Berkshire County. Federally declared disaster open up additional FEMA grant opportunities for regional recovery and mitigation projects. The hazard profiles provided below contain further information about federally declared disasters.

4.1.3 Impacts of Climate Change

Climate changes will exacerbate Savoy's current natural hazards, and may elevate the potential for other hazards, such as wildfires (which can occur in periods of drought). Many of the hazards that Savoy commonly experiences are projected to worsen due to climate change. Climate change refers to changes in regional weather patterns that are linked to warming of the Earth's atmosphere as a result of both human activity and natural fluctuations. The Earth's atmosphere has naturally occurring greenhouse gases (GHGs), like carbon dioxide (CO2), that capture heat and contribute to the regulation of the Earth's climate. When fossil fuels (oil, coal, and gas) are burned, GHGs are released into the atmosphere and the Earth's temperature tends to increase. The global temperature increase affects the jet stream and climate patterns. The climate in Massachusetts is expected to reflect historic climate patterns of Southern New England or Mid-Atlantic States depending upon GHG emission scenarios. Climate change has already started to change the climate in Massachusetts and these trends are likely to continue. Climate change is likely to affect Massachusetts's typical precipitation cycle, leading to more intense rainfall and storms and more episodic or flash droughts. Temperatures will increase in both summer and winter. Each of the hazard profiles provided below includes more detail on how hazard frequency and intensity are likely to shift with climate change.

4.2 Flood-Related Hazards

Flooding can be caused by various weather events including hurricanes, extreme precipitation, thunderstorms, nor'easters, and winter storms. Beaver dams can also contribute to flood concerns in Savoy. This section also covers flooding as a result of dam failure. Flooding events in Savoy have been classified as a high frequency event. As defined by the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (EEA and EOPSS, 2018), this hazard occurs once in three years (33% chance per year). The impacts of flooding include injury or death, property damage, and traffic disruption. Flood storage in riverfront parks, smart development and stormwater infiltration can assist in mitigating flooding. Areas within the FEMA Flood Zones, repetitive loss sites, and local areas identified as flood prone are more vulnerable to the impacts of flooding. The following sub-sections provide more information on historic flooding events, potential flood hazards, a vulnerability assessment, locally identified as areas of flooding, and information on the risk of dam failures. This analysis of flood hazard areas was informed by the FEMA NFIP Flood Insurance Rate Maps (FIRMs), a GIS vulnerability assessment, information from the Town of Savoy, and accounts of past flood events provided by participants during the town's public workshop.

Flood hazards are also directly linked to erosion, which can compromise the stability of building foundations. This puts current and future structures and populations located near steep embankments at risk. Erosion can also undercut streambeds and pose a risk to those walking along the banks. Structures or critical facilities located near the streams and lakes in Savoy may be considered at risk from fluvial erosion.

4.2.1 Areas Vulnerable to Flooding

Flooding can be both riverine (topping the banks of streams, rivers, ponds) and from stormwater that is not properly infiltrated into the ground.

<u>Riverine Flooding</u>

Savoy is dotted with ponds, rivers, and brooks that provide for potential flooding. The Cold River marks a portion of the town's northern boundary but is in a sparsely populated area of town. The southern portion of town contains a portion of the Westfield River, often intersecting with areas of development on its course through town. In public meetings, residents cited River Road and Route 116 as areas of flood concerns as well as areas around Black Brook.

A series of lakes and ponds may also cause flooding. These include:

- Burnett Pond
- Bog Pond
- South Pond
- Cold River
- Tannery Brook
- Westfield River
- Drowned Land Brook
- Savoy Hollow Brook
- Black Brook

FEMA maps flood zones as part of the NFIP called Flood Insurance Rate Maps (FIRMS). Areas within the flood zones are vulnerable to storm events that have a 1% chance or a 0.2% chance of occurring on an annual basis. The definitions of these flood zones are provided below. A map of the FEMA designated flood zones from the NFIP FIRM are included in Appendix B.

Flood Insurance Rate Map Zone Definitions

Zone A (1% annual chance or 100-year flood zone): Zone A is the flood insurance rate zone corresponding to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Detailed hydraulic analyses are not performed for such areas, therefore, no BFEs (base flood elevations) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone AE and A1-A30 (1% annual chance or 100-year flood zone): Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Zone X (0.2% annual chance or 500-year flood zone): Zone X is the flood insurance rate zone that corresponds to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

(FEMA, 2019b)

Repetitive Loss Sites

As defined by FEMA and the NFIP, a repetitive loss property is any insured property which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978 (FEMA and NFIP, 2018). Savoy does not participate in the NFIP.

Stormwater Flooding

Stormwater flooding occurs during a precipitation event where the rate of rainfall is greater than the stormwater management system can handle. This may be due to an undersized culvert, poor drainage, topography, high amounts of impervious surfaces, or debris that causes the stormwater system to function below its design standard. In these cases, the stormwater management system becomes overwhelmed, causing water to inundate roadways and properties. Stormwater flooding can occur anywhere in Town and is not limited to areas surrounding water bodies.

Most stormwater systems in Massachusetts are aging and have been designed with rainfall data that is no longer accurate. Figure 13 shows how the amount of rainfall of design storm data has increased from 1961 to 2015, especially for the larger 24-hour, 100-year event. Green infrastructure or low impact development improvements can help reduce stress on the capacity of the existing stormwater system by increasing infiltration on site. A rain garden or pervious pavement are example strategies. Upsizing culverts with new rainfall data is also recommended.

4.2.2 Historic Flood Events

Locally Significant Floods

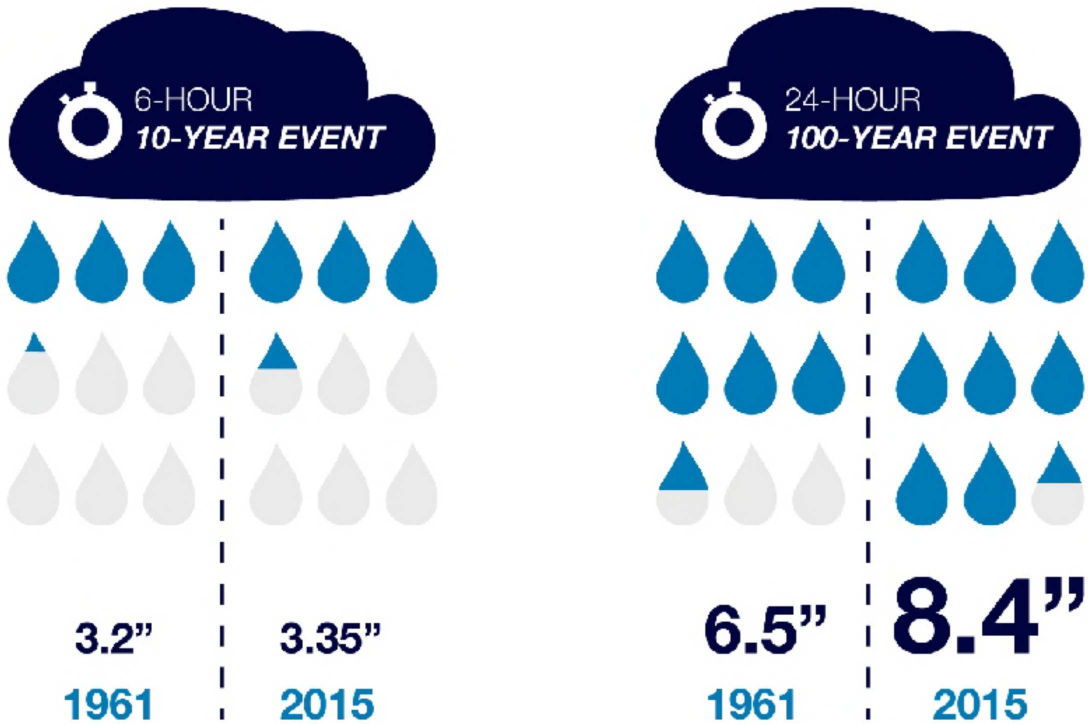


Figure 5: Stormwater Design Standards

Sources: NOAA TP-40, 1961, and NOAA Atlas Volume 10 (2015)

Berkshire Flooding Events

NOAA’s National Centers for Environmental Information Storm Events Database (NOAA NCEI, 2019) provides information on previous flood events for Berkshire County. Savoy is in the Central Berkshire Zone. Flash Flood events are considered by the NOAA’s NCEI Storm Events Database as “a life-threatening, rapid rise of water into a normally dry area beginning within minutes to multiple hours of the causative event (e.g., intense rainfall, dam failure, ice jam).” Since the 1960s, Berkshire County saw 46 flash floods, but Savoy has one individual record for a flash flood. In 2008, Route 8A (Windsor Road) was washed out.

Floods are considered, “any high flow, overflow, or inundation by water which causes damage. In general, this would mean the inundation of a normally dry area caused by an increased water level in an established watercourse, or ponding of water, that poses a threat to life or property” (NOAA NCEI, 2018c). Since the 1960s, 32 floods have impacted Berkshire County, but only four caused property damage: two in 1996 and two in 2008.

Federally Declared Flood Disasters in Berkshire County

A disaster declaration is a statement made by a community when the needs required by a disaster or emergency is beyond the capabilities of that community. Only three disaster declarations were made that included Berkshire County due to flooding between 2000 and 2015, as can be seen in Table 15.

Table 14. Previous Federal and State Disaster Declarations for Flooding

Disaster Name and Date of Event	Type of FEMA Assistance	Counties Under Declaration
Severe Storms and Flooding October 7-16, 2005	Public Assistance; Individual & Households Program; Hazard Mitigation Grant Program	All 14 Massachusetts Counties
Severe Winter Storm and Flooding December 11-18, 2008	Public Assistance; FEMA Hazard Mitigation Grant Program	All 14 Massachusetts Counties
Severe Winter Storm, Snowstorm, and Flooding February 8-9, 2013	Public Assistance; Hazard Mitigation Grant Program	All 14 Massachusetts Counties

Source: MEMA, 2019; FEMA, 2018b; EEA and EOPSS, 2018

4.2.3 GIS Flooding Exposure Analysis

Hazard location and extent of riverine flooding was determined using the current effective FEMA FIRM data for Savoy dated 2010. The FIRM is the official map on which FEMA has delineated both the special flood hazard areas and the risk premium zones. Under the NFIP, the 100-year floodplain is linked to mandatory purchase requirements for federally backed mortgage loans. The 500-year floodplain is defined as a moderate- to low-risk areas. For the purposes of this exposure analysis, the following special flood hazard areas as identified in the Town of Savoy's current FIRMs were included: Flood Zone AE – Regulatory Floodway, Flood Zone A (AE, AH) – 1% Annual Chance Flood Hazard, Flood Zone X (shaded) – 0.2% Annual Chance Flood Hazard.

A flood exposure analysis was conducted for critical facilities and vulnerable populations throughout the municipality utilizing MassGIS data, FEMA flood maps, and information gathered from the municipality. Savoy does not have extensive flood zones, and those that exist are around brooks, wetlands, and/or forested areas. Table 16 displays critical facilities in Savoy that are located within either the 100-year or 500-year FEMA flood zone, and Table 17 shows all census blocks in Savoy that contain a high concentration of a vulnerable population.

Table 15. Critical Facilities

Facility Name	Location	100-Year FEMA Flood Zone, Only	500-Year FEMA Flood Zone
Safety and Security			
Police Department	720 Main Road	X	
Fire Department	17 Center Road	X	
Highway Department/Public Works	262 Main Road		
Savoy Town Hall	720 Main Road	X	
Food, Water, Shelter			
Grocery	668 Main Road		
Designated Shelter- Hoosac High School	125 Savoy Road		
Emma L. Miller Memorial Elementary School	26 Chapel Road		
Savoy Town Park Building	Main Road		
Public Water Supply (Elementary School)	26 Chapel Road		
Energy			
Electricity (Eversource) Woodland Substation	Lee, MA		
Solar Array	Windsor Road, Rte. 8A		
Emergency Fuel Station (Highway Dept.)	262 Main Road		
Communication			
Cell Tower	Windsor Road		
Borden Mountain Tower (Public Safety Communications)	Adams Road/Tower Road		
Portable Radios	Fire, Police, Highway Departments		
Fixed Radios	Fire, Police, Highway Departments	X	
External Communication (Borden Mountain Tower)	Berkshire County Sheriff		
Transportation			
Evacuation Routes - Black Brook Road	Route 2, Route 116, Route 8A	X (Route 8A)	
Salt Storage (Highway Department)	262 Main Road		
Hazardous Material and Waste Management			
Solid Waste Facility/Transfer Station	Chapel Road		
Community and Cultural Sites			
Economic Center/Town Center	Route 116		
Star Seed Sanctuary	662 Chapel Road		

The Fire Department is in the flood zone, and the Police Department and Town Hall are in the vicinity of the flood zone. These facilities are essential to the ongoing operations of the Town and it is important that they are protected so that they can continue to function even during times of a crisis.

During the workshop, stakeholders discussed concern around the location of vulnerable populations. Some of these community members rely on outside assistance and it is important that someone is able to access them if needed. It becomes a concern if the vulnerable populations are located within a flood zone or in an area that extreme flooding could isolate them from the rest of the town. Savoy includes one census block, so it is not possible to determine specific areas that include high populations of vulnerable residents. The Town's existing tax parcel and property value data, obtained from MassGIS, were used to estimate the number of parcels (developed and undeveloped) and buildings located in identified hazard areas along with their respective assessed values. The parcel data set provides information about the parcel size, land use type, and assessed value among other characteristics. The parcel data was also classified into various land use types based on the Massachusetts Department of Revenue's Property Type Classification Code, 2016.

An analysis was conducted on all developed parcels in the Town. To determine the vulnerability of each parcel and building, a GIS overlay analysis was conducted in which the flood hazard extent zones were overlaid with the parcel data and existing building footprint data. These developments were overlaid with historic flood zones to determine these parcels vulnerability to flooding. They were categorized by land use type, and the exposure of each land use type was documented by the total area and percentage of parcels that overlap with a flood zone. The risk or impact of potential flooding was captured by summarizing the total property value in each parcel.

4.2.4 Dams and Dam Failure

Dam failure is defined as a collapse of an impounding structure resulting in an uncontrolled release of impounded water from a dam (DCR, 2017a). There are two types of dam failures that can occur. Catastrophic failure occurs when there is a sudden, rapid, uncontrolled release of impounded failure. The other is design failure, which occurs as a result of minor overflow events. Dam overtopping occurs when floods exceed the capacity of the dam and can occur as a result of inadequate spillway design, or other outside factors such as settlement of the dam crest or backage of spillways. Thirty-four percent of all dam failures that occur in the United States are a result of overtopping (EEA and EOPSS, 2018). Dam failures during flood events are of concern in Massachusetts, given the high density of dams constructed in the 19th century (MEMA and DCR, 2013).

Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage (MEMA and DCR, 2013). Dam failure can cause property damage, injuries, and potentially fatalities. These impacts can be at least partially mitigated through advance warning to communities impacted by a dam failure. In addition, the breach may result in erosion on the rivers and stream banks that are inundated.

No recorded dam failures have occurred in Savoy, and dam failure is classified as a very low frequency event. Dam failure can still present a high level of risk and could result in a catastrophic event with extreme damage and loss of life. As defined by the *2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan* (EEA and EOPSS, 2018), a very low frequency hazard may occur less frequently than once in 100 years (less than a 1% chance per year). According to Town officials and the Massachusetts Department of Conservation and Recreation's (DCR) Office of Dam Safety, there are four dams in Savoy. Information related to these dams is summarized in Table 25. This summary table includes the hazard classification for each dam, which is defined by DCR as described below.

- *High:* Dams located where failure or mis-operation will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).
- *Significant:* Dams located where failure or mis-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s), or cause interruption of use or service or relatively important facilities.
- *Low:* Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

Name	Owner	Hazard Potential Classification[1]
Burnett Pond Dam	Dept. of Conservation & Recreation	Low
Bog Pond Dam	Dept. of Conservation & Recreation	Low
Sharkey Pond Dam	Private	Low
Luczynksi Pond Dam	Private	Low

Of the four dams located in town, two are privately owned and the other two are owned by DCR. All four of the dams are considered low hazard as defined by DCR. Savoy's Zoning Bylaws and Subdivision Regulations require a review of the potential impacts of new development in relation to flood hazard areas and moderate or high hazard dams.

4.2.5 Climate Change Impacts: Flooding

Extreme rain and snow events are becoming increasingly common and severe particularly in the Northeast region of the country (Figure 14). Regional increases in heavy precipitation events exceed the rest of the US by a 74% increase in the heaviest 1% of all precipitation events since 1958. The eastern region of Massachusetts has shown an increase in heavy precipitation of two inches or more since 1970. Annual maximum daily precipitation in the area has also increased by up to 2 inches since 1970 (UMass, 2019).

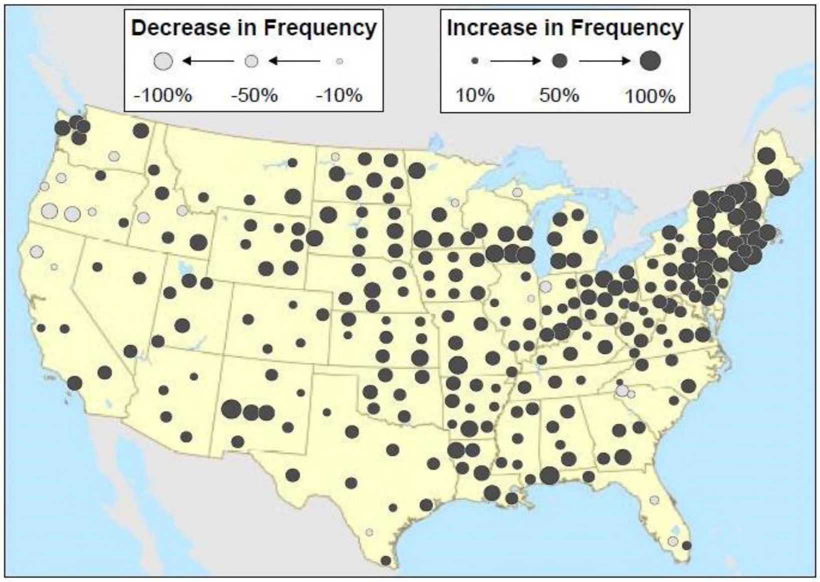


Figure 6. Changes in Frequency of Extreme Downpours
Source: Madsen and Willcox, 2012, page 19.

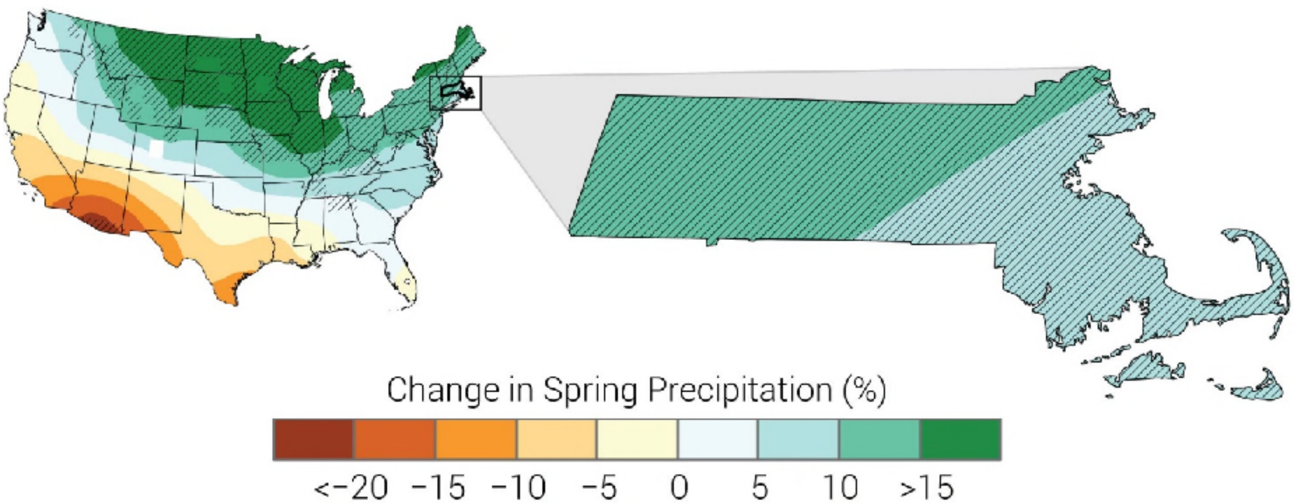


Figure 7. Projected Change in Spring Precipitation. **Wind-Related Hazard**
"Projected change in spring precipitation (%) for the middle of the 21st century relative to the late 20th century under a higher emissions pathway." Hatching represents portions of the state where the majority of climate models indicate a statistically significant change. Precipitation in the spring is projected to increase in Massachusetts by mid-century. Data from CICS-NC and NOAA NCEI" (NOOA and Department of Commerce, 2017).

High winds can occur during hurricanes, tropical storms, tornadoes, nor'easters, and thunderstorms. The entire planning area is vulnerable to the impacts of high wind. All current and future buildings including critical facilities and populations are considered to be vulnerable during high wind events. Wind may down trees and power lines. High wind and storm events cause property damage and hazardous driving conditions. While Savoy's current 100-year wind speed is 110 mph, climate change will likely increase events and severity. Extreme winds can take down trees and branches that cause service disruptions and block roads.

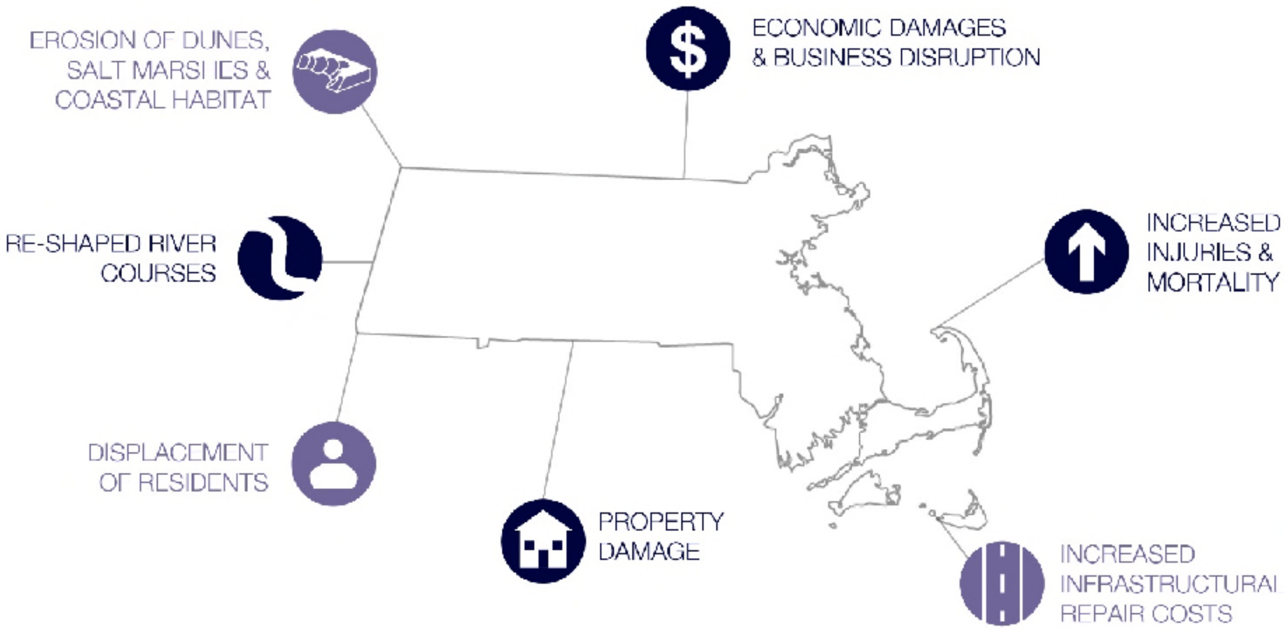


Figure 8: Potential Impacts of Extreme Storms
Source: Weston & Sampson based on EEA, 2018.

4.2.6 Hurricanes and Tropical Storms

Tropical cyclones (including tropical depressions, tropical storms, and hurricanes) form over the warm waters of the Atlantic, Caribbean, and Gulf of Mexico. A tropical storm is defined as having sustained winds from 39 to 73 mph. If sustained winds exceed 73 mph, it is categorized a hurricane. The Saffir-Simpson scale ranks hurricanes based on sustained wind speeds from Category 1 (74 to 95 mph) to Category 5 (156 mph or more). Category 3, 4, and 5 hurricanes are considered "Major" hurricanes. Wind gusts associated with hurricanes may exceed the sustained winds and cause more severe localized damage (EEA and EOPSS, 2018).

When hurricanes and tropical storms occur, they will impact the entire planning area. All existing and future buildings including critical facilities and populations are at risk to the hurricane and tropical storm hazard (including critical facilities). Hurricane events have a large spatial extent and would potentially affect all of Savoy's infrastructure and buildings. Impacts include water damage in buildings from building envelope failure, business interruption, loss of communications, and power failure. Flooding is a major concern as slow-moving hurricanes can discharge tremendous amounts of rain on an area.

The official hurricane season runs from June 1 to November 30. However, storms are more likely to occur in New England during August, September, and October (EEA and EOPSS, 2018). The Saffir/Simpson scale categorizes or rates hurricanes from 1 (minimal) to 5 (catastrophic) based on their intensity. This is used to provide an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on context (EEA and EOPSS, 2018). More information is included in Table 26.

Table 16. Saffir/Simpson Scale

Scale No. (Category)	Winds (mph)	Potential Damage
1	74 – 95	Minimal: damage is primarily to shrubbery and trees, mobile homes, and some signs. No real damage is done to structures.
2	96 – 110	Moderate: some trees topple, some roof coverings are damaged, and major damage is done to mobile homes.
3	111 – 130	Extensive: large trees topple, some structural damage is done to roofs, mobile homes are destroyed, and structural damage is done to small homes and utility buildings.
4	131 – 155	Extreme: extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail; and some curtain walls fail.
5	> 155	Catastrophic: roof damage is considerable and widespread, window and door damage are severe, there are extensive glass failures, and entire buildings could fail.

Source: EEA and EOPSS, 2018 based on information from NOAA

The region has been impacted by hurricanes throughout its history, starting with the Great Colonial Hurricane of 1635. Between 1851 and 2012, Massachusetts experienced 13 hurricanes and two named tropical storms. The most recent FEMA disaster declaration in Massachusetts due to a hurricane was Hurricane Sandy in 2012 (FEMA, 2018b). Hurricanes that have occurred in the region since 1938 are listed in Table 27. Four were Category 3 events.

Table 17. Hurricane Records for Eastern Massachusetts, 1938 to 2019

Hurricane Event	Date
Great New England Hurricane	September 21, 1938
Great Atlantic Hurricane	September 14-15, 1944
Hurricane Doug	September 11-12, 1950
Hurricane Carol	August 31, 1954
Hurricane Edna	September 11, 1954
Hurricane Diane	August 17-19, 1955
Hurricane Donna	September 12, 1960
Hurricane Gloria	September 27, 1985
Hurricane Bob	August 19, 1991
Hurricane Katrina	September 13, 2005
Hurricane Earl	September 4, 2010
Tropical Storm Irene	August 28, 2011
Hurricane Sandy	October 29-30, 2012
Hurricane Florence	September 18, 2018
Tropical Storm Dorian	September 7, 2019

Source: NOAA, 2020

Hurricane damage in Savoy was estimated using a hurricane modeling software called Hazus (meaning Hazards United States). Hazus Multi-Hazard (Hazus) is a GIS model developed by FEMA to estimate losses in a defined area due to a specified natural hazard. The Hazus hurricane model allows users to input specific parameters in order to model a defined hurricane magnitude, which is based on wind speed. The largest hurricane ever witnessed in Massachusetts was a Category 3 hurricane, which occurred in 1954. For the purpose of this analysis, in order to estimate potential damage, both a category 2 and a category 4 hurricane were modeled. Although there have been no recorded Category 4 hurricanes recorded in Massachusetts, this storm was modeled to show the impact that could occur from an extreme scenario, something that could possibly happen in the future due to climate change.

HAZUS models hurricanes are based upon their "return period" or repeat interval. In Massachusetts, the return period for a category 2 hurricane is approximately 0.01 percent, and for a category 4 hurricane it is approximately 0.005 percent. Therefore, a category 2 was modeled as a 100-year hurricane and a category 4 was modeled as a 500-year hurricane. In order to model each of these hurricanes, the study region must first be defined. Savoy is a small town consisting of one census tract and 742 buildings with an aggregate replacement value of $177 million. The probabilistic scenario was used for Savoy. This scenario considers the associated impact of thousands of storms that have a multitude of tracks and intensities. The output shows the potential impact that could occur in Savoy if either a category 2 or a category 4 hurricane passed through town. HAZUS is based on 2010 census data and 2014 dollars. The tables below show the estimated damage from both a category 2 and a category 4 hurricane in the municipality.

Table 18. Category 2 Hurricane Damage Potential

Land Use Type	Total # of Buildings	Total # of Buildings Damaged[1]	% of Buildings Damaged[1]	Total Value of Building Damage[2]
Residential	702	.14	.02	$ 137,980
Commercial	23	.06	.26	$ 890
Industrial	7	.02	.3	$ 140
Others	10	.02	.78	$ 520
TOTAL	742	.24	1.36	$ 139,530

[1]Numbers include Slight, Moderate, Extensive, and Total Damage
[2]Includes Building, Content, and Inventory

Table 19. Category 4 Hurricane Damage Potential

Land Use Type	Total # of Buildings	Total # of Buildings Damaged[1]	% of Buildings Damaged[1]	Total Value of Building Damage[2]
Residential	702	9.19	1.31	$ 936,740
Commercial	23	.28	1.14	$ 2,360
Industrial	7	.08	2.02	$ 390
Others	10	.08	3.34	$1,270
TOTAL	742	9.63	7.81	$940,760

[1]Numbers include Minor, Moderate, Severe, and Total Damage
[2]Includes Building, Content, and Inventory

In both category 2 and 4 hurricane scenarios, Hazus estimates that damage will occur to three essential facilities: the fire department and two schools. Damage is not expected in any of these facilities greater than 50% and expected loss of use for the Fire Station is one day, and two days for the schools. Because so much of Savoy is forested, we can expect that the Town will experience heavy debris after a hurricane. For the category 2 hurricane, Hazus estimates that the town will see 1,467 tons of debris from trees. A category 4 hurricane will generate 13,150 tons in tree debris. All other forms of debris for a category 4 storm were minor (and no non-tree debris is estimated for a category 2 hurricane).

Hurricanes are a townwide hazard in Savoy and are considered a medium frequency event. The average number of hurricane or tropical storm events is one every two years (EEA and EOPSS, 2018).

Figure 9: Hurricane Irene severely damaged Black Brook Road in the fall 2011.
Source: Weston & Sampson

4.2.7 Tornadoes

A tornado is violently rotating column of air that extends from the base of a cloud to the ground that can be a mile or more wide. Tornadoes are the most violent of all atmospheric storms (EEA and EOPSS, 2018). According to the 2018 SHMCAP, the following are common factors in tornado formation:

- Very strong winds in the middle and upper levels of the atmosphere
- Clockwise turning of the wind with height
- Increasing wind speed in the lowest 10,000 feet of the atmosphere (i.e. 20 mph at the surface and 50 mph at 7,000 feet)
- Very warm, moist air near the ground, with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

Tornadoes can be spawned by tropical cyclones or the remnants thereof, and weak tornadoes can even form from little more than a rain shower if air is converging and spinning upward. The most common months for tornadoes to occur are June, July, and August. There are exceptions: The Great Barrington, Massachusetts, tornado in 1995 occurred in May; and the Windsor Locks, Connecticut, tornado in 1979 occurred in October (EEA and EOPSS, 2018).

The Fujita Tornado Scale measures tornado severity through estimated wind speed and damage. The National Weather Service began using the Enhanced Fujita-scale (EF-scale) in 2007, which led to increasingly accurate estimates of tornado severity. Table 30 provides more detailed information on the EF Scale.

Table 20. Enhanced Fujita Scale

Fujita Scale			Derived		Operational EF Scale	
F Number	Fastest ¼ mile (mph)	3-second gust (mph)	EF Number	3-second gust (mph)	EF Number	3-second gust (mph)
0	40 – 72	45 – 78	0	65 – 85	0	65 – 85
1	73 – 112	79 – 117	1	86 – 109	1	86 – 110
2	113 – 157	118 – 161	2	110 – 137	2	111 – 135
3	158 – 207	162 – 209	3	138 – 167	3	136 – 165
4	208 – 260	210 – 261	4	168 – 199	4	166 – 200
5	261– 318	262 – 317	5	200 – 234	5	Over 200

Source: MEMA and DCR, 2013

Massachusetts averages 1.7 tornadoes per year, which is far fewer than most of the United States. The most tornado-prone areas of the state are the central counties. Tornadoes are comparatively rare in western Massachusetts, although Franklin County and the southern Berkshires are considered at-risk locations (EEA and EOPSS, 2018). The most devastating tornado in Massachusetts in the history of recorded weather occurred in Worcester in 1953, it killed 94 people, injured more than 1,000, and caused more than $52 million in damages (more than $460 million in current dollars). There have been 18 recorded tornados in Berkshire County since 1955. Over this period, a total of two fatalities and 60 injuries (NOAA NCEI) (Table 31). Some more recent tornadoes in Massachusetts occurred in 2011 in Springfield, 2014 in Revere, and 2016 in Concord (Morrison 2014; Epstein 2016). Monson also experienced a tornado in 2011 and Yarmouth and Barnstable experienced tornadoes in 2019.

Tornadoes present a townwide hazard and the damages would depend on the track of the tornado. However, tornado damage could be high due to the prevalence of older construction and the density of development. Structures built before current building codes may be more vulnerable. Evacuation, sheltering, debris clearance, distribution of food and other supplies, search and rescue, and emergency fire and medical services may be required. Critical evacuation and transportation routes may be impassable due to downed trees and debris, and recovery efforts may be complicated by power outages.

Tornados are difficult to simulate well in climate models because of their small size when compared to other weather events.

Table 21. Tornado Records for Berkshire County

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
7/12/1955	F2	0	0	33	0.5	$ -
9/7/1958	F0	0	0	67	2.3	$ 2,500
10/3/1963	F1	0	0	17	3	$ 2,500
3/1/1966	F2	0	0	33	0	$ 25,000
8/11/1966	F2	0	0	33	8	$ 25,000
6/18/1970	F1	0	0	440	18.7	$ 250,000
8/28/1973	F4	4	36	313	6.4	$ 25,000,000
7/13/1975	F2	0	0	27	0.3	$ 25,000
7/27/1978	F0	0	0	100	0.1	$ 250
7/11/1984	F1	0	0	50	0.5	$ 25,000
5/29/1995	F4	3	24	12	300	$ 250
7/3/1997	F1	0	0	75	1.3	$ 15,000
7/3/1997	F2	0	0	600	4.5	$ 1,500,000
7/3/1997	F2	0	0	600	3.7	$ 1,500,000
7/3/1997	F1	0	0	100	0.5	$ 50,000
8/20/2004	F0	0	0	150	1	$ 25,000
6/29/2005	F0	0	0	50	200	$ -
7/27/2014	EF1	0	0	20	0.25	$ -

Source: NOAA NCEI Storm Events Database

4.2.8 Nor'easters

A nor'easter is characterized by large counterclockwise wind circulation around a low-pressure center that often results in heavy snow, high winds, waves, and rain along the East Coast of North America. The term nor'easter refers to their strong northeasterly winds blowing in from the ocean. These weather events are among the season's most ferocious storms, often causing beach erosion, flooding, and structural damage (EEA and EOPSS, 2018).

Nor'easters generally occur in Savoy on at least an annual basis, typically in late fall and early winter. Some years bring four or more nor'easter events. The storm radius is often as much as 100 miles and sustained wind speeds of 20 to 40 mph are common, with short-term gusts of up to 50 to 60 mph. Nor'easters are commonly accompanied by a storm surge equal to or greater than two feet. High surge and winds during a hurricane can last from 6 to 12 hours, while these conditions during a nor'easter can last from 12 hours to three days (EEA and EOPSS, 2018). Previous nor'easters events are listed in Table 32.

Table 22. Nor'easter Events for Massachusetts, 1978 to 2019

Nor'easter Event	Date
Blizzard of 1978	February 1978
Severe Coastal Storm ("Perfect Storm")	October 1991
Great Nor'easter of 1992	December 1992
Blizzard, Nor'easter	January 2005
Coastal Storm, Nor'easter	October 2005
Severe Storms, Inland and Coastal Flooding	April 2007
Winter Storm and Nor'easter	January 2011
Severe Storm and Snowstorm	October 2011
Severe Winter Storm, Snowstorm, and Flooding	April 2013
Severe Winter Storm, Snowstorm, and Flooding	April 2015
Severe Winter Storm and Flooding	March 2018
Severe Winter Storm and Snowstorm	March 2018
Source: NOAA, 2018a	

Some of the historic events described in the "Flood-Related Hazards" section of this report were preceded by nor'easters, including the 1991 "Perfect Storm." The Blizzard of '78 was a notable storm. More recently, winter storms in 2015 and 2018 caused significant snowfall amounts.

The Town of Savoy is vulnerable to high winds, snow, and extreme rain during nor'easters. These impacts can lead to property damage, downed trees, power service disruptions, surcharged drainage systems, and localized flooding. These conditions can impact evacuation and transportation routes and complicate emergency response efforts. Due to its inland location, Savoy is not subject to the coastal hazards often associated with nor'easters.

4.2.9 Thunderstorms and Related Wind Events

Thunderstorms can include lightning, strong winds, heavy rain, hail, and sometimes tornados. Thunderstorms typically last for about 30 minutes and can generate winds of up to 60 mph. Thunderstorms are considered high frequency events in Savoy. Massachusetts experiences 20-30 thunderstorm days per year. Thunderstorms with little or no rainfall are rare in New England but have occurred (EEA and EOPSS, 2018).

Thunderstorms are typically less severe than other events discussed in this section. However, thunderstorms can cause local damage and are a townwide risk in Savoy. Winds associated with thunderstorms can knock down trees resulting in power outages and blocked evacuation and transportation routes. Extreme rain during thunderstorms can cause inland flooding around waterbodies or due to surcharged drainage systems. During periods of drought, lightning from thunderstorm cells can result in fire ignition.

NOAA's National Centers for Environmental Information offers thunderstorm data for Berkshire County, which includes Savoy. Between 2008 and 2018, 77 thunderstorm events caused $12,000 in property damages. Four injuries and one death were reported. The severe thunderstorm on July 18, 2016 toppled a tree in Savoy, blocking Main Road. Wind gusts reached 50 mph. Winds associated with thunderstorms can knock down trees resulting in power outages and blocked evacuation and transportation routes. Extreme rain during thunderstorms can cause inland flooding around waterbodies or due to surcharged drainage systems. Thunderstorms are considered high frequency events in Savoy.

Severe storms are declared disasters when heavy rainfall and flooding, create widespread damage. Massachusetts has experienced six federal and state disasters since 1963 because of severe storms (see Table 33, below), although none of these storms have occurred in Berkshire County.

Table 23. Previous Federal and State Disaster Declarations for Severe Storms

Disaster Name and Date of Event	Type of FEMA Assistance	Counties Under Declaration
Severe Storms/Flooding October 20-25, 1996	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
Heavy Rain and Flooding June 13-July 6, 1998	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Severe Storms & Flooding March 5-April 16, 2001	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Severe Storms and Flooding October 7-16, 2005	Public Assistance; Individual & Households Program; Hazard Mitigation Grant Program	All 14 Massachusetts Counties
Severe Storms and Flooding May 12-23, 2006	Public Assistance; Individual & Households Program; Hazard Mitigation Grant Program	Middlesex, Essex, Suffolk
Severe Storm and Flooding March 12-April 26, 2010	Public Assistance; Individual & Households Program; Hazard Mitigation Grant Program	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester

4.2.10 Climate Change Impacts: Wind-Related Hazards

Savoy's current 100-year wind speed is 110 mph. Climate change will likely increase the number of extreme wind events and their severity. Additionally, rising sea temperature could lengthen the hurricane season and fuel stronger hurricane events. Hurricanes have increased in intensity, frequency, and duration have since the early 1980s (Walsh and Wuebbles, 2014) This trend will result in greater losses due to increased flooding, associated building damages and business interruption impacts (Walsh and Wuebbles, 2014). The anticipated increase in frequency and intensity of severe thunderstorms may also increase the risk of tornadoes (EEA and EOPSS, 2018).

4.3 Winter Storms

Figure 10. MA DOT Snow Removal on Chapel Road, 2010.
Source: Wikimedia Commons.

Winter storm events are atmospheric in nature and can impact the entire planning area. All current and future buildings and populations are considered to be at risk of winter storms, which have a variety of potential impacts. Heavy snow loads may cause roofs and trees to collapse leading to structural damage. Deaths and injury are also possible impacts. Additional impacts can include road closures, power outages, business interruption, business losses (i.e., due to road closures), hazardous driving conditions, frozen pipes, fires due to improper heating, and second-hand health impacts caused by shoveling (such as a heart attack). Public safety issues are also a concern, as streets and sidewalks can become difficult to pass. This issue may be especially difficult for vulnerable populations such as elderly people who may have trouble crossing at intersections due to large accumulations of snow. Impassable streets can also complicate emergency response efforts during an extreme event.

Winter storms are a potential townwide hazard in Savoy. These events can include wind, heavy snow, blizzards, and ice storms. Blizzards and ice storms in Massachusetts can range from mere inconveniences to extreme events that cause significant impacts and require a large-scale, coordinated response. There have been six federal and state disaster declarations since 1996 in Berkshire County, four of which were due to snow (Table 34).

Table 24. Previous Federal and State Disaster Declarations for Winter Storms

Disaster Name and Date of Event	Type of FEMA Assistance	Counties Under Declaration
Severe Winter Storm and Flooding December 11-18, 2008	Public Assistance; Hazard Mitigation Grant Program	All 14 Massachusetts Counties
Severe Winter Storm and Snowstorm January 11-12, 2011	Public Assistance; Hazard Mitigation Grant Program	Berkshire, Essex, Hampden, Hampshire, Middlesex, Norfolk, Suffolk
Severe Storm and Snowstorm October 29-30, 2011	Public Assistance; Public Assistance Snow Removal; Hazard Mitigation Grant Program	Berkshire, Franklin, Hampden, Hampshire, Middlesex, Worcester

Table 24. Previous Federal and State Disaster Declarations for Winter Storms

Disaster Name and Date of Event	Type of FEMA Assistance	Counties Under Declaration
Severe Winter Storm, Snowstorm, and Flooding February 8-9, 2013	Public Assistance; Hazard Mitigation Grant Program	All 14 Massachusetts Counties

Source: FEMA, 2018b

4.3.1 Heavy Snow and Blizzards

Figure 11. Downed tree from the 2008 Ice Storm
Source: Wikimedia

A blizzard is a winter snowstorm with sustained wind or frequent wind gusts of 35 mph or more, accompanied by falling or blowing snow that reduces visibility to or below a quarter of a mile. These conditions must be the predominant condition over a 3-hour period. Extremely cold temperatures are often associated with blizzard conditions but are not a formal part of the criteria. However, the hazard created by the combination of snow, wind, and low visibility increases significantly with temperatures below 20°F. A severe blizzard is categorized as having temperatures near or below 10°F, winds exceeding 45 mph, and visibility reduced by snow to nea zero (EEA and EOPSS, 2018).

Winter storms include multiple risks, such as wind, ice, and heavy snow. The National Weather Service defines "heavy snow" as snowfall accumulating to 4" or more in 12 hours or less; or snowfall accumulating to 6" or more in 24 hours or less (NOAA, 2019b). Winter storms can be combined with the nor'easters discussed previously in the "Wind-Related Hazards" section.

There is no widely used scale to classify snowstorms. 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, as shown in Table 35. 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. This scale was developed because of the impact northeast snowstorms can have on the rest of the country in terms of transportation and economics. 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 1 for smaller storms to over 10 for extreme storms. The raw score is 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. NOAA began using the NESIS in 2005 to determine impact from snow events (MEMA and DCR, 2013).

Table 25. NESIS Categories

Category	NESIS	Value Description
1	1 – 2.499	Notable
2	2.5 – 3.99	Significant
3	4 – 5.99	Major
4	6 – 9.99	Crippling
5	10+	Extreme

Source: EEA and EOPSS, 2018

The current winter snowfall record in Western Massachusetts is 108.6 inches during the 2014-2015 season ((NOAA, 2015). The Town of Savoy provides standard snow plowing operations and clearing snow has not posed any significant challenges. The "Blizzard of 1978" is a well-known winter storm that deposited more than three feet of snow and led to multiday closures of roads, businesses, and schools. Table 36 provides additional information on significant snow events.

Table 26. Severe Winter Storm Records for Massachusetts

Type of Event	Date
Blizzard	February 1978
Blizzard	March 1993
Blizzard	January 1996
Severe Snowstorm	March 2001
Severe Snowstorm	December 2003
Severe Snowstorm	January 2004
Severe Snowstorm	January 2005
Severe Snowstorm	April 2007
Severe Snowstorm	December 2010
Severe Snowstorm	January 2011
Blizzard	February 2013
Blizzard	January 2015
Severe Snowstorm	March 2018

Source: NOAA, 2019a

NOAA's National Centers for Environmental Information Storm Events Database provide information for blizzards, winter weather, heavy snow, and winter storms. There were 140 winter weather and storm events between 2000 and 2020 in Berkshire County totaling $10,000 dollars of damage. Most of the electric customers (99%) were out of electricity during a snowstorm in October 2011 (NMCOG, 2015). Earlier that same year (in January), Savoy experienced 40 inches of snowfall in a single storm (NOAA, 2020).

Blizzards are classified as high frequency events in Savoy. As defined by the *2013 Massachusetts State Hazard Mitigation Plan*, this hazard can occur more than once in five years (a greater than 20% chance of occurring each year). High-impact snowstorms occur more frequently at approximately the rate of once per year (EEA and EOPSS, 2018).

4.3.2 Ice Storms

Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects creating ice build-ups of ¼ inch or more that can cause severe damage. An ice storm warning, now included in the criterion for a winter storm warning, is for severe icing. This is issued when ½ inch or more of accretion of freezing rain is expected. This may lead to dangerous walking or driving conditions and the weighing down of power lines and trees. Icy roads can also complicate emergency response efforts during an extreme event. Ice storms are classified as medium frequency events in Savoy. Ice storms impact the Commonwealth on at least an annual basis.

Sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. Sleet differs from hail: sleet is a wintertime phenomenon, while hail usually falls during thunderstorms in the spring and summer (EEA and EOPSS, 2018).

NOAA's National Centers for Environmental Information Storm Events Database offers data on hail events, ice storms, and sleet in Berkshire County. There were 55 hail events, three ice storms, and no reported sleet hazards between 2000 and 2019. No deaths or injuries were reported. Over $6.2 million dollars in damages were incurred.

4.3.3 Climate Change Impacts: Winter Storms

Evidence suggests that nor'easters along the Atlantic coast are increasing in frequency and intensity. Future nor'easters may become more concentrated during the coldest winter months when atmospheric temperatures are still low enough to result in snowfall rather than rain (EEA and EOPSS, 2018). Climate projections indicate that climate change will result in more precipitation during the winter in the Northeast (EEA, 2018a). This trend may result in more frequent and/or more severe winter storms.

4.4 Geological Hazards

Geologic hazards can include earthquakes, landslides, sinkholes, and subsidence. town officials did not identify any local areas that were previously recorded as being vulnerable to geologic hazards.

4.4.1 Earthquakes

An earthquake is the vibration, sometimes violent, of the earth's surface that follows a release of energy in the Earth's crust due to fault fracture and movement. The magnitude or extent of an earthquake is a seismograph-measured value of the amplitude of the seismic waves. The Richter magnitude scale (Richter scale) was developed in 1932 as a mathematical device to compare the size of earthquakes. The Richter scale is the most widely known scale that measures earthquake magnitude. It has no upper limit and is not a direct indication of damage. An earthquake in a densely populated area, which results in many deaths and considerable damage, can have the same magnitude as an earthquake in a remote area that causes no damage. Table 37 summarizes Richter scale magnitudes and corresponding earthquake effects (EEA and EOPSS, 2018).

Table 27. Richter Scale and Effects

Richter Magnitudes	Earthquake Effects
Less than 3.5	Generally, not felt, but recorded
3.5- 5.4	Often felt, but rarely causes damage
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.

Table 27. Richter Scale and Effects

Richter Magnitudes	Earthquake Effects
6.1-6.9	Can be destructive in areas up to about 100 km across where people live.
7.0- 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred meters across.

Louie, 1996

Earthquakes occur in New England, albeit infrequently as compared to other parts of the country. The first recorded earthquake was noted by the Plymouth Pilgrims and other early settlers in 1638. Of the over 5,000 earthquakes recorded in the Northeast Earthquake Catalog through 2008, 1,530 occurred within the boundaries of the six New England States, with 366 earthquakes recorded for Massachusetts between 1627 and 2008. The probability of a magnitude 5.0 or greater earthquake centered in New England is about 10-15% in a 10-year period (EEA and EOPSS, 2018). A summary of historic earthquakes in the Boston area is included in Table 38.

Table 28. Historical Earthquakes in Boston or Surrounding Area, 1727-2012

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA - Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA - Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA - Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA - Brewster	8/8/1847	4.2
MA - Boxford	5/12/1880	NA
MA - Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4

Location	Date	Magnitude
MA - Nantucket	10/25/1965	NA
MA - Boston	12/27/1974	2.3
VA - Mineral	8/23/2011	5.8
MA - Nantucket	4/12/2012	4.5
ME - Hollis	10/17/2012	4.0
MA – Newburyport	2/20/2013	2.3
NH – Contoocook	10/11/2013	2.6
MA – Freetown	1/9/2014	2.0
MA – Bliss Corner	2/11/2014	2.2
MA – off Northshore	8/18/2014	2.0
CT - Deep River Center	8/14/2014	2.7
CT – Wauregan	1/12/2015	3.3
CT – Wauregan	1/13/2015	2.6
RI – Newport	2/3/2015	2.0
NH – Epsom	8/2/2015	2.2
NH – Contoocook	3/21/2016	2.8
MA – Rockport Coast	6/1/2016	2.2
NH – Bedford	2/11/2017	2.2
NH – East Kingston	2/15/2018	2.7
ME – Cape Neddick	7/16/2018	2.1
MA – Nantucket	8/18/2018	2.4
MA – Templeton	12/21/2018	2.1
MA – Gardner	12/23/2018	2.2
RI – Charlestown	3/1/2019	2.3
MA – Rockport	4/27/2019	2.1
MA – North Plymouth	12/3/2019	2.1

Source: USGS, 2020

Ground shaking or ground motion is the primary cause of earthquake damage to manmade structures. Ground motion from earthquakes is amplified by soft soils and reduced by hard rock. Ground motion.is measured by maximum peak horizontal acceleration expressed as a percentage of gravity (%g). Peak ground acceleration in the state ranges from 10 %g to 20 %g, with a 2% probability of exceedance in 50 years (Figure 18). Savoy is located in an area with a PGA of 10%g with a 2% probability of exceedance in 50 years as shown in Figure 18. This is the lowest zone in the state: in other words, a low area of earthquake risk. Compared to the rest of the United States, Massachusetts overall has a low risk of earthquakes.

A serious earthquake in Massachusetts is possible, however. These events can strike without warning and can have a devastating impact on infrastructure and buildings constructed prior to earthquake resistant design considerations. No earthquake epicenters have been recorded within Savoy. Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the town pre-dates the current building code. If an earthquake occurs, the entire region, not just the town, would face significant challenges since earthquakes often trigger fires and can damage transportation and utility infrastructure.

All existing and future buildings and populations are at risk to an earthquake hazard. Impacts from earthquakes can be from slight to moderate building damage, to catastrophic damage and fatalities, depending on the severity of the earthquake event. Events may cause minor damage such as cracked plaster and chimneys, or broken windows, or major damage resulting in building collapse. Based on the 2018 *Massachusetts State Hazard Mitigation and Climate Adaptation Plan* (EEA and EOPSS), the degree of exposure depends on many factors, including the building's age, construction type, soil type under the structures, and the proximity to the fault location. Furthermore, the time of day exposes different sectors of the community to the hazard. Earthquakes can lead to business interruptions, loss of utilities and road closures which may isolate populations. People who reside or work in unreinforced masonry buildings are vulnerable to liquefaction. (Liquefaction is the phenomenon that occurs when the strength and stiffness of a soil is reduced by earthquake).

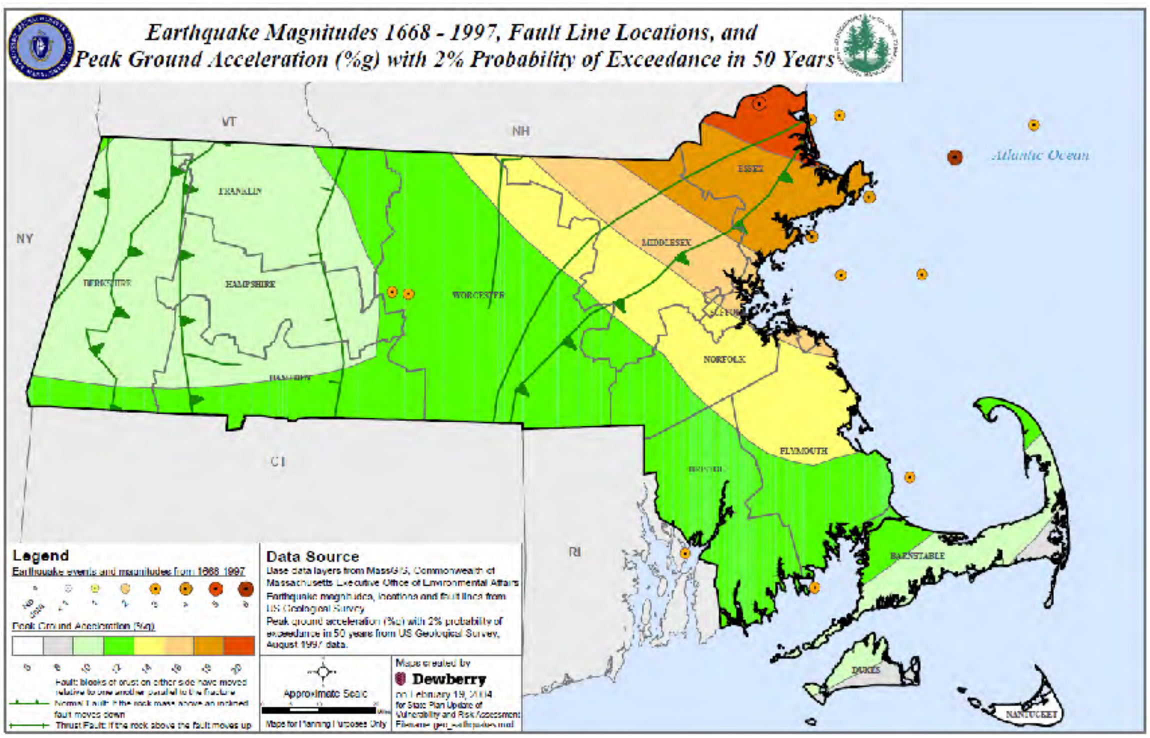


Figure 12. State of Massachusetts Earthquake Probability Map

Source: EEA and EOPSS, 2018

Potential earthquake damage was modeled for Savoy. Hazus Multi-Hazard (Hazus) is a GIS model developed by FEMA to estimate losses in a defined area due to a specified natural hazard (it is used for hurricanes in this report as well). The Hazus earthquake model allows users to input specific parameters in order to model a defined earthquake magnitude, with the epicenter located at the center of the municipality. In this analysis, two earthquakes were modeled: a magnitude 5.0 and a magnitude 7.0 earthquake. While large earthquakes are rare in Massachusetts, there was a magnitude 5.0 earthquake recorded in 1963. There is a possibility for larger scale earthquakes to occur in Massachusetts at some point, therefore a magnitude 7.0 earthquake was modeled as well to demonstrate the damage that could occur.

In order to model each of these earthquakes, the study region must first be defined. Savoy is comprised of one census tract and 741 buildings. The arbitrary event scenario was used, which allows the user to input the magnitude, depth, with, and epicenter of the earthquake. This must be done for each earthquake magnitude chosen. The output shows the potential impact that could occur in Savoy if either a magnitude 5.0 or a magnitude 7.0 earthquake occurred with the epicenter located in the center of the Town. HAZUS is based on 2010 census data and 2014 dollars. The tables below show the estimated damage from both a magnitude 5.0 and a magnitude 7.0 earthquake in the municipality.

Table 29. Magnitude 5.0 Earthquake Damage

Land Use Type	Total # of Buildings	# of Buildings Damaged	% of Buildings Damaged[1]
Residential	702	347	47%
Commercial	23	19	2.6%
Industrial	7	7	.9
Others	10	5	.7%
TOTAL	742	385	52%

[1]Numbers include Slight, Moderate, Extensive, and Total Damage
[2]Includes Building, Content, and Inventory

Table 30. Magnitude 7.0 Earthquake Damage

Land Use Type	Total # of Buildings	# of Buildings Damaged	% of Buildings Damaged[1]
Residential	702	698	94 %
Commercial	23	23	3.1%
Industrial	7	7	.9%
Others	10	8	1%
TOTAL	742	738	99%

[1]Numbers include Slight, Moderate, Extensive, and Total Damage
[2]Includes Building, Content, and Inventory

As the tables indicate, with a 5-7 Magnitude earthquake in Savoy, at least 171 buildings (52%) would experience some damage. In addition to the infrastructural damage, HAZUS also calculated the potential social impact of a magnitude 5.0 and magnitude 7.0 earthquake on the community. This is shown as monetary value of business interruption loss of wages, capital related loss, rental and relocation costs. It also estimates displaced households, persons seeking temporary public shelter, and casualties. The full HAZUS earthquake global risk report can be found in the Appendix C.

Earthquakes are classified as a low-frequency event in Savoy. As defined by the *2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan*, the probability of a magnitude 5.0 or greater earthquake centered in New England is about 10-15% in a 10-year period.

Wood frame construction makes up 81% of Savoy's building inventory.

4.4.2 Landslides

Landslides include 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. These contributing factors can include erosion by rivers, rock and soil slopes weakened through saturation by snowmelt or heavy rains, earthquake-created stresses that make weak slopes fail, excess weight from accumulation of rain or snow, and stockpiling of rock or ore from waste piles or man-made structures (USGS, 2019).

Figure 13. View of landslide in Savoy from Hurricane Irene.
Source: Massachusetts Geological Survey.

Landslides occur throughout the United States, causing an estimated $1 billion in damages and 25-50 deaths each year. Any area composed of very weak or fractured materials resting on a steep slope will likely experience landslides. Although the physical cause of many landslides cannot be removed, geologic investigations, good engineering practices, and effective enforcement of land-use management regulations can reduce landslide hazards (USGS, 2019). Landslides can damage buildings and infrastructure and cause sedimentation of water bodies. Landslide intensity can be measured in terms of destructiveness, as demonstrated by Table 41.

Table 31. Landslide Volume and Velocity

Estimate Volume (m^3)	Expected Landslide Velocity		
	Fast moving (rock fall)	Rapid moving (debris flow)	Slow moving (slide)
<0.001	Slight intensity	--	--
<0.5	Medium intensity	--	--
>0.5	High intensity	---	--
<500	High intensity	Slight intensity	--
500-10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,000	--	Very high intensity	High intensity
>>500,000	--	--	Very high intensity

Cardinali et al., 2002

While landslides occur with moderate frequency throughout Berkshire County, no *significant* landslides have been recorded (Berkshire County HMP, 2012). Rather, local officials indicate that there are occasionally localized issues of erosion during construction, as a result of development, or as a result of clearing vegetation. Landslides are classified as low frequency events in Savoy. These events can occur once in 50 to 100 years (i.e., 1% to 2% chance of occurring each year).

4.5 Fire-Related Hazards

Fire risk is influenced by type of fuel, terrain, and weather. Strong winds can exacerbate extreme fire conditions, especially wind events that persist for long periods, or ones with significant sustained wind speeds that quickly promote fire spread through the movement of embers or exposure within tree crowns. Fires can spread quickly into developed areas.

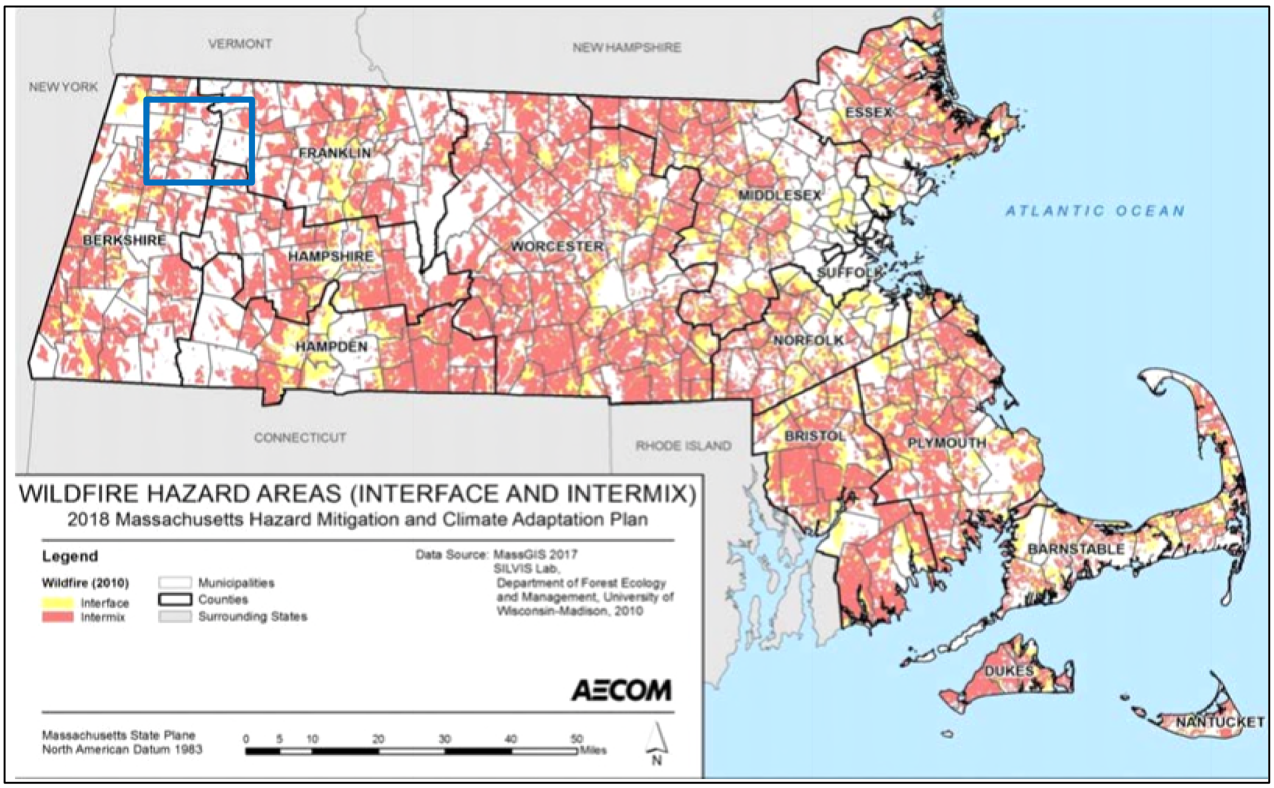


Figure 14. Interface and Intermix Areas

Source: MA EOEEA and EOPSS, 2018

Savoy is more susceptible to brushfire compared to a wildfire (or fire with a larger impact area). Brushfires and wildfires occur in the vegetative wildland, including grass, shrub, leaf litter, and forested-tree fuels. Fires can be caused by natural events or human activity, which then can spread quickly, igniting brush, trees, and homes (MEMA and DCR, 2013). The State Hazard Mitigation and Climate Adaptation Plan (EEA and EOPPS, 2018) states:

> *The ecosystems that are most susceptible to the wildfire hazard are pitch pine, scrub oak, and oak forests, as these areas contain the most flammable vegetative fuels. Other portions of the Commonwealth are also susceptible to wildfire, particularly at the urban-*

> *wildland interface…. Intermix communities are those where housing and vegetation intermingle and where the area includes more than 50 percent vegetation and has a housing density greater than one house per 16 hectares (approximately 6.5 acres). Interface communities are defined as those in the vicinity of contiguous vegetation, with more than one house per 40 acres and less than 50 percent vegetation, and within 1.5 miles of an area of more than 500 hectares (approximately 202 acres) that is more than 75 percent vegetated.*

The Massachusetts Hazard Mitigation and Climate Adaptation Plan presents summarizes wildfire and brushfire data in its Risk Assessment (4-177). Savoy, which includes some intermix areas near the southern border, is considered a low risk area (as is most of Berkshire County). Because of the high percentage of forested terrain in Savoy, however, drought conditions can increase the likelihood of wildfires and brushfires. Causes of these fires are due to human carelessness, such as discarded cigarettes or unattended campfires. Approximately 84% of brushfires are caused by humans (Balch et al., 2017). Lightning can also be a culprit, igniting a fire when striking dry tinder on the forest floor.

Brush fires can lead to property damage and even death. Individuals whose homes or workplaces are located in brushfire hazard zones are more vulnerable to this hazard. The most vulnerable members of this population are those who would be unable to evacuate quickly, including those over the age of 65, households with young children under the age of 5, people with mobility limitations, and people with low socioeconomic status (EEA and EOPSS, 2018). Secondary effects from brushfire include contamination of waterways; destroyed power, gas, water, and broadband lines. Brush fires can also contribute to flooding as they strip slopes of vegetation, thereby exposing them to greater amounts of runoff which may cause soil erosion and ultimately the chance of flooding. Additionally, subsequent rains can worsen erosion because brushfires burn ground vegetation and ground cover.

4.6 Extreme Temperatures

Extreme temperatures are considered a townwide hazard in Savoy. These events can include both temperatures over and under seasonal averages.

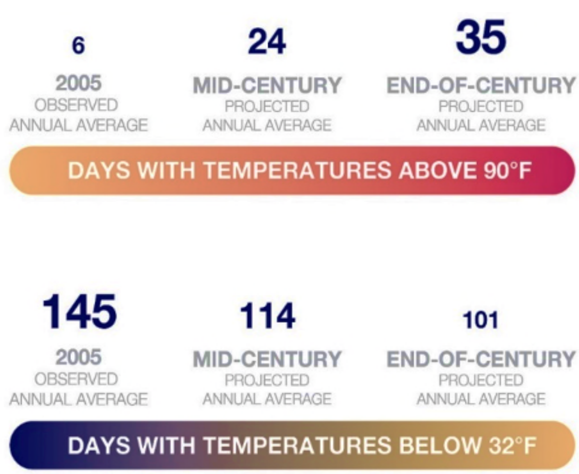


Figure 15. Anticipated Temperature Changes
Source: Weston & Sampson based on EEA, 2018

4.6.1 Extreme Cold

Extremely cold temperatures are measured using the Wind Chill Temperature Index provided by the National Weather Service (NWS). The updated index was implemented in 2001 and helps explain the impact of cold temperatures on unexposed skin. Figure 16, below, provides more information.

Extremely cold temperatures can create dangerous conditions for homeless populations, stranded travelers, and residents without sufficient insulation or heat. The homeless, the elderly, and people with disabilities are often most vulnerable. In Savoy, 21% of the population is over 65 years old and 12% percent of the population has a disability (US Census, 2019). Cold weather events can also have significant health impacts such as frostbite and hypothermia. Furthermore, power outages during cold weather may result in inappropriate use of combustion heaters, cooking appliances, and generators in poorly ventilated areas which can lead to increased risk of carbon monoxide poisoning. NOAA's National Centers for Environmental Information Storm Events Database provides data for extreme cold events. Between 2000 and 2020, Berkshire County experienced 25 extreme cold and wind chill events, which caused no deaths, injuries, or property damage.

Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes / 10 minutes / 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

Figure 16. Windchill Temperature Index and Frostbite Risk

Source: National Weather Service

4.6.2 Extreme Heat

Increased temperatures will impact all locations within Savoy. According to the Centers for Disease Control and Prevention, the populations most vulnerable to extreme heat impacts include the following:

- People over the age of 65 (e.g., with limited mobility),
- Children under the age of five,
- Individuals with pre-existing medical conditions that impair heat tolerance,
- Low-income individuals who cannot afford proper cooling,
- Individuals with respiratory conditions,
- The general public who may overexert themselves during extreme heat events.

The NWS issues a Heat Advisory when the Heat Index (Figure 23) is forecast to reach 100-104˚ F for two or more hours (https://www.weather.gov/bgm/heat). The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105˚+F for two or more hours. Heat waves cause more fatalities in the U.S. than the total of all other meteorological events combined. In Boston, over 50 people die each year due to heat-related illnesses. From 1979-2016, excessive heat exposure caused in excess of 9,000 deaths in the United States (EEA and EOPSS, 2018). During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

Based on Figure 18, compiled by the Massachusetts Department of Public Health Bureau of Environmental Health (MA DPH 2019), there is at least one population vulnerability measure in each Census Tract (2010). The population vulnerability measures include low income, minimal English proficiency, people of color, and elderly. Savoy has a population density of 19 people per square mile.

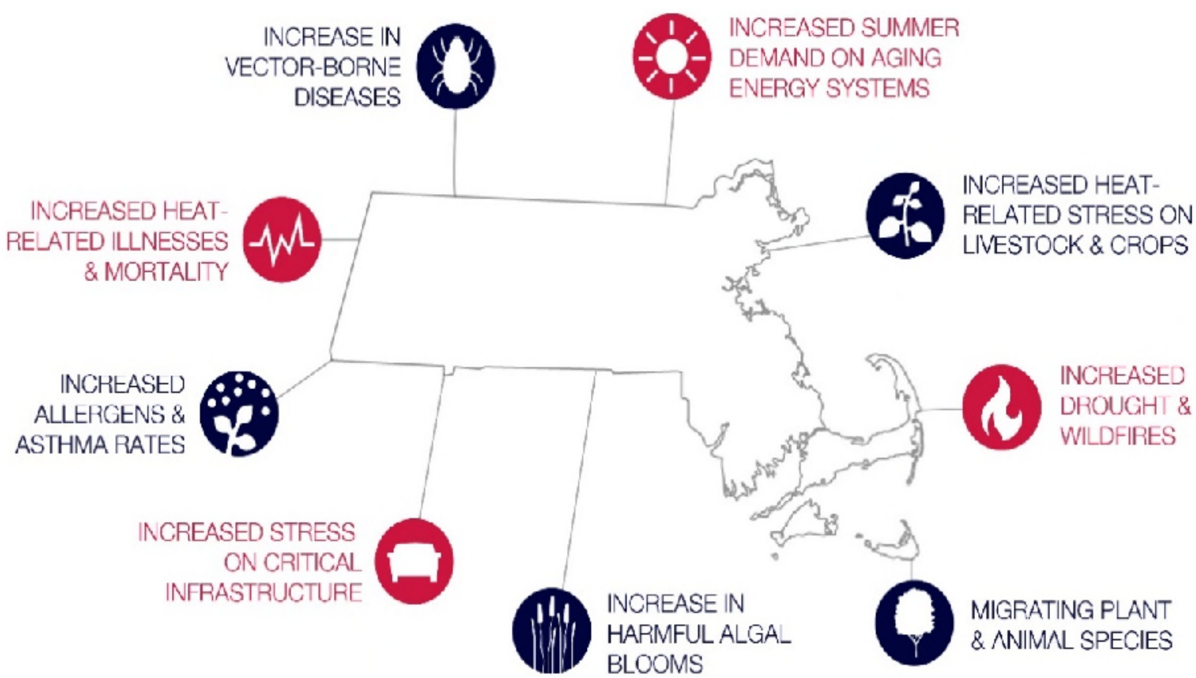


Figure 17. Potential Impacts from Increasing Temperatures
Source: Weston & Sampson based on EEA, 2018

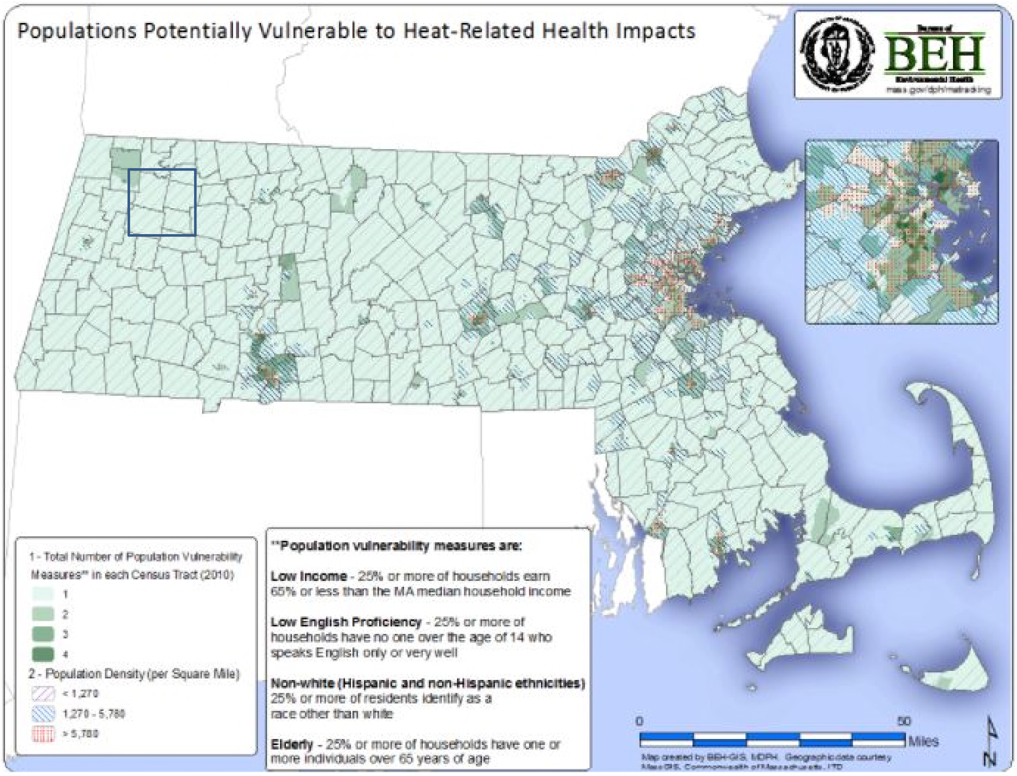


Figure 18. Populations Potentially Vulnerable to Heat Related Health Impacts

Source: Massachusetts Department of Public Health, Bureau of Environmental Health, 2019

Relative Humidity (%)	Temperature (°F) 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.

Figure 19. Heat Index Chart

Source: NOAA, n.d.

Because most heat-related deaths occur during the summer, people should be aware of who is at greatest risk and what actions can be taken to prevent a heat-related illness or death. The populations at greater risk are the elderly, children, and people with certain medical conditions, such as heart disease. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Some behaviors also put people at greater risk drinking alcohol, taking part in strenuous outdoor physical activities in hot weather, and taking medications that impair the body's ability to regulate its temperature or that inhibit perspiration (EEA and EOPSS, 2018).

Increased temperatures can lead to a longer growing season, which in turn leads to a longer pollen season. Warmer weather can also support the migration of invasive species and lead to an increase in vector-borne diseases. Increasing temperatures can also worsen air pollution, which can lead to negative health impacts such as respiratory problems.

Extreme temperatures are classified as medium frequency events. According to the *2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan* (EEA and EOPSS, 2018), between four and five heat waves (3 or more consecutive days of 90˚F+ temperatures) occur annually in Massachusetts. The Town of Savoy does not collect data on heat occurrences. The best available local data are for Berkshire County, through the National Environmental Information Center. NOAA's National Centers for Environmental Information Storm Events Database provides data on excessive heat. Between 1998 and 2020, Berkshire County experienced two extreme heat days, which did not result in injury or property damage.

4.6.3 1.1.1 Climate Change Impacts: Extreme Temperatures

Between 1961 and 1990, Boston experienced an average of one day per year in excess of 100°F. That could increase to six days per year by 2070, and 24 days per year by 2099. Under these conditions by the end of the century, Massachusetts's climate would more closely resemble that of Maryland or the Carolinas (Figure 25). These changes in temperature would also have a detrimental impact on air quality and public health concerns including asthma and other respiratory conditions (Frumhoff et al., 2007). Savoy has not experienced temperatures over 100°F, but it has seen high heat days in the mid-upper 90s.

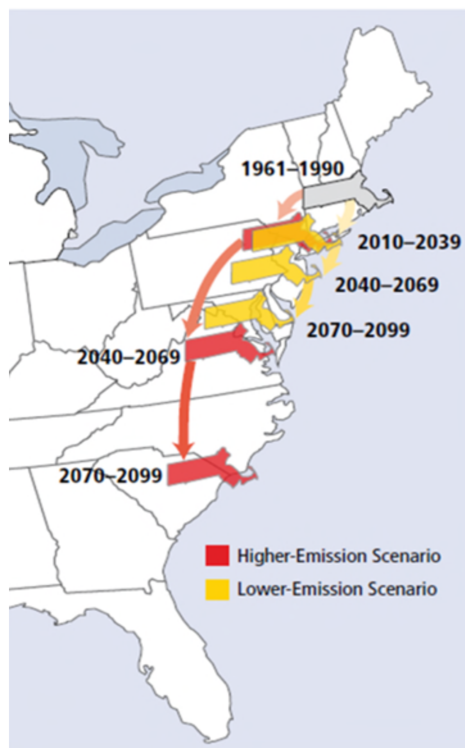


Figure 20. Massachusetts Extreme Heat Scenarios
Source: Frumhoff et al., 2007

4.7 Drought

Drought is an extended period of deficient precipitation. Drought conditions occur in virtually all climatic zones, yet its characteristics vary significantly from one region to another since it is relative to the normal precipitation in that region. Agriculture, the water supply, aquatic ecosystems, wildlife, and the economy are vulnerable to the impacts of drought (EEA and EOPSS, 2018).

Average annual precipitation in Boston is 53.32 inches per year, with approximately two to five-inch average amounts for each month of the year (NOAA, 2019c). Although Massachusetts is relatively small, it has a number of distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive. In accordance with the Massachusetts Drought Management Plan (Massachusetts Water Resource Commission, 2019), the Drought Management Task Force will make recommendations to the Secretary of Energy & Environmental Affairs about the location and severity of drought in the Commonwealth. The Drought Management Plan divides the state into six regions: Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape and islands. Savoy is located within the Western region (EEA and EOPSS, 2018).

Five levels of drought have been developed to characterize drought severity: Normal, Advisory, Watch, Warning, and Emergency; these correspond to Level 0 – Normal, Level 1 - Mild Drought, Level 2 - Significant Drought, Level 3 - Critical Drought (was Warning), and Level 4 – Emergency Drought (was Emergency), respectively, of the Drought Management Plan update. The drought levels are based on the severity of drought conditions and their impacts on natural resources and public water supplies.

The Drought Management Plan specifies the agency response and interagency coordination and communication corresponding to the various drought levels. During normal conditions, data are routinely collected and distributed. There is heightened vigilance with additional data collection during an advisory, and increased assessment and proactive education during a watch. Water restrictions might be appropriate at the watch or warning stage, depending on the capacity of each individual water supply system. A warning level indicates a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is one in which use of emergency supplies become necessary or in which the Governor may exercise his authority to require mandatory water restrictions or (EEA and EOPSS, 2018).

A variety of drought indices are available to assess the various impacts of dry conditions. The Commonwealth uses a multi-index system to determine the severity of a drought or extended period of dry conditions. A determination of drought level is based on seven indices: Standardized Precipitation Index, Precipitation (percent of normal), Crop Moisture Index, Keetch-Byram Drought Index (KBDI), Groundwater levels, Stream flow levels, and Index Reservoir levels.

Drought level is determined monthly based on the number of indices which have reached a given drought level. A majority of the indices would need to be triggered in a region in order for a drought designation to move to a more severe level. Drought levels are declared on a regional basis for each of the six regions in Massachusetts. Drought levels may also be made county by county or be watershed specific. The end of a drought is determined by precipitation and groundwater levels since these have the greatest long-term impact on streamflow, water supply, reservoir levels, soil moisture and potential for forest fires (EEA and EOPSS, 2018). Figure 20 illustrates weeks of extreme drought between 2001 and 2017. Table 42 summarizes all recorded droughts in Massachusetts's history between 1879 and 2017.

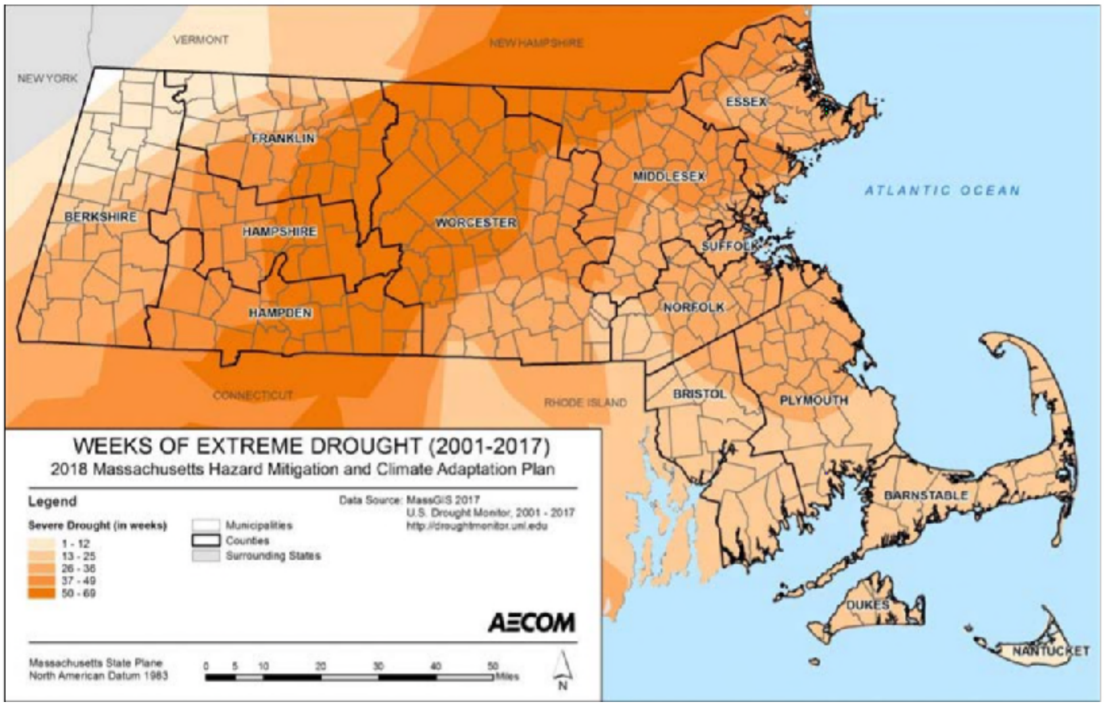


Figure 21. Weeks of Severe Drought (2001 - 2017)
Source: EEA and EOPSS, 2018

Massachusetts has five drought emergencies on record: 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought is considered the most severe Massachusetts drought in modern times, given its length. On a monthly basis over the 162-year period of record, there is a one percent chance of being in a Drought Emergency (EEA and EOPSS, 2018).

Table 32. Droughts in Massachusetts Based on Instrumental Records

Date	Area Affected	Recurrence Interval (yrs)	Remarks
1879 to 1883	–	–	–
1908 to 1912	–	–	–
1929 to 1932	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.
1939 to 1944	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.
1957 to 1959	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.

Table 32. Droughts in Massachusetts Based on Instrumental Records

Date	Area Affected	Recurrence Interval (yrs)	Remarks
1961 to 1969	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.
1980 to 1983	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.
1985 to 1988	Housatonic River Basin	25	Duration and severity unknown. Streamflow showed mixed trends elsewhere.
1995	–	–	Based on statewide average precipitation.
1998 to 1999	–	–	Based on statewide average precipitation.
2001 to 2003	Statewide	–	Level 2 drought (out of 4 levels) was reached statewide for several months.
2007 to 2008	Statewide except West and Cape and Islands regions	–	Level 1 drought (out of 4 levels)
2010	Connecticut River Valley, Central and Northeast regions	–	Level 1 drought (out of 4 levels)
2014	Southeast and Cape and Islands regions	–	Level 1 drought (out of 4 levels)
2016 to 2017	Statewide	–	Level 3 drought (out of 4 levels).

Source: EEA and EOPSS, 2018

Drought Warning levels not associated with Drought Emergencies would have occurred in 1894, 1915, 1930,1985, 2016, and 2017. On a monthly basis over the 162-year period of record, there is a 2% chance of being in a drought Warning level (DCR, 2017b). Drought watches not associated with higher levels of drought generally would have occurred three to four times per decade between 1850 and 1950. The drought emergency declarations dominated the 1960s. There were no Drought Watches or above in the 1970s. In the 1980s, there was a lengthy Drought Watch level of precipitation between 1980 and 1981, followed by a Drought Warning in 1985. A frequency of drought Watches at a rate of three years per decade resumed in the 1990s (1995, 1998, 1999). In the 2000s, Drought Watches occurred in 2001 and 2002. There were six drought watches in Massachusetts in 2002, five drought watches in 2016, and two drought watches in 2017 (DCR 2017b, 1). Figure 22 presents an example of drought conditions in the six drought regions.

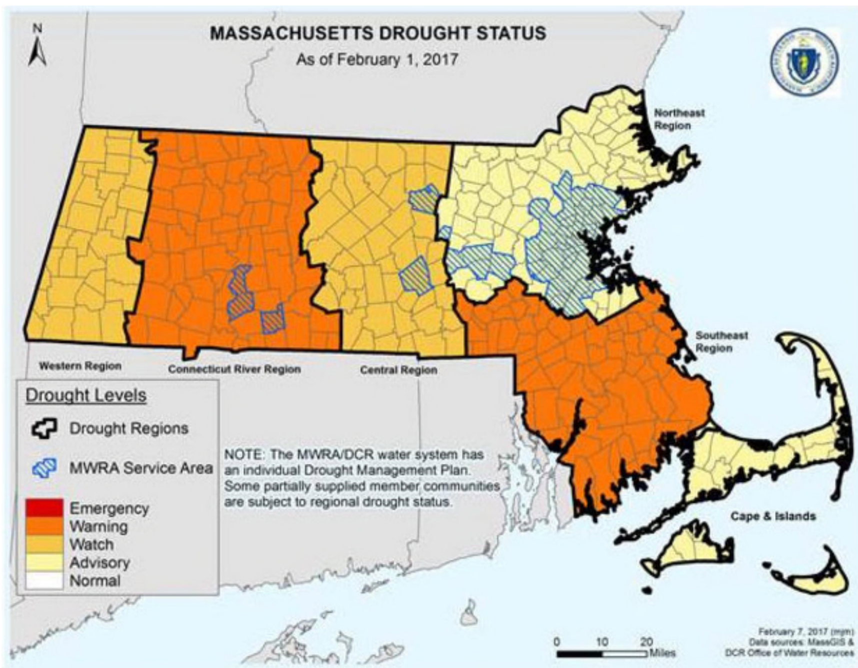


Figure 21. Massachusetts Drought Status, February 2017
Source: DCR, 2017b

Drought is a potential townwide hazard in Savoy. Droughts are classified as a low-frequency, natural-hazard event. As defined by the *2013 Massachusetts State Hazard Mitigation Plan*, these events can occur between once in 50 years to once in 100 years (a 1% to 2% chance of occurring per year).

4.7.1 Climate Change Impacts: Drought

With climate change, temperature is projected to increase and may lead to exacerbated drought conditions especially in summer and fall months. Droughts can also increase fire risk. Fires can be caused by lightning, and a 2014 study found that the frequency of lightning strikes could increase by more than 10% for every degree Celsius of warming (EEA and EOPSS, 2018). A long-term drought could reduce flow in Savoy's wetlands, streams, and the Cold River. In a drought emergency affecting the water supply, water-use restrictions would be implemented in Savoy, which could result in loss of gardens and landscaped areas depending on the length of the water use restriction.

5.0 EXISTING MITIGATION MEASURES

The Town of Savoy is already mitigating local hazards. Chapter 5 documents the Town's current operations and discusses potential improvements. The *Local Mitigation Planning Handbook* categorizes hazard mitigation measures into four types as displayed in Table 43 (FEMA, 2013). The Town of Savoy uses many of these tools, which are presented by hazard type.

Table 43. FEMA's Types of Mitigation

Mitigation Category	Description	Examples
Local Plans and Regulations	These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.	• Land use ordinances • Subdivision regulations • Development review regulations • Building codes and enforcement • Open space preservation • Stormwater management regulations and master plans
Structure and Infrastructure Projects	These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.	• Acquisitions and elevations of structures in flood prone areas • Utility undergrounding • Structural retrofits • Detention and retention structures • Culverts
Natural Systems Protection	These are actions that minimize damage and losses and preserve or restore the functions of natural systems.	• Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements • Wetland restoration and preservation

Table 43. FEMA's Types of Mitigation

Mitigation Category	Description	Examples
Education and Awareness Programs	These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.	• Websites with maps and information • Real estate disclosure • Presentations to school groups or neighborhood organizations

Table adapted from Local Mitigation Planning Handbook (FEMA, 2013).

5.1 Commonwealth and Town Mitigation Measures

Table 44. Savoy Mitigation Measures and Improvements

Mitigation Measures	Area Covered	Recommended Improvements
Emergency Operations Center (EOC)	Townwide	Centralize emergency response activities in a single complex away from the flood zone.
Public Education	Townwide	The Town can make better use of its website and social media. An email list or other portal for residents to sign up for news and updates can eliminate misinformation and further public education efforts.
Emergency Shelters	Townwide	Expand outreach to public so that they are aware of shelter facilities in case of emergency.
Multi-Department Review of Developments	Townwide	None
Communications Equipment	Townwide	None
Backup Generators	Shelters, Communication Infrastructure	Expand to other critical facilities
Massachusetts State Building Code	Townwide	Outside of local authority
Berkshire Medical Reserve Corps	Regional	None

Table 44. Savoy Mitigation Measures and Improvements

	Mitigation Measures	Area Covered	Recommended Improvements
	FEMA Deployment	Statewide	Outside of local authority
	Tree Maintenance	Townwide	Expand education about private tree trimming benefits
	Tree Maintenance by Eversource	Townwide	Include contact information for residents in public education efforts.
	Ongoing Operation and Maintenance	Townwide	Increase staff dedicated to culvert cleaning after storms increase funding and/or staff capacity for roadway and drainage.
FLOOD HAZARDS	The Town actively enforces the floodplain regulations for new development but does not participate in the NFIP.	Areas identified on the FIRM maps	Encourage all eligible homeowners to obtain insurance. Participate in NFIP Training offered by the MEMA and FEMA to address flood hazard planning and management.
FLOOD HAZARDS	Ongoing Drainage Improvement Program	Townwide	Continue current improvements
FLOOD HAZARDS	Zoning Bylaws and Subdivision Regulations related to flood plains	Townwide	Revise Zoning Bylaws and Subdivision Regulations so that future flood events projected under climate change are accounted for, such as new development in proximity to all dams (not just moderate or high hazard).
FLOOD HAZARDS	Massachusetts Stormwater Regulations	Conservation Commission jurisdictional areas	Currently being updated.
FLOOD HAZARDS	Wetlands Protection Act	Wetland Resource Areas	Location of wetlands is required for subdvision review. Per the Wetlands Protection Act, the Conservation Commission may require a hearing.
FLOOD HAZARDS	Development Review	Townwide	Develop guidelines to promote climate resilient design
FLOOD HAZARDS	Public Education on Stormwater	Townwide	Continue to update and inform the public
DAM HAZARDS	DCR Dam Safety Regulations	Specific Sites	Outside of local authority. Savoy dams are considered “low hazard” by the MA Office of Dam Safety.
DAM HAZARDS	Permits Required for Construction	Townwide	Subdivision and land development plans must show proximity to high hazard dams per the Zoning Bylaw.

Table 44. Savoy Mitigation Measures and Improvements

	Mitigation Measures	Area Covered	Recommended Improvements
WIND HAZARDS	Addressed in multiple hazard section		
WINTER HAZARDS	Snow-Plowing and De-icing Operations	Townwide	None
BRUSH FIRE HAZARDS	Open Burning Permits Required	Townwide	None
	Fire Department Review of Proposal Developments	Townwide	None
	Public Education	Townwide	Conduct additional public education on drought conditions and climate change and how they contribute to fire hazards.
	Firefighting Water Supplies	Townwide	Identify high risk fire areas and ensure and document nearby water access
	Statewide Fire Mobilization Plan	Statewide	None currently
EXTREME HAZARDS	Addressed in Multiple Hazard Section of Table		
GEOLOGIC HAZARDS	Addressed in Multiple Hazard Section of Table		

5.2 Mitigation Capabilities and Local Capacity for Implementation

Under the Massachusetts system of Home Rule, the Town of Savoy is authorized to adopt, and from time to time, amend certain local bylaws and regulations that support the Town's authority to mitigate natural hazards. These include the General Bylaws, Zoning Ordinance, Subdivision Regulations, Health Regulations, Highway regulations, and local enforcement of the State Building Code. Local bylaws may be amended by the Town Select Board to improve the Town's authority, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission. The Town of Savoy has recognized several existing mitigation measures that require implementation or improvements and has the capacity based on these Home Rule powers within its local boards and departments to address them. The Town also has the authority to expand on and improve the existing policies and programs listed above.

6.0 HAZARD MITIGATION STRATEGY

6.1 Identification of Hazard Mitigation Strategies

The Town developed a list of priority hazard mitigation strategies through multifaceted approach. Strategies were developed upon review of the:

- Community profile, including the Town's strengths and vulnerabilities.
- Hazard and climate change risk assessment.
- Existing measures.
- Input from stakeholders.

Stakeholders were engaged through core team and the public input session. Table 46 represents the Town's recommended hazard mitigation and climate adaptation measures and implementation roadmap. The estimated cost, timeframe, and implementation responsibility were developed for the road map, but along with the core team's prioritization based upon the societal benefit and feasibility. A description of the categories in Table 46 is identified below.

Priority – Designation of high, medium, or low priority was based on overall potential benefits and feasibility. A high priority action is very likely to have political and public support. The necessary maintenance and continued operation following the project is feasible. A medium priority action may have some political and public support. Necessary maintenance may be feasible once the project is complete. A low priority action may not have political and public support for implementation or the necessary maintenance support following the project.

Mitigation Action – A brief description of each mitigation measure that was identified in this plan.

Implementation Responsibility – Most mitigation measures will require a multi-department approach where several Town departments share responsibility. The designation of implementation responsibility in the table was assigned based on general knowledge of the responsibilities of each municipal department. The lead department for each action item is bolded.

Timeframe – The timeframe designates the most likely initial start time of the project. The timeframes represented below are assigned based on the complexity of the measure, the overall priority of the measure and at what stage of design and/or funding has been attained. The identification of time frames is not meant to prevent a community from actively seeking out and taking advantage of funding opportunities as they arise. Projects that involve maintenance or do not have a definitive end date are classified as Ongoing.

- Less than 1 year
- 1-3 years
- 3-5 years
- 5-10 years
- More than 10 years
- Ongoing

Estimated Cost – Costs are provided for each mitigation measures. In some cases, costs are provided for different phases of the project. All cost data would need to be updated at the time of design and construction and is only provided as an estimate. Costs are represented as follows:

- $ = less than $10,000
- $$ =$10,000 to $100,000
- $$$ =$100,000-$500,000
- $$$$ = more than $500,000

Table 45. Priority Action Items

Priority& Hazard	Mitigation Action	Implementation Responsibility	Timeframe	Cost
High (multi-hazard)	Pursue funding for a combined Town Hall/Public Safety Complex	Select Board, Highway	3-5 years	$$$$
High (flooding)	Right size and replace culverts and implement projects already designed	Select Board, Highway	1-2 years per culvert	$$$$ per culvert
High (flooding)	Address stream crossings, such as culverts and bridges; design these assets based on vulnerability	Highway Select Board, Conservation and	1-3 years	$$
High (multi-hazard)	Consider applying for a Municipal Vulnerability Grant so that the Town can consider impacts from climate change and develop strategic actions to protect infrastructure, people, and environmental quality.	Select Board, Fire, Conservation and Health	1-2 years	Varied
High (multi-hazard)	Ensure that seniors (particularly those living alone) have help in case of an emergency and/or if family is unavailable.	Health and Emergency/ Fire	Less than 1 year	$

Table 45. Priority Action Items

Priority& Hazard	Mitigation Action	Implementation Responsibility	Timeframe	Cost
High (fire)	Locate funding for water tanks to ensure water access throughout town in case roads wash out.	Fire/Emergency	1-2 years	$$
High (tornado)	Ensure that schools and municipal buildings have a shelter plan in the event of a tornado warning.	Emergency/Fire	Less than 1year	$
Medium (wind, ice, storms)	Work with electric utility companies to increase proactive tree management above and beyond current tree trimming program and identify more funding for tree trimming.	Highway, State Agencies, and Utility Companies	1-3 years	$
Medium	Maintain vulnerable roofs at the schools to maintain insurance	Highway, Building	ongoing	$
Medium	Increase web-based education and outreach efforts related to public safety and climate resilience on the Town website	Select Board, Conservation, Emergency/Fire, State Agencies	Less than 1 year, Ongoing	$ up to $$

6.2 Potential Funding Sources

The identification of potential funding sources in is preliminary and may vary depending on numerous factors. These factors include, but are not limited to, if a mitigation measure is conceptual or has been studied, evaluated, or designed. In most cases, the measure will require an assemblage of funding sources. The funding sources identified are not a guarantee that a specific project will be eligible for or receive funding. Upon adoption of this plan, the local representatives responsible for implementation should begin to explore the funding sources in more detail. Funding source could include the following:

Traditional funding sources within the Town of Savoy such as funding from the operating and capital budgets may be able to cover some of the cost. State revolving funds and other no or low interest loans may also be of interest. Massachusetts municipalities can tap a wide variety of funding sources through state and federal governments, but smaller towns like Savoy often have difficulty competing for grant funding. Regional applications can often be more compelling to funders, so Savoy may want to consider a joint application with an adjacent jurisdiction with shared issues. A full list of funding opportunities can be found on the Community Grant Finder webpage. The Community Grant finder provides a streamlined interface where municipalities can easily learn about grant opportunities. Specific funding opportunities related to Action Items developed by Savoy are listed in Table 46.

Table 46. Potential Grant Funding Sources

Source	Grant (Hyperlinked)	Description of Funding
Department of Housing and Community Development (DHCD)	Massachusetts Downtown Initiative	Offers services and assistance to communities seeking help on how to revitalize their downtowns
Executive Office of Housing and Economic Development	MassWorks Infrastructure Program	Provides grants to communities to help them prepare for success and contribute to the long-term strength and sustainability of the Commonwealth.
Massachusetts Emergency Management Agency (MEMA)	Flood Mitigation Assistance Grant Program	Implements cost-effective measures that reduce or eliminate the long-term risk of flood damage
	Hazard Mitigation Grant Program	Provides funding after a disaster to significantly reduce or permanently eliminate future risk to lives and property from natural hazards
	Pre-Disaster Mitigation (PDM) Grant Program	Provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event
	Emergency Management Performance Grant (EMPG)	Reimbursable grant program to assist local emergency management departments to build and maintain an all-hazards emergency preparedness system
	Public Assistance Program	The state reimburses governments and other applicants for disaster related costs
Department of Energy Resources (DOER)	DOER Grants	The DOER provides grant funding for clean energy-related programs
Department of Conservation and Recreation (DCR)	Community Forest Grant Program	Funding to establish community forests
Division of Ecological Restoration	Culvert Replacement Municipal Assistance Grant Program	Grant to replace undersized, perched, and/or degraded culverts located in an area of high ecological value

Table 46. Potential Grant Funding Sources

Source	Grant (Hyperlinked)	Description of Funding
Department of Environmental Protection (DEP)	604b Grant Program	Water quality assessment and management planning
	MS4 Grant Program	Meeting the requirements of the 2016 MS4 permit and reduce stormwater pollution through partnerships
Executive Office of Energy and Environmental Affairs (EEA)	Dam and Seawall Program	Grants for the repair or removal of dams, seawalls, and levees
	Drinking Water Supply Protection Grant Program	Financial assistance to public water systems and municipal water departments for the purchase of land or interests in land
	Land Use Planning Grants	Support effort to plan, regulate, and act to conserve and develop land consistent with the Massachusetts' Sustainable Development Principles
	LAND Grant Program	Helps cities and towns acquire land for conservation and passive recreation
	Federal Land & Water Conservation Fund	Funding for the acquisition, development, and renovation of parks, trails, and conservation areas.
	MassTrails Program	Trail protection, construction, and stewardship projects
	MVP Program	Provides support in implanting climate change resiliency priority projects
Department of Fire Services	Senior SAFE	Supports fire and life safety education for seniors
	Student Awareness of Fire Education (S.A.F.E.)	Grants for local fire departments to teach fire and life safety to schools
MA Department of Transportation (DOT)	Chapter 90 Program	Reimbursable grants on approved projects
	Community Transit Grant Program	Funding to the transportation and mobility needs of seniors and people with disabilities
	Complete Streets Funding Program	Technical assistance and construction funding
	Municipal Small Bridge Program	Funding for small bridge replacement, preservation, and rehab projects

Table 46. Potential Grant Funding Sources

Source	Grant (Hyperlinked)	Description of Funding
US Economic Development Administration	Disaster Supplemental Funding	Funding available to communities impacted by natural disasters and flooding
US department of Agriculture	Watershed and Flood Prevention Operations Program	Helps municipalities protect and restore watersheds
	Emergency Watershed Protection Program	Funds to help communities quickly address serious and long-lasting damages to infrastructure and the land
	Regional Conservation Partnership Program	NRCS seeks to co-invest with partners to implement projects that demonstrate innovative solutions
U.S. Department of the Interior	Land and Water Conservation Fund	Secures public access, improves recreational opportunities, and preserves ecosystem benefits for local communities (multiple funding options)
US Environmental Protection Agency	Healthy Communities Grant Program	Reduce environmental risk to protect and improve human health and the quality of life

6.3 Regional Partnerships

Mitigating natural hazards is not merely a local issue. Savoy's utilities and critical infrastructure are dependent or interconnected with surrounding communities. Savoy will benefit from making a concerted effort to partner with neighboring towns and cities to find mutually beneficial partnerships and support systems. In addition, infrastructure and other facilities within a town are often owned and operated by a wide variety of agencies including the Massachusetts Department of Transportation (MassDOT) and the Department of Conservation and Recreation (DCR). The planning, construction, operation, and maintenance of these structures are integral to hazard mitigation efforts of communities. These agencies are the town's regional partners in hazard mitigation efforts. Mitigation measures for the following regional issues should be considered as Savoy develops its own local plan. These agencies also operate under the same constraints as communities do including budgetary and staffing limitations. And as all communities do, they must make decisions about numerous competing priorities. In order to implement many of these mitigation measures, all parties will need to work together towards a mutually beneficial solution.

7.0 PLAN ADOPTION AND MAINTENANCE

7.1 Plan Adoption

The 2020 Savoy HMP Plan was adopted by the Board of Selectmen on *[ADD DATE]*. See Appendix D for documentation. The plan was approved by FEMA on [*ADD DATE*] for a five-year period that will expire on [*ADD DATE*]. See Appendix E for FEMA approval

7.2 Plan Implementation

The time frame, responsible department, and funding mechanisms in Table 46 layout out an action plan for the core team to implement. The core team will be held accountable through the tracking mechanisms explained in the following section. The HM-MVP Plan will also inform future planning and budgeting processes.

7.3 Plan Maintenance

7.3.1 Tracking Progress and Updates

FEMA's initial approval of this plan is valid for five years. During that time, the Town will need to continue to track progress, document hazards, and identify future mitigation efforts. The core team, co-coordinated by the Planning Department and Fire Department, will meet annually in November or on an as-needed basis, whichever is most frequent, to monitor plan implementation. The core team will be amended as needed. The co-coordinators of core team will also prepare and distribute instruction on how to collaborate to keep the plan current every two years. The co-coordinators wills utilize a series of shared spreadsheets be made available to all core team members and any other interested local stakeholders. The spreadsheet and discussion about the spreadsheet will assist in determining any necessary changes or revisions to the plan that may be needed. In addition, it will help provide information on progress and accomplishments for implementation and any new hazards or problem areas that have been identified since the plan drafting. The information collected through the survey will be used to formulate a report and/or addendum to the plan.

7.3.2 Continuing Public Participation

The adopted plan will be posted on the Town's website. The posting of the plan on the Town's web site will provide a mechanism for citizen feedback, such as an e-mail address for interested parties to send comments. The Town will encourage local participation whenever possible during the next five-year planning cycle and. The core team will incorporate engagement into the implementation of the priority action items. All updates to the plan, including implementation progress, will be placed on the Town's web site. All public meetings related to the HM-MVP Plan will be publicly noticed in accordance with town and state open meeting laws.

7.3.3 Integration of the Plans with Other Planning Initiatives

Upon approval of the 2021 Savoy HMP by FEMA, the core team will make the plan available to all interested parties and all departments with an implementation responsibility. The group will initiate a discussion with those various departments regarding how the plan can be integrated into their ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments and the Town Administrator's Office: Appropriate sections of the HMP will be integrated into other plans, policies, and documents as those are updated and renewed, including the Master Plan, Comprehensive Emergency Management Plan, and Capital Investment Program. Coordination with the regional government entities, land conservation organizations and watershed groups will be required for successful implementation and continued updating.

7.4 Process of Updating

By maintaining the 2021 HMP, the Town will have a competitive application when applying to FEMA for funding to update the plan. Once the resources have been secured to update the plan, the core team will need to determine whether to undertake the update itself or hire a consultant. If the core team decides to update the plan itself, the group will need to review the current FEMA hazard mitigation plan guidelines for any change in the requirements. The Savoy HMP will be forwarded to MEMA for review and to FEMA for ultimate approval. The core team will begin drafting the full update of the plan in four years. This will help the Town avoid a lapse in its approved plan status and grant eligibility when the current plan expires at the end of year five.

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APPENDIX A

PUBLIC PARTICIPATION MATERIALS

1

2

Overview of the Agenda

1. Hazard Mitigation Planning
2. Hazard Profiles (Berkshire County)
3. Critical Facilities
4. Proposed HMP Goals
5. Funding Opportunities
6. Next Steps

3

Hazard Mitigation Planning

- Reduces loss of life and property by minimizing the impact of disasters.
  - Identify natural hazard risks and vulnerabilities.
  - Develop long term strategies for protecting people and property.

4

Hazard Profiles

FLOOD HAZARDS

WIND HAZARDS

WINTER STORMS

EARTHQUAKES, LANDSLIDES, ETC.

FIRE

EXTREME TEMPERATURES

DROUGHT

CLIMATE CHANGE

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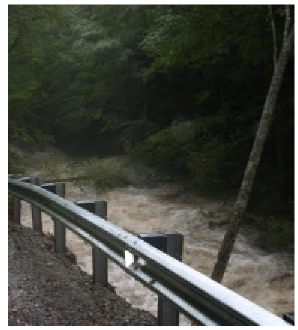
5

Flood Hazards



- 109 flood related events reported by NOAA since 2000 (floods, flash floods, heavy rain):
  - No reported deaths or injuries
  - Just under $550,000 in damages

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6

Wind Hazards

- 13 hurricanes recorded by NOAA since 1938 (in Massachusetts), 4 since 2010, 1 category 3 (1938).
- No recorded tornadoes in Savoy, but there have been 4 tornadoes in Berkshire County responsible for approximately $34,000 in damages.
- 12 Nor'easters since 1978.
- 128 severe thunderstorms in Berkshire County since 2000, responsible for $717,500 in damages.
  - No deaths
  - 5 injuries

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7

Winter Storms

- Nor'easters and severe winter storms are often one and the same.
- Nor'easters rotate counterclockwise and typically include storm surges.
- Blizzards bring very cold temperatures and whiteout conditions.

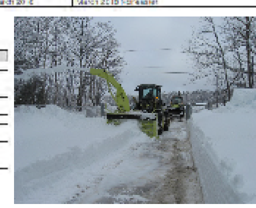
Table 2-15. Winter Storm

Date	Winter Storm Type
February 1978	Blizzard of 1978
October 1991	Severe Coastal Storm ("Perfect Storm")
December 1992	Great Nor'easter of 1992
January 2005	Blizzard/Nor'easter
October 2005	Coastal Storm/Nor'easter
April 2007	Severe Storms, Inland & Coastal Flooding/Nor'easter
January 2011	Winter Storm/Nor'easter
October 2011	Severe Storm/Nor'easter
February 2013	Blizzard/Nor'easter
January 2015	Blizzard/Nor'easter
March 2015	March 2015 Nor'easter
March 2018	March 2018 Nor'easter

Table 2-12 Nor'easter Events for Massachusetts, 1978 to 2015

Nor'easter Event	Date
Blizzard of 1978	February 1978
Severe Coastal Storm ("Perfect Storm")	October 1991
Great Nor'easter of 1992	December 1992
Blizzard/Nor'easter	January 2005
Coastal Storm/Nor'easter	October 2005
Severe Storms, Inland and Coastal Flooding	April 2007
Winter Storm and Nor'easter	January 2011
Severe Storm and Snowstorm	October 2011
Severe Winter Storm, Snowstorm and Flooding	[illegible]
Severe Winter Storm, Snowstorm, and Flooding	April 2015
Severe Winter Storm and Flooding	March 2018
Severe Winter Storm and Snowstorm	March 2018

Source: MEMA and DCR 2013, pages 402-406; MEMA and EOEEA 2018, Appendix D



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8

Earthquakes and Landslides

- Massachusetts has recorded over 400 “felt” earthquakes since records began in 1668 (USGS).
- Most natural landslides in Massachusetts are caused by a combination of adverse geological conditions and extreme wetness.

9

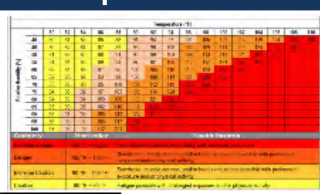
Fires

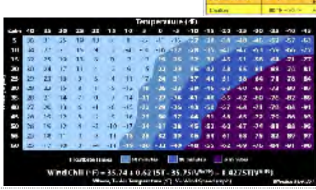
- Brush Fires
- Wildfires

10

Extreme Temperatures

- Heat or cold event



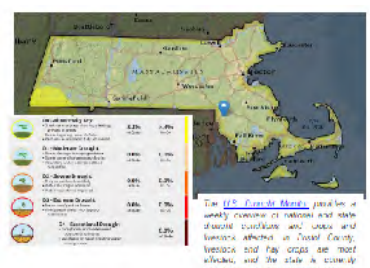


- 19 extreme cold events since 2000.
- 1 extreme heat event since 2000.

11

Droughts

- 2 drought events since 1990 (not severe).
- Severe droughts are 50 – 100-year events.



12

Climate Change

- Could worsen any climatic event.
- Actual effects are unknown since predictive modelling is changing all the time.

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Critical Facilities

- Government Center/Municipal Offices
- Fire Stations
- Police Stations
- Emergency Operations Centers
- Schools (Public and Private, including Universities/Colleges)
- Senior Center
- Water Treatment Plant
- Wastewater Treatment Plant
- Sewage Pumping Stations
- Satellite Municipal Buildings
- Hospitals
- Day–Care Facilities
- Public Works Highway Yard / Satellite Facilities
- Nursing Homes/Elderly Housing
- Emergency Shelters

A critical facility provides services and functions essential to a community, especially during and after a disaster.

Source: https://www.fema.gov/media-library-data/1436818953164-4f8f6fc191d26a924f67911c5eaa6848/FPM_1_Page_CriticalFacilities.pdf

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Funding Opportunities

Hazard Mitigation Assistance Grants

- Flood Mitigation Assistance Grants (FMA)
- Building Resilient Infrastructure Grants (BRIC) (formerly Pre-Disaster Mitigation Grants)

Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the National Flood Insurance Program.

The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.

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Next Steps

1. Complete the Vulnerability Analysis for each of the hazards
2. Develop goals, actions, and policies to mitigate the impact from hazards
3. Compile data, analysis and action plan into a draft plan for review by the community
4. Submit the report to MEMA for review

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Proposed HMP Goals

1) Develop programs and mitigation measures in the high-risk areas to protect the following from current and projected hazards:
   a) Residents' health, safety, and property.
   b) Commercial and industrial interests.
   c) Cultural and historic resources.
2) Protect critical infrastructure and essential services from disruption as a result of current or projected hazards by improving the resiliency of, and developing mitigation plans for the following:
   a) Critical infrastructure and the built environment.
   b) Essential services, such as electric power delivery, public and private drinking water supplies, and sewer service.
3) Incorporate hazard mitigation measures into local plans, bylaws, regulations, and other planning tools to protect critical infrastructure and property and to encourage resilient development.
4) Plan for all phases of the emergency management cycle, including mitigation, preparation, response, and recovery.
5) Increase awareness and provide resources for hazard mitigation to businesses and residents through outreach and education.
6) Identify funding opportunities specific to hazard mitigation projects.
7) Increase the Town's capacity for responding to a natural hazard event through coordination with businesses, institutions, and non-profits, surrounding communities, and state, regional, and federal agencies.

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thank you

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ARE WE PREPARED FOR NATURAL HAZARDS?

Take our survey and share your thoughts and ideas!

https://tinyurl.com/SavoyHMPSurvey

The **Town of Savoy** received a grant from the Federal Emergency Management Agency (FEMA) to develop a plan to prepare for and respond to natural hazards affecting the town. Help Savoy become a more responsive and resilient community by joining a virtual meeting for a presentation and public discussion. Two dates are scheduled:

Tuesday, January 26th
4:30 p.m. - 5:30 p.m.
AND
Thursday, January 28th
4:30 p.m. - 5:30 p.m.

Join the meeting by phone or computer

by computer

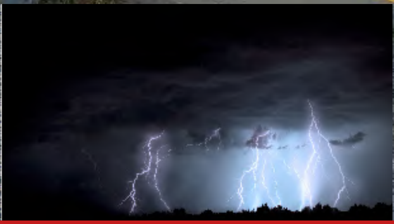
https://tinyurl.com/SavoyHMPMeeting

by phone

Dial 1-301-715-8592
Meeting ID: 884 7307 0761
Passcode: 54015614

TOWN OF SAVOY INCORPORATED FEB.20, 1797. MASSACHUSETTS

www.townofsavoy.org



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The **Town of Savoy** received a grant from the Federal Emergency Management Agency (FEMA) to develop a plan to prepare for and respond to natural hazards affecting the town. Help Savoy become a more responsive and resilient community by joining a virtual meeting for a presentation and public discussion. Two dates are scheduled:

Tuesday, February 23rd
10:00 a.m. - 11:00 a.m.
AND
Thursday, February 25th
6:30 p.m. - 7:30 p.m.

Join the meeting by phone or computer

by computer

Tuesday: https://us02web.zoom.us/j/85102142619
Thursday: https://us02web.zoom.us/j/82866966588

by phone

Dial 1 929 436 2866
Tuesday Meeting ID: 851 0214 2619
Thursday: Meeting ID: 828 6696 6588

TOWN OF SAVOY INCORPORATED FEB.20,1797. MASSACHUSETTS

www.townofsavoy.com

Savoy, MA Hazard Mitigation Planning Survey

Hello and happy 2021! We thank you for taking our survey.

Natural hazards, such as hurricanes, floods, and blizzards, have the potential to impact how our lives, our property, and our environment. We can prepare for these hazards by identifying those that are most likely to affect Savoy, and creating a plan designed to reduce the impacts of these hazards. In the planning process, we will address a number of issues, such as vulnerable public infrastructure, the people in Savoy who are most vulnerable in an emergency, or what critical resources are needed to keep people safe - and many other factors.

This is where we need your help. Your experience living or working in Savoy means that you have both knowledge and perspective on hazards and what is important. We'd love to hear your thoughts, experiences, and ideas.

1. On a scale of 1-5 (5 being very knowledgeable), how would you rate your knowledge of local hazard and climate impacts?

1	2	3	4	5
○	○	○	○	○

2. What hazards are you most concerned about?

	Very concerned	Somewhat concerned	Very unconcerned	Neither concerned nor unconcerned
Extreme temperatures	◯	◯	◯	◯
Flooding	◯	◯	◯	◯
Winter weather (snow storms and blizzards)	◯	◯	◯	◯
Ice storms	◯	◯	◯	◯
Drought	◯	◯	◯	◯
Fire	◯	◯	◯	◯
Strong winds (including Nor'easters)	◯	◯	◯	◯

3. Are there any other hazards that concern you?

4. How have these hazards impacted you, or what impacts have you seen in your community? Memories of recent climate hazards could include:

   - flooding of local roads

   - four Nor'easters in one month in 2018

   - heat waves with multiple days over 90 degrees F

   - drought conditions this year

5. How prepared do you think Savoy is for future climate hazard events?

   - ◯ Very prepared
   - ◯ Somewhat prepared
   - ◯ Not prepared
   - ◯ I'm not sure
   - ◯ Other

6. Please explain your reason for selecting your answer in Question 5.

7. What steps have you already taken to prepare for extreme hazard events? Check all that apply.

- [ ] I have a kit in case of emergencies (which may include food, water, flashlights, batteries, and other supplies)
- [ ] I am familiar with climate change data and news, like NOAA's Climate Change website at https://www.noaa.gov/climate (https://www.noaa.gov/climate)
- [ ] I receive news, updates, and information about emergency preparedness in Stoneham
- [ ] I know where the nearest emergency shelter is
- [ ] I have reached out to neighbors and community groups to see if they need help
- [ ] I have not made any preparations for extreme climate hazards
- [ ] Other

8. What resources do you need to feel more prepared? Check all that apply.

- ☐ Training on how to be better prepared
- ☐ The financial resources to take action
- ☐ More information on what I can do on my own
- ☐ Community resources that might be useful in an emergency
- ☐ Web resources so I can stay updated
- ☐ I do not feel that I need any resources
- ☐ Other

9. How would you like to receive information about resiliency projects and actions in Savoy? Check all that apply.

- ☐ Public events, including virtual webinars
- ☐ Printed media, including reports, fact sheets, or brochures
- ☐ Online, including through the Town of Savoy website, Twitter, and Facebook
- ☐ Local groups and organizations, including newsletters and existing meetings
- ☐ I do not want to receive any information about resiliency
- ☐ Other

10. Are there any additional comments or questions that you would like to share with the project team?

11. Thank you for completing this survey. If you are interested in receiving additional updates related to climate initiatives in Savoy, please enter your email below.

TOWN OF SAVOY, MA

Hazard Mitigation Planning Project
Public Meeting

Virtual Via Zoom
Thursday, February 25, 2021
6:30 – 7:30 pm

Meeting Notes

ATTENDEES:

- Judy Zepka
- River Road Savoy,
- Reggie and Promise Gist, 521 Luc Road
- Melanie and John Glin, Haskins Road
- Laurie Ann Cleary, 100 River Road
- Christine Reeves

AGENDA

1. PRESENTATION. Weston & Sampson presented information on the Hazard Mitigation Plan and the process overall. We reviewed the following potential goals for the HMP with the attendees:

   I. Develop programs and mitigation measures in the high-risk areas to protect the following from current and projected hazards:

      a. Residents' health, safety, and property.

      b. Commercial and industrial interests.

      c. Cultural and historic resources.

   II. Protect critical infrastructure and essential services from disruption as a result of current or projected hazards by improving the resiliency of, and developing mitigation plans for the following:

      a. Critical infrastructure and the built environment.

      b. Essential services, such as electric power delivery, public and private drinking water supplies, and sewer service.

   III. Incorporate hazard mitigation measures into local plans, bylaws, regulations, and other planning tools to protect critical infrastructure and property and to encourage resilient development.

IV. Plan for all phases of the emergency management cycle, including mitigation, preparation, response, and recovery.

V. Increase awareness and provide resources for hazard mitigation to businesses and residents through outreach and education.

VI. Identify funding opportunities specific to hazard mitigation projects.

VII. Increase the Town's capacity for responding to a natural hazard event through coordination with businesses, institutions, and non-profits, surrounding communities, and state, regional, and federal agencies.

2. DISCUSSION. Caroline then opened the floor to hear feedback from the community – their observations in the community and the resources that they know to be in place in times of emergency. Below are comments from the discussion:

- Do we have an emergency management protocol in Town? Fire is volunteer. Does not know of any emergency management plan in the case of an emergency.
- Hurricane Irene caused many problems on River Road. Caused a bridge to have to be replaced. Bridge at the edge of state forest on River Road. Will the new bridge on Route 116 hold in the face of another storm like Irene?
- Lots of dirt roads in town. In bad flood situations they can wash out and create problems. Bush Road, Roads in State Forest, Griffin Hill, Center Road, Black Brook Road (near tannery and the briar). Black Brook was wiped out and rebuilt in Irene.
- The Town did not replace bridge at the bottom of Black Brook. Green bridge. Jersey barriers floating down black brook during Irene.
- The center of Town has wetlands. How well will they hold water in a hurricane?
- Flooding is a concern. Main Road on 116 has been redone with new drains and still floods near the fire house.
- Route 2 and 116 are main thoroughfares. Question about hazardous materials and how that should be addressed if there is a crash.
- Savoy has an elderly residents that live on their own. Families help, and the group was not sure of any specific services. Build the Town's social network to help vulnerable population.
- Internet access should be considered critical facility. Needs expansion in Savoy. The Town has an MBI grant with poles with WiFi with receivers and transmitters which can get knocked out easily.
- Many people have generators for their homes.
- Fire dept. is well equipped. Snowmobile club can get into the woods with just about any supply/equipment needed.
- Home-based business in Savoy are susceptible to loss of power

- Residents go to grocery shops in North Adams, Pittsfield, Lanesborough. No local grocery store. Many residents keep themselves stocked with necessities. Residents will shop for elderly and deliver groceries and supplies.
- Schools may be vulnerable. The local school expanded into four trailers and the Town voted down a brick-and-mortar structure. The preschool is in old one room schoolhouse from 1800s, but it is up on high ground.
- New park building off 116 was built near the center of town and is supposed to be a possible emergency shelter but it has no running water or bathroom facilities. There are wetlands there.
- Local development consists mostly of single permit house construction, no big subdivisions.
- In terms of cultural and historic resources, the Town's historic cemeteries are vulnerable. 21 cemeteries are in Savoy. All but one has been located. They are not kept up and are on property owned by the State. Loop Road has 2 tombstones on the side of the road.
- Trash removal is either private or taken to the transfer station. Where will people take their trash if there is an emergency? Was the transfer station a former dump site that was capped?
- Communication from the Town to the residents is problematic sometimes and needs to be improved. Savoy lacks a complete email list of people to contact for information dissemination. The Town needs an emergency communication strategy. Reverse 911 or other communication tool should be considered.
- Town Hall records may be vulnerable in an emergency and should be digitized for safety and preservation. Town Hall is vulnerable to hazards. It is housed in an old schoolhouse.

The meeting adjourned at 7:30 p.m.

APPENDIX B

CRITICAL FACILITIES MAP

FIGURE 1

TOWN OF SAVOY, MASSACHUSETTS

HAZARD MITIGATION PLAN
CRITICAL FACILITIES MAP

MARCH 2021 SCALE: NOTED

Weston & Sampson

APPENDIX C

HAZUS REPORTS

Hazus: Hurricane Global Risk Report

Region Name: Savoy

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Friday, September 18, 2020

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 60.61 square miles and contains 1 census tracts. There are over 0 thousand households in the region and a total population of 1,444 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 0 thousand buildings in the region with a total building replacement value (excluding contents) of 177 million dollars (2014 dollars). Approximately 95% of the buildings (and 91% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 742 buildings in the region which have an aggregate total replacement value of 177 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

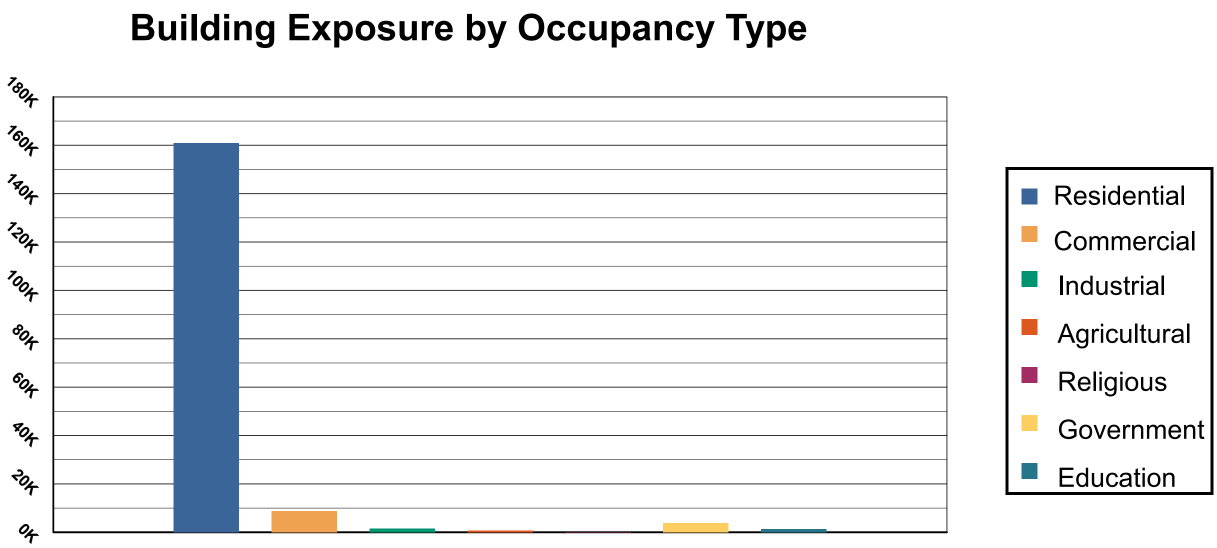


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	160,881	90.82 %
Commercial	8,883	5.01%
Industrial	1,450	0.82%
Agricultural	752	0.42%
Religious	197	0.11%
Government	3,742	2.11%
Education	1,247	0.70%
Total	**177,152**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 2 schools, 1 fire stations, no police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

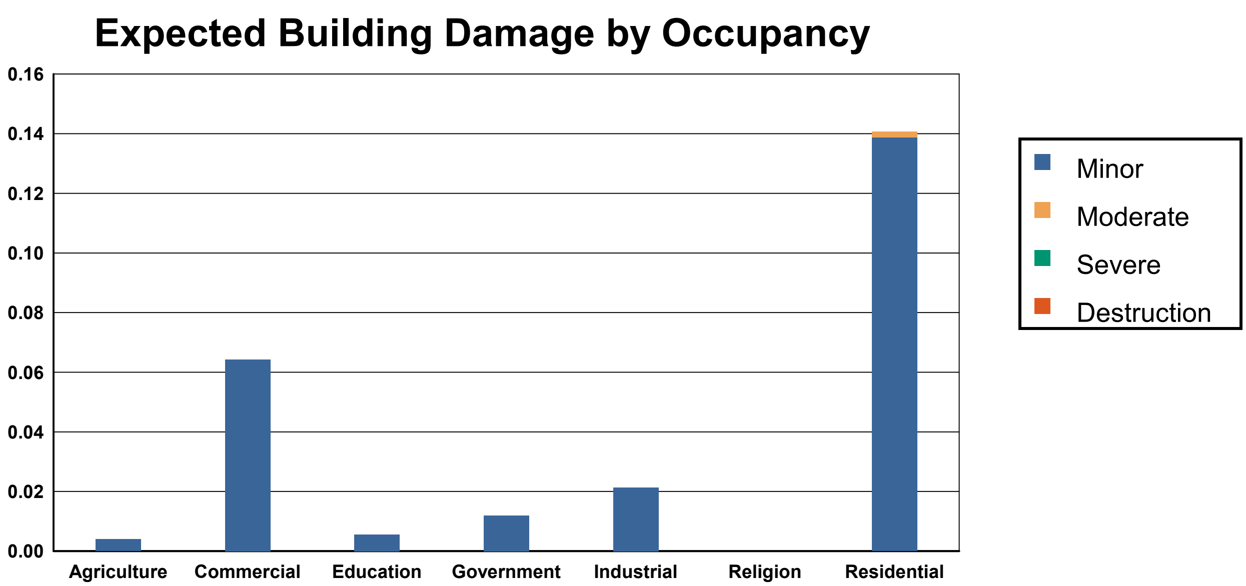


Table 2: Expected Building Damage by Occupancy : 100 - year Event

Occupancy	None Count	None (%)	Minor Count	Minor (%)	Moderate Count	Moderate (%)	Severe Count	Severe (%)	Destruction Count	Destruction (%)
Agriculture	2.00	99.80	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	24.94	99.74	0.06	0.26	0.00	0.00	0.00	0.00	0.00	0.00
Education	1.99	99.72	0.01	0.28	0.00	0.00	0.00	0.00	0.00	0.00
Government	3.99	99.70	0.01	0.30	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	6.98	99.70	0.02	0.30	0.00	0.00	0.00	0.00	0.00	0.00
Religion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	701.86	99.98	0.14	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Total	**741.75**		**0.25**		**0.00**		**0.00**		**0.00**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	9	99.82	0	0.17	0	0.01	0	0.00	0	0.00
MH	53	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	20	99.69	0	0.31	0	0.00	0	0.00	0	0.00
Wood	599	99.99	0	0.01	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

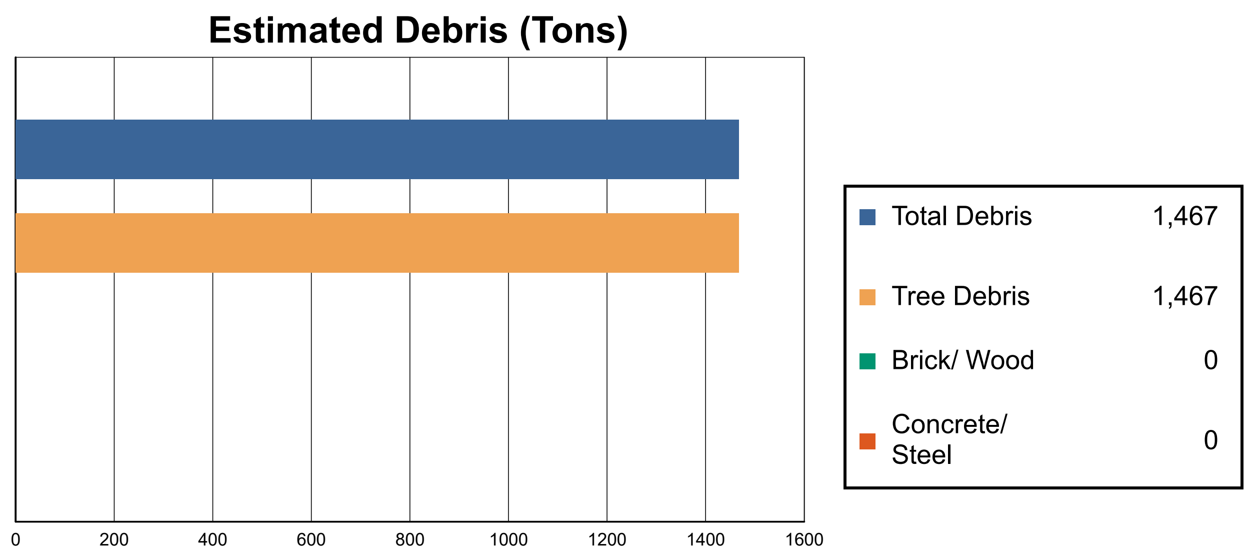
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

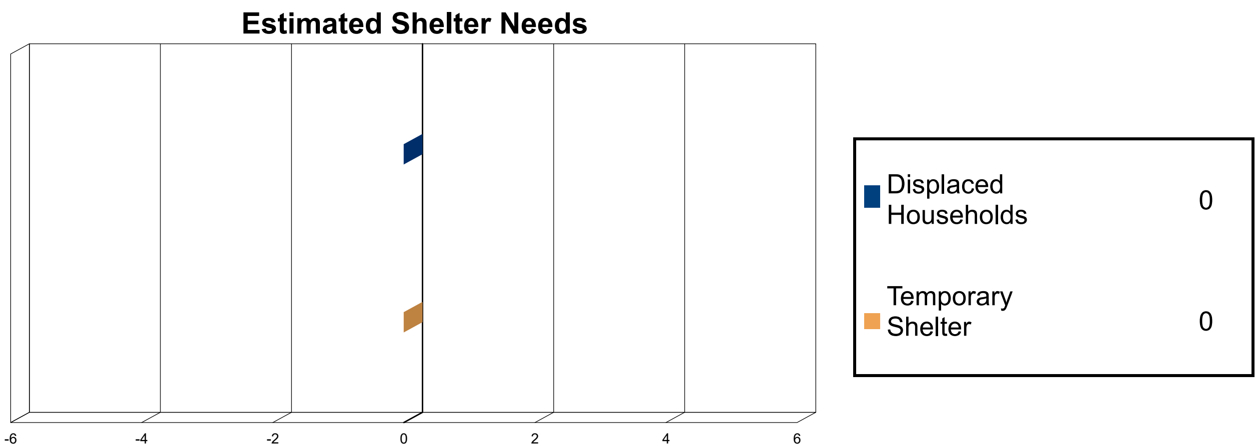


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 1,467 tons of debris will be generated. Of the total amount, 1,406 tons (96%) is Other Tree Debris. Of the remaining 61 tons, Brick/Wood comprises 0% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 61 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 1,444) will seek temporary shelter in public shelters.

Economic Loss

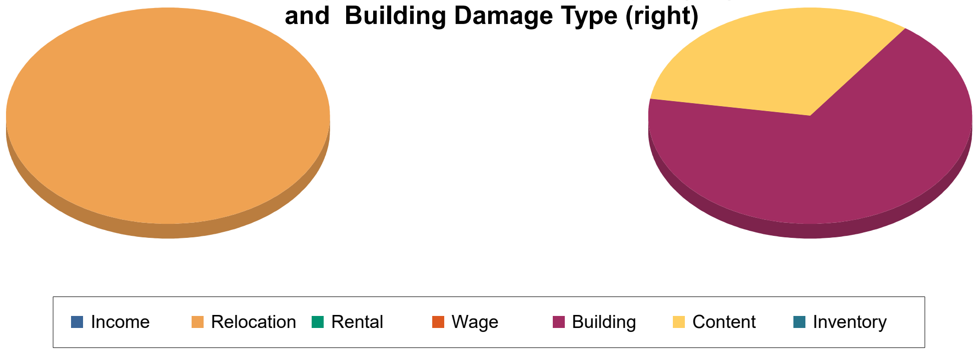
The total economic loss estimated for the hurricane is 0.1 million dollars, which represents 0.08 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 99% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left)
and Building Damage Type (right)



Loss Type by General Occupancy

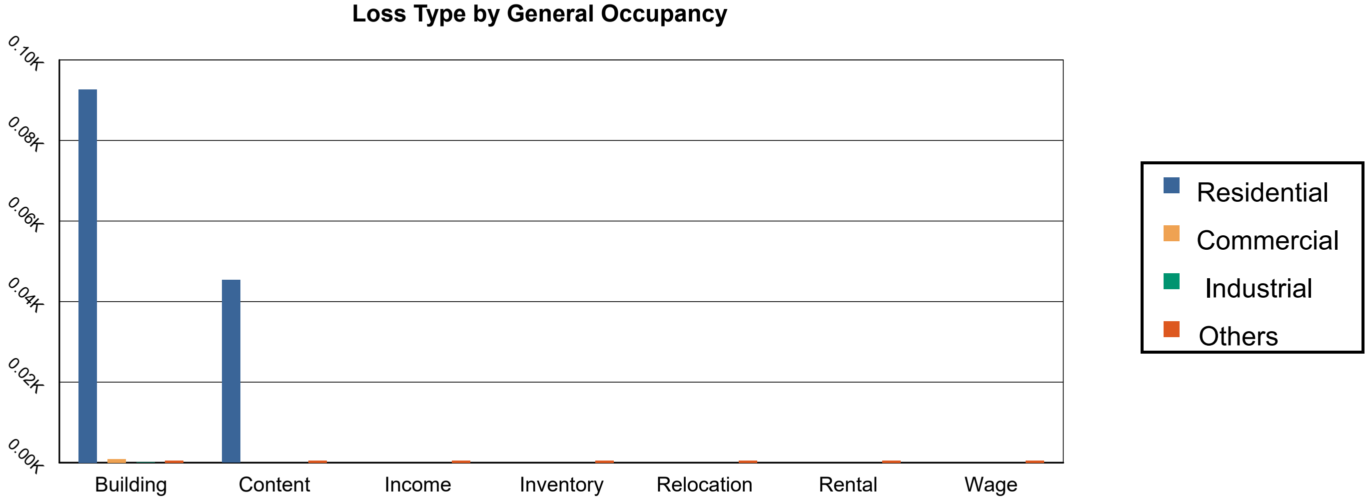


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	92.63	0.89	0.14	0.52	94.18
	Content	45.35	0.00	0.00	0.00	45.35
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**137.98**	**0.89**	**0.14**	**0.52**	**139.53**
<u>Business Interruption Loss</u>						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Total

Total	**137.98**	**0.89**	**0.14**	**0.52**	**139.53**

Appendix A: County Listing for the Region

Massachusetts
- Berkshire

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Berkshire	1,444	160,881	16,271	177,152
Total	**1,444**	**160,881**	**16,271**	**177,152**
Study Region Total	**1,444**	**160,881**	**16,271**	**177,152**

Hazus: Hurricane Global Risk Report

Region Name: Savoy

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Friday, September 18, 2020

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 60.61 square miles and contains 1 census tracts. There are over 0 thousand households in the region and a total population of 1,444 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 0 thousand buildings in the region with a total building replacement value (excluding contents) of 177 million dollars (2014 dollars). Approximately 95% of the buildings (and 91% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 742 buildings in the region which have an aggregate total replacement value of 177 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	160,881	90.82 %
Commercial	8,883	5.01%
Industrial	1,450	0.82%
Agricultural	752	0.42%
Religious	197	0.11%
Government	3,742	2.11%
Education	1,247	0.70%
Total	**177,152**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 2 schools, 1 fire stations, no police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

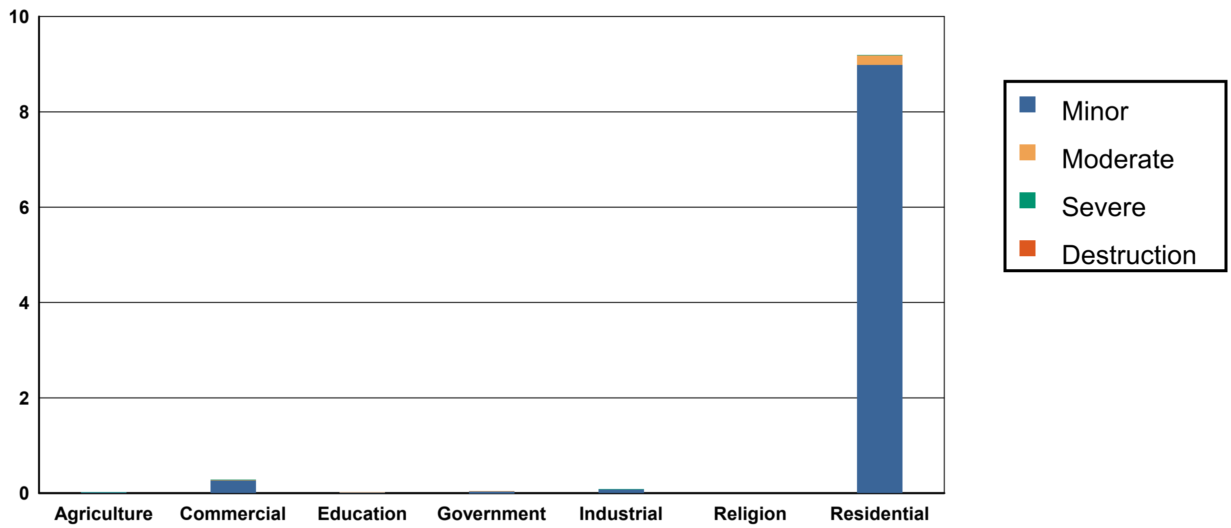


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	1.98	98.83	0.02	1.07	0.00	0.08	0.00	0.02	0.00	0.00
Commercial	24.72	98.86	0.26	1.05	0.02	0.09	0.00	0.00	0.00	0.00
Education	1.98	98.93	0.02	1.06	0.00	0.01	0.00	0.00	0.00	0.00
Government	3.96	98.89	0.04	1.11	0.00	0.01	0.00	0.00	0.00	0.00
Industrial	6.91	98.77	0.08	1.19	0.00	0.04	0.00	0.01	0.00	0.00
Religion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential	692.81	98.69	8.99	1.28	0.20	0.03	0.00	0.00	0.00	0.00
Total	**732.35**		**9.42**		**0.23**		**0.00**		**0.00**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	9	98.62	0	1.32	0	0.05	0	0.01	0	0.00
MH	53	99.96	0	0.03	0	0.01	0	0.00	0	0.00
Steel	20	98.84	0	1.11	0	0.05	0	0.00	0	0.00
Wood	591	98.59	8	1.39	0	0.02	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

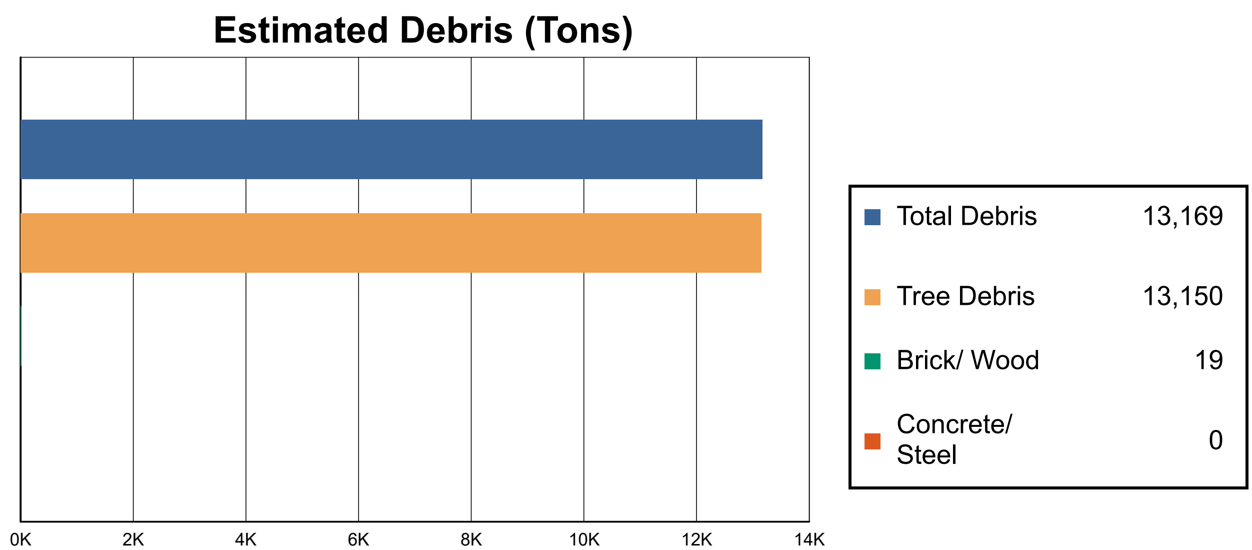
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

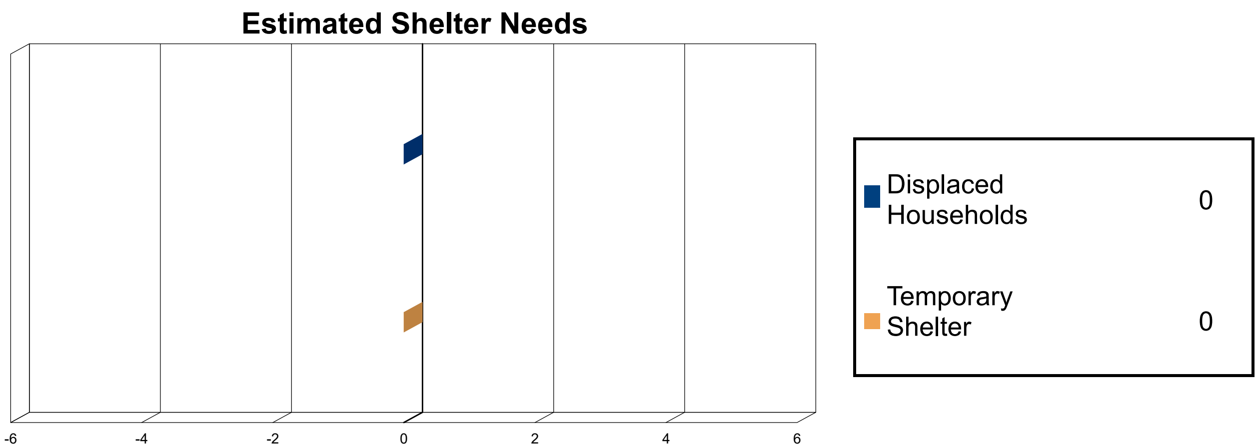


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 13,169 tons of debris will be generated. Of the total amount, 12,605 tons (96%) is Other Tree Debris. Of the remaining 564 tons, Brick/Wood comprises 3% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 1 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 545 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 1,444) will seek temporary shelter in public shelters.

Economic Loss

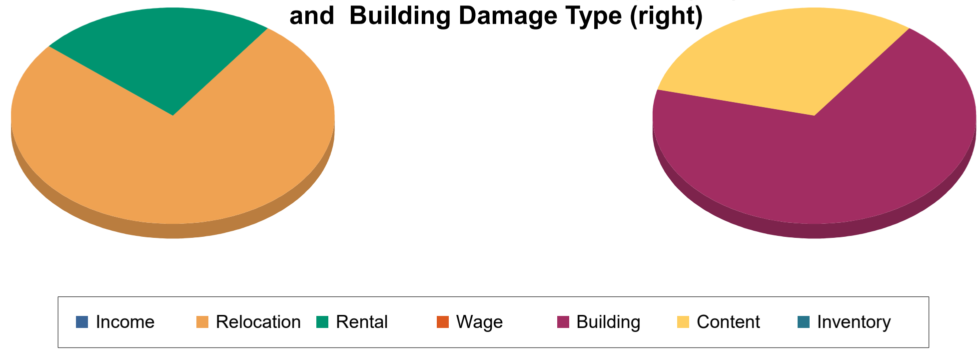
The total economic loss estimated for the hurricane is 0.9 million dollars, which represents 0.53 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 1 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 100% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

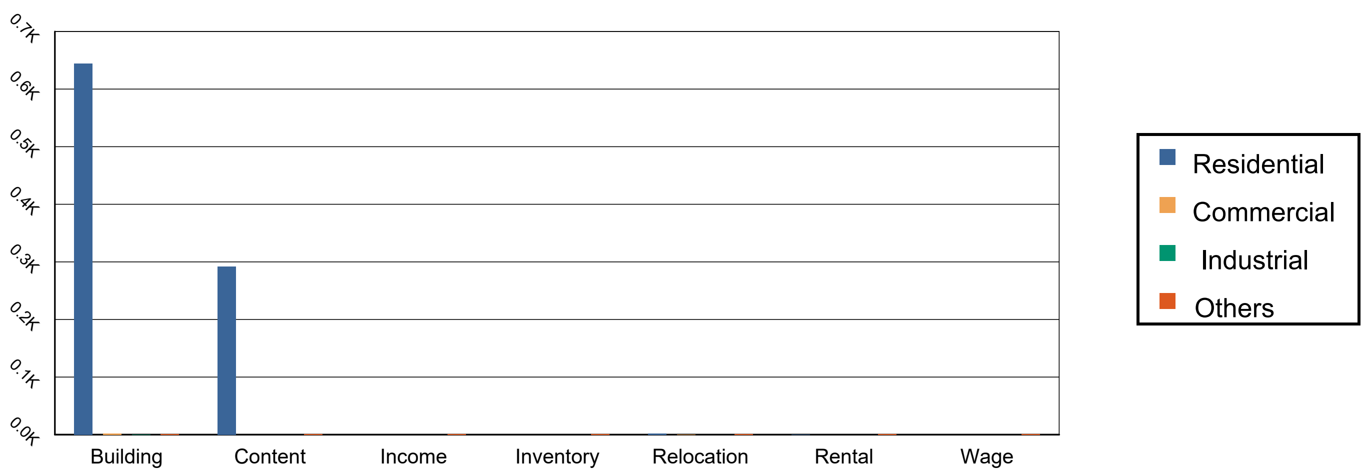


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	644.58	2.36	0.39	1.27	648.60
	Content	292.16	0.00	0.00	0.00	292.16
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**936.74**	**2.36**	**0.39**	**1.27**	**940.76**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	1.96	0.05	0.00	0.01	2.02
	Rental	0.63	0.00	0.00	0.00	0.63
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**2.59**	**0.05**	**0.00**	**0.01**	**2.65**

Total

Total	**939.33**	**2.41**	**0.39**	**1.28**	**943.41**

Appendix A: County Listing for the Region

Massachusetts
- Berkshire

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Massachusetts				
Berkshire	1,444	160,881	16,271	177,152
Total	**1,444**	**160,881**	**16,271**	**177,152**
Study Region Total	**1,444**	**160,881**	**16,271**	**177,152**

Hazus: Earthquake Global Risk Report

Region Name Savoy

Earthquake Scenario: Savoy Magnitude 5 Earthquake

Print Date: September 17, 2020

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 60.59 square miles and contains 1 census tracts. There are over 0 thousand households in the region which has a total population of 1,444 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 0 thousand buildings in the region with a total building replacement value (excluding contents) of 177 (millions of dollars). Approximately 95.00 % of the buildings (and 91.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 133 and 13 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 0 thousand buildings in the region which have an aggregate total replacement value of 177 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 81% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 2 schools, 1 fire stations, 0 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes no hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 146.00 (millions of dollars). This inventory includes over 13.67 miles of highways, 18 bridges, 434.34 miles of pipes.

Table 1: Transportation System Lifeline Inventory

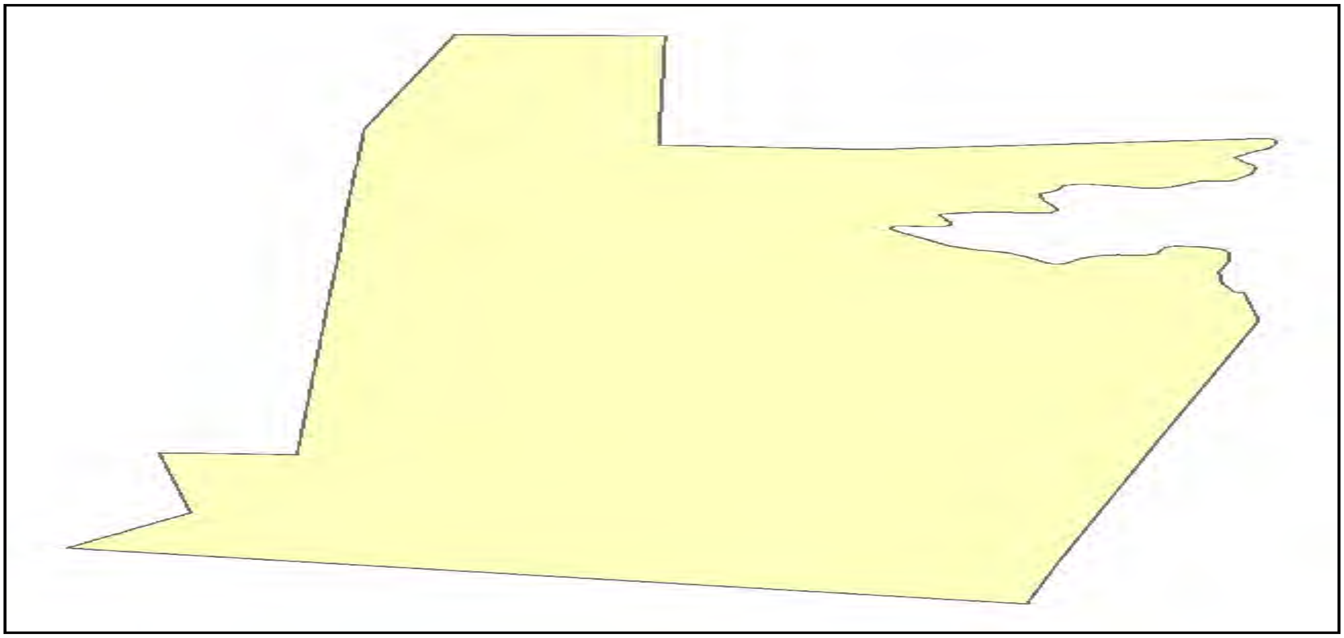
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	18	52.0919
	Segments	2	73.8357
	Tunnels	0	0.0000
		Subtotal	**125.9276**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	7.4190
	Tunnels	0	0.0000
		Subtotal	**7.4190**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**133.30**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.9957
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.9957**
Waste Water	Distribution Lines	NA	4.1974
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**4.1974**
Natural Gas	Distribution Lines	NA	2.7983
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.7983**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**14.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	Savoy Magnitude 5 Earthquake
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-73.02
Latitude of Epicenter	42.58
Earthquake Magnitude	5.00
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 171 buildings will be at least moderately damaged. This is over 23.00 % of the buildings in the region. There are an estimated 9 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

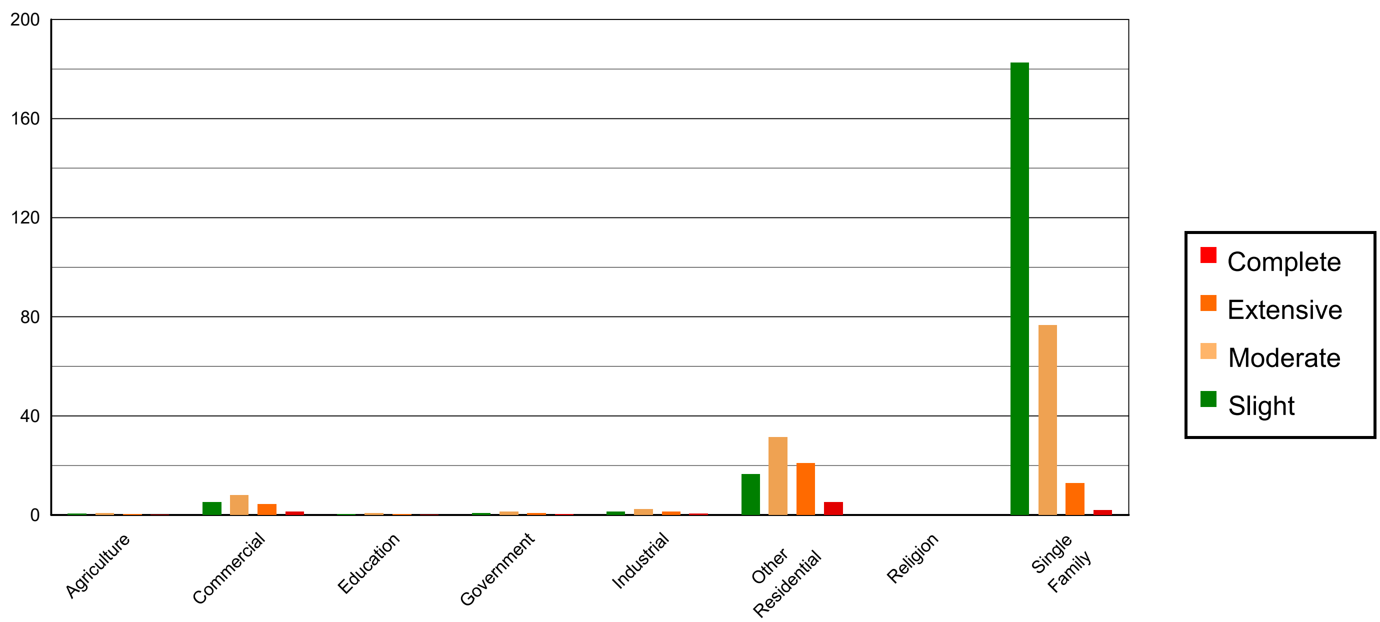


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.47	0.13	0.49	0.24	0.65	0.54	0.29	0.72	0.09	1.01
Commercial	5.97	1.64	5.27	2.54	8.05	6.65	4.31	10.58	1.40	14.83
Education	0.51	0.14	0.41	0.20	0.64	0.53	0.34	0.82	0.11	1.12
Government	0.91	0.25	0.76	0.37	1.32	1.09	0.77	1.89	0.25	2.64
Industrial	1.56	0.43	1.32	0.64	2.31	1.91	1.36	3.34	0.44	4.70
Other Residential	13.90	3.82	16.51	7.96	31.49	25.99	20.93	51.38	5.18	55.02
Religion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Single Family	340.09	93.59	182.53	88.05	76.69	63.30	12.74	31.27	1.95	20.68
Total	**363**		**207**		**121**		**41**		**9**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	336.18	92.51	179.65	86.66	72.58	59.91	9.69	23.79	0.63	6.70
Steel	3.97	1.09	3.32	1.60	6.69	5.52	4.10	10.07	1.41	14.94
Concrete	0.50	0.14	0.42	0.20	0.98	0.81	0.60	1.48	0.18	1.89
Precast	0.23	0.06	0.16	0.08	0.39	0.32	0.36	0.89	0.10	1.04
RM	0.96	0.26	0.45	0.22	0.93	0.77	0.73	1.79	0.12	1.26
URM	9.45	2.60	7.81	3.77	8.88	7.33	4.65	11.42	1.90	20.15
MH	12.13	3.34	15.48	7.47	30.72	25.35	20.59	50.56	5.08	54.02
Total	**363**		**207**		**121**		**41**		**9**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	2	1	0	0
EOCs	0	0	0	0
PoliceStations	0	0	0	0
FireStations	1	1	0	0

Transportation Lifeline Damage

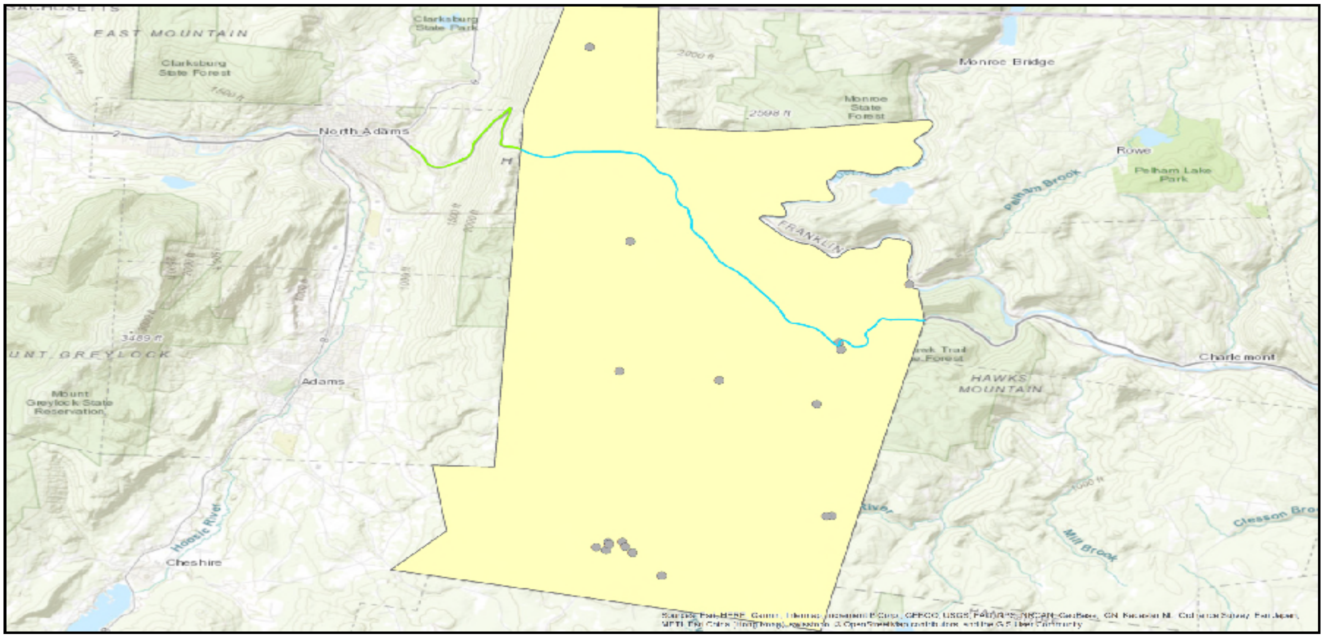


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	2	0	0	2	2
	Bridges	18	0	0	18	18
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	1	1
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	217	54	14
Waste Water	130	27	7
Natural Gas	87	9	2
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	606	0	0	0	0	0
Electric Power		496	315	122	20	1

Induced Earthquake Damage

Fire Following Earthquake

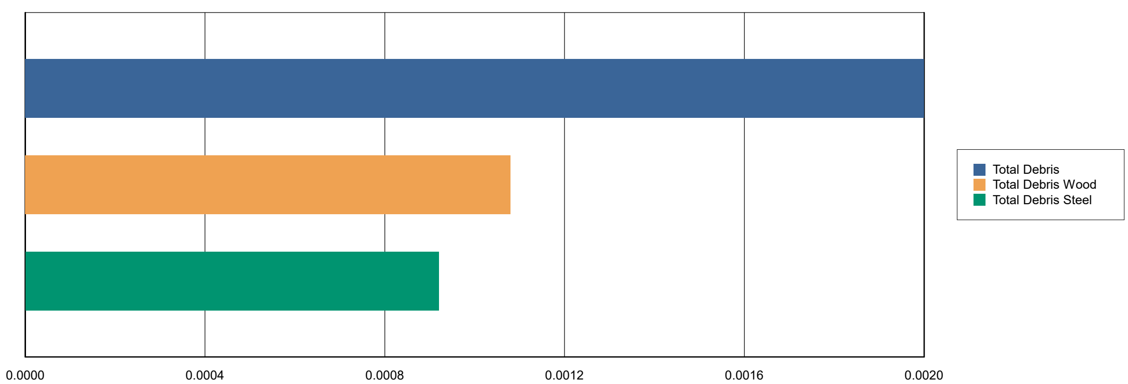
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 2,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 54.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 80 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



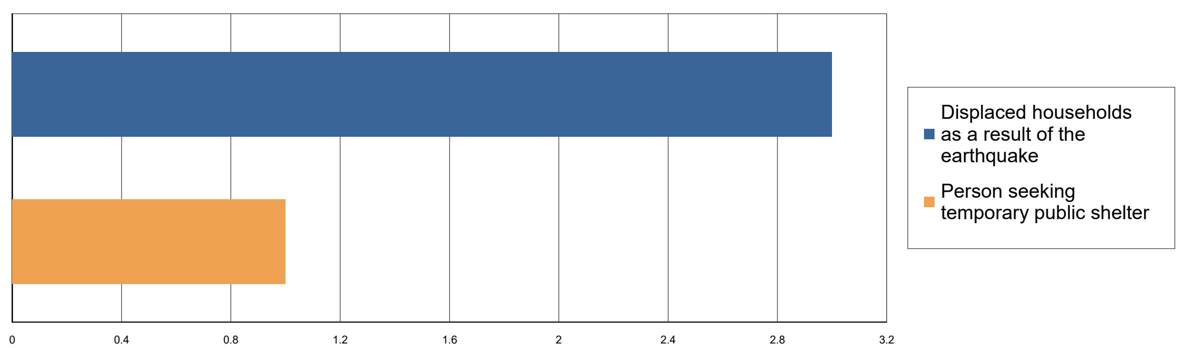
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	80 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 3 households to be displaced due to the earthquake. Of these, 1 people (out of a total population of 1,444) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
3	1

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

· Severity Level 1:Injuries will require medical attention but hospitalization is not needed.
· Severity Level 2:Injuries will require hospitalization but are not considered life-threatening
· Severity Level 3:Injuries will require hospitalization and can become life threatening if not promptly treated.
· Severity Level 4:Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0.13	0.03	0.00	0.01
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.15	0.04	0.01	0.01
	Other-Residential	0.93	0.18	0.01	0.02
	Single Family	1.38	0.23	0.02	0.05
	Total	**3**	**0**	**0**	**0**
2 PM	Commercial	7.10	1.73	0.24	0.46
	Commuting	0.00	0.00	0.00	0.00
	Educational	1.96	0.49	0.07	0.14
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.14	0.28	0.04	0.08
	Other-Residential	0.16	0.03	0.00	0.00
	Single Family	0.26	0.05	0.00	0.01
	Total	**11**	**3**	**0**	**1**
5 PM	Commercial	4.98	1.22	0.17	0.32
	Commuting	0.00	0.02	0.02	0.00
	Educational	0.22	0.05	0.01	0.02
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.71	0.18	0.02	0.05
	Other-Residential	0.33	0.06	0.00	0.01
	Single Family	0.54	0.09	0.01	0.02
	Total	**7**	**2**	**0**	**0**

Economic Loss

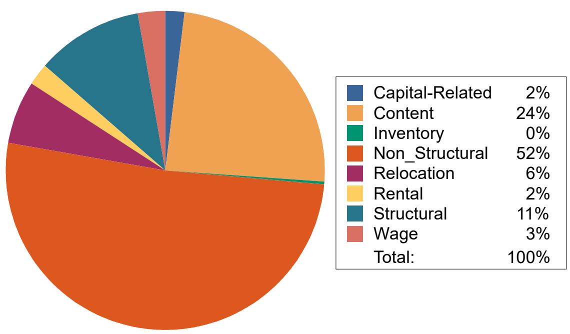
The total economic loss estimated for the earthquake is 19.28 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 18.01 (millions of dollars); 13 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 75 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

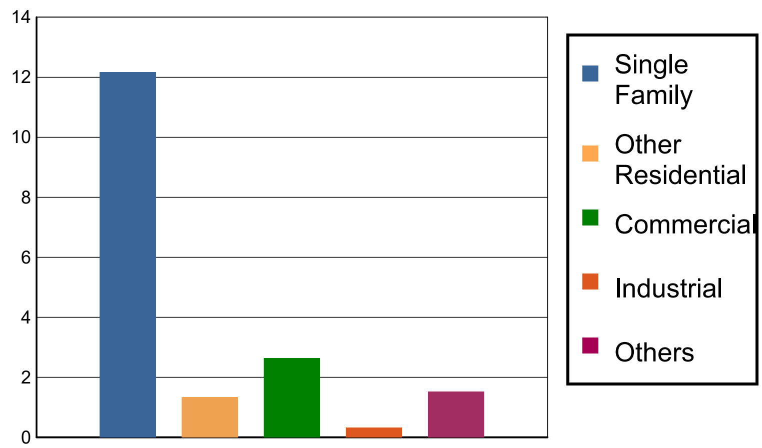


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0183	0.3222	0.0083	0.1640	0.5128
	Capital-Related	0.0000	0.0078	0.3495	0.0047	0.0048	0.3668
	Rental	0.1782	0.0438	0.1313	0.0018	0.0293	0.3844
	Relocation	0.6379	0.1454	0.1841	0.0127	0.1561	1.1362
	Subtotal	**0.8161**	**0.2153**	**0.9871**	**0.0275**	**0.3542**	**2.4002**
Capital Stock Losses							
	Structural	1.1561	0.2472	0.2926	0.0451	0.2198	1.9608
	Non_Structural	6.9105	0.7383	0.8965	0.1495	0.5912	9.2860
	Content	3.2859	0.1471	0.4537	0.0882	0.3576	4.3325
	Inventory	0.0000	0.0000	0.0085	0.0184	0.0049	0.0318
	Subtotal	**11.3525**	**1.1326**	**1.6513**	**0.3012**	**1.1735**	**15.6111**
	Total	**12.17**	**1.35**	**2.64**	**0.33**	**1.53**	**18.01**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	73.8357	0.0000	0.00
	Bridges	52.0919	0.8587	1.65
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**125.9276**	**0.8587**	
Railways	Segments	7.4190	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**7.4190**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**133.35**	**0.86**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	6.9957	0.2449	3.50
	Subtotal	**6.9957**	**0.2449**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	4.1974	0.1230	2.93
	Subtotal	**4.1974**	**0.1230**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	2.7983	0.0421	1.50
	Subtotal	**2.7983**	**0.0421**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**13.99**	**0.41**	

Appendix A: County Listing for the Region

Berkshire,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Berkshire	1,444	160	16	177
Total Region		**1,444**	**160**	**16**	**177**

Hazus: Earthquake Global Risk Report

Region Name Savoy

Earthquake Scenario: Savoy Magnitude 7 Earthquake

Print Date: September 17, 2020

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 60.59 square miles and contains 1 census tracts. There are over 0 thousand households in the region which has a total population of 1,444 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 0 thousand buildings in the region with a total building replacement value (excluding contents) of 177 (millions of dollars). Approximately 95.00 % of the buildings (and 91.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 133 and 13 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 0 thousand buildings in the region which have an aggregate total replacement value of 177 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 81% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 2 schools, 1 fire stations, 0 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes no hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 146.00 (millions of dollars). This inventory includes over 13.67 miles of highways, 18 bridges, 434.34 miles of pipes.

Table 1: Transportation System Lifeline Inventory

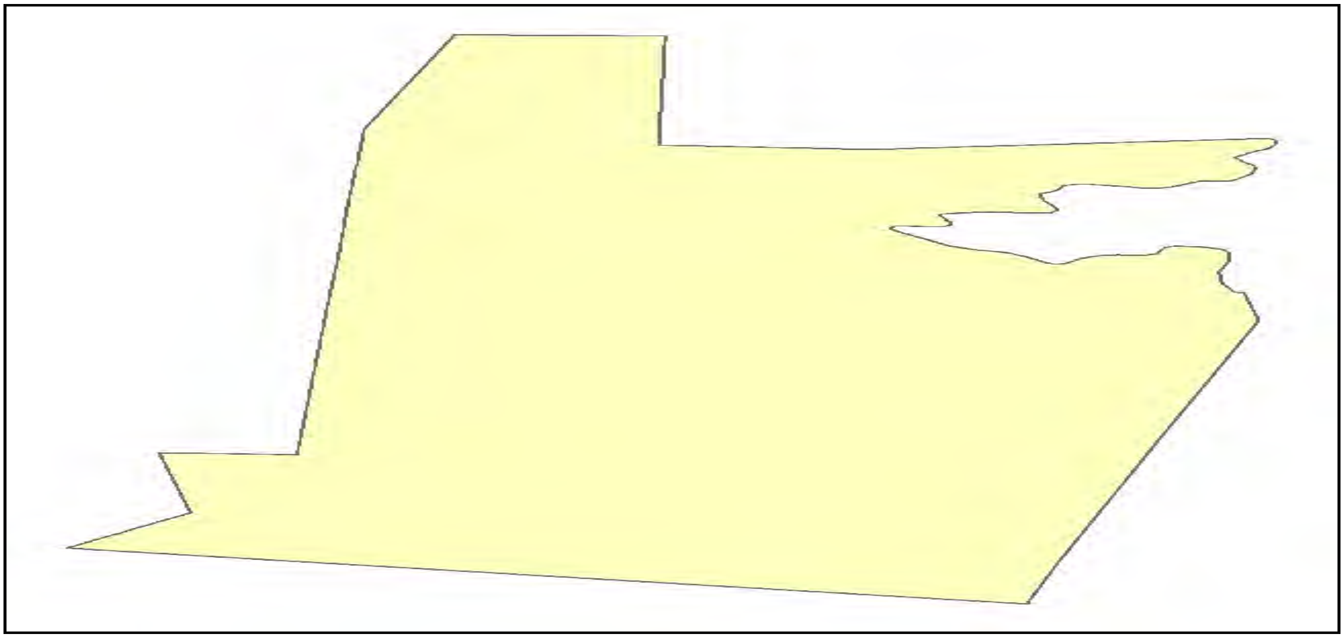
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	18	52.0919
	Segments	2	73.8357
	Tunnels	0	0.0000
		Subtotal	**125.9276**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	7.4190
	Tunnels	0	0.0000
		Subtotal	**7.4190**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**133.30**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	6.9957
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**6.9957**
Waste Water	Distribution Lines	NA	4.1974
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**4.1974**
Natural Gas	Distribution Lines	NA	2.7983
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**2.7983**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**14.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	Savoy Magnitude 7 Earthquake
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-73.01
Latitude of Epicenter	42.58
Earthquake Magnitude	7.00
Depth (km)	12.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 694 buildings will be at least moderately damaged. This is over 94.00 % of the buildings in the region. There are an estimated 294 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

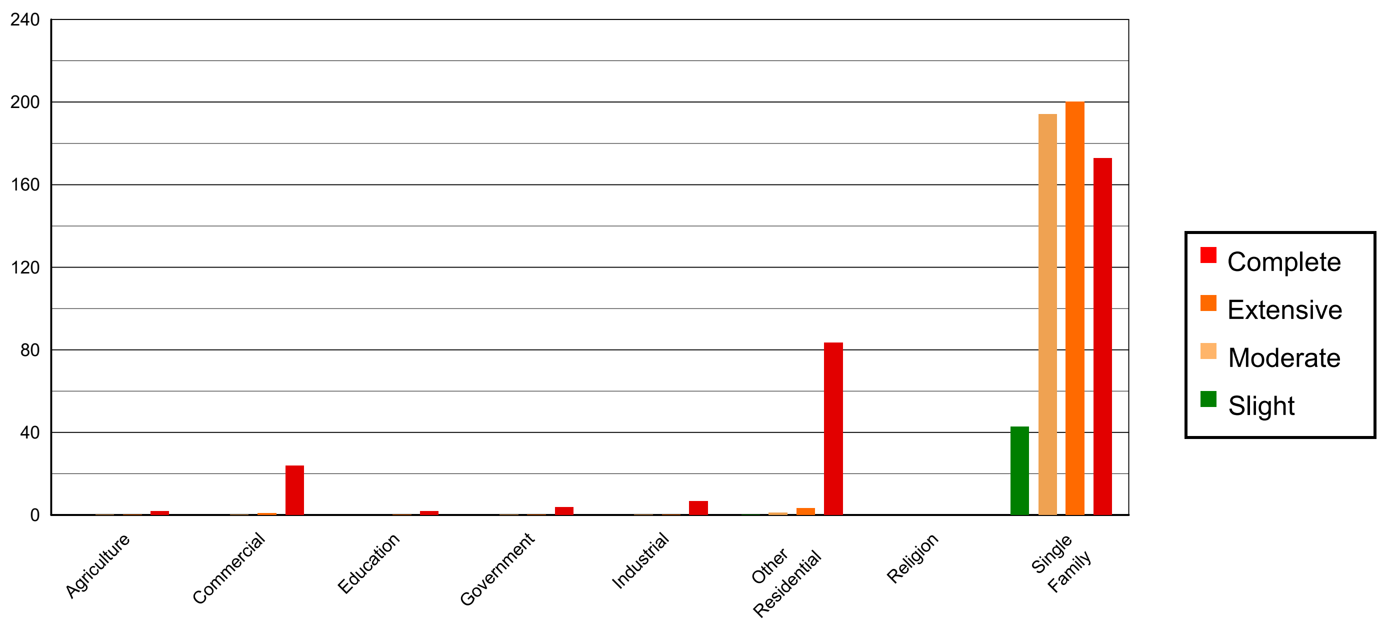


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.00	0.00	0.00	0.00	0.01	0.01	0.12	0.06	1.87	0.63
Commercial	0.00	0.05	0.01	0.02	0.11	0.05	0.94	0.46	23.95	8.13
Education	0.00	0.00	0.00	0.00	0.01	0.00	0.07	0.03	1.92	0.65
Government	0.00	0.01	0.00	0.00	0.01	0.01	0.10	0.05	3.88	1.32
Industrial	0.00	0.01	0.00	0.00	0.02	0.01	0.19	0.09	6.79	2.30
Other Residential	0.02	0.40	0.19	0.45	1.03	0.53	3.24	1.58	83.53	28.34
Religion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Single Family	4.25	99.52	42.75	99.53	194.10	99.39	200.11	97.73	172.79	58.63
Total	**4**		**43**		**195**		**205**		**295**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	4.26	99.85	42.91	99.90	194.76	99.73	200.74	98.04	156.05	52.95
Steel	0.00	0.03	0.00	0.00	0.02	0.01	0.36	0.18	19.10	6.48
Concrete	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02	2.64	0.90
Precast	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	1.23	0.42
RM	0.00	0.02	0.00	0.00	0.02	0.01	0.04	0.02	3.12	1.06
URM	0.00	0.11	0.02	0.04	0.24	0.12	1.17	0.57	31.26	10.61
MH	0.00	0.00	0.02	0.05	0.25	0.13	2.40	1.17	81.33	27.59
Total	**4**		**43**		**195**		**205**		**295**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	2	2	2	0
EOCs	0	0	0	0
PoliceStations	0	0	0	0
FireStations	1	1	1	0

Transportation Lifeline Damage

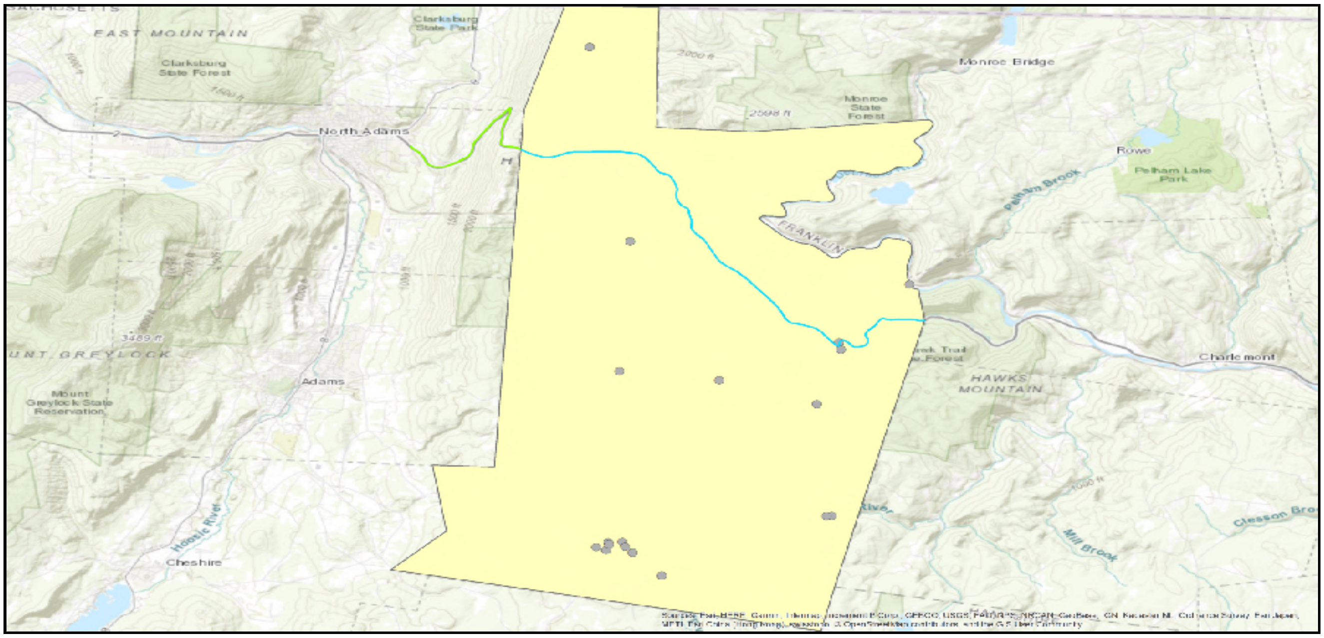


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	2	0	0	2	2
	Bridges	18	18	17	0	1
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	1	1
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	217	1709	427
Waste Water	130	858	215
Natural Gas	87	294	74
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	606	605	604	600	0	0
Electric Power		584	547	445	185	1

Induced Earthquake Damage

Fire Following Earthquake

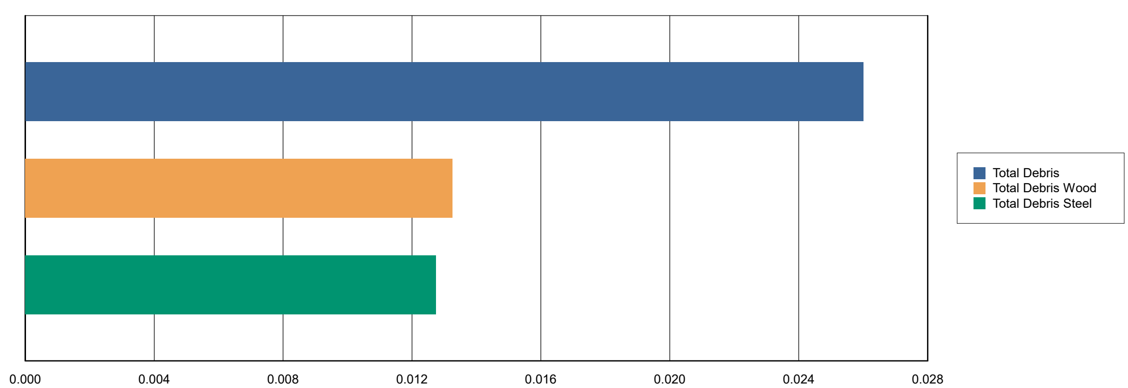
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 26,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 51.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 1,040 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



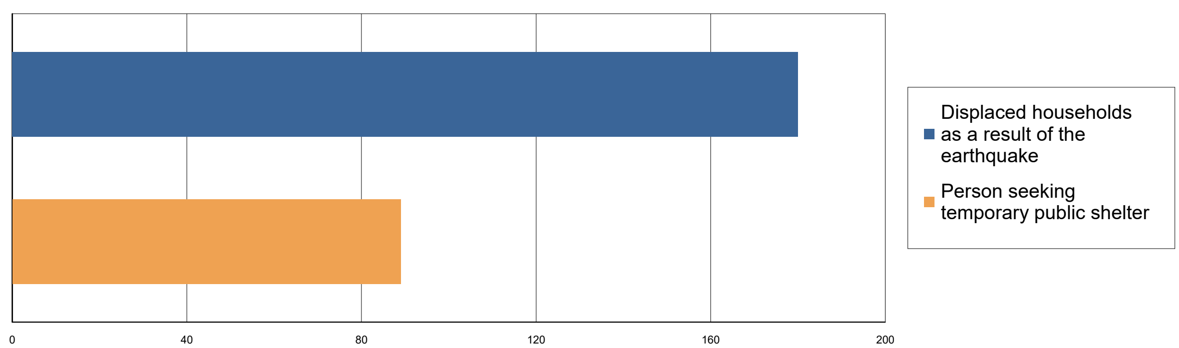
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.01	0.01	0.03	1,040 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 180 households to be displaced due to the earthquake. Of these, 89 people (out of a total population of 1,444) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
180	89

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1:Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2:Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3:Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4:Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	1.38	0.44	0.07	0.14
	Commuting	0.00	0.01	0.01	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.55	0.51	0.08	0.16
	Other-Residential	8.16	2.17	0.17	0.29
	Single Family	29.77	7.38	0.66	1.19
	Total	**41**	**11**	**1**	**2**
2 PM	Commercial	77.20	24.68	3.94	7.72
	Commuting	0.02	0.09	0.07	0.02
	Educational	22.00	7.20	1.21	2.35
	Hotels	0.00	0.00	0.00	0.00
	Industrial	11.53	3.75	0.62	1.20
	Other-Residential	1.42	0.38	0.03	0.05
	Single Family	5.78	1.44	0.15	0.23
	Total	**118**	**38**	**6**	**12**
5 PM	Commercial	54.56	17.45	2.82	5.40
	Commuting	0.46	2.18	1.78	0.44
	Educational	2.43	0.79	0.13	0.26
	Hotels	0.00	0.00	0.00	0.00
	Industrial	7.20	2.34	0.38	0.75
	Other-Residential	2.94	0.79	0.06	0.11
	Single Family	12.00	3.00	0.31	0.49
	Total	**80**	**27**	**5**	**7**

Economic Loss

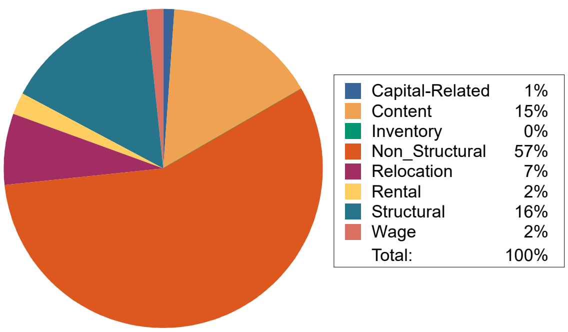
The total economic loss estimated for the earthquake is 186.51 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 139.17 (millions of dollars); 12 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 81 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

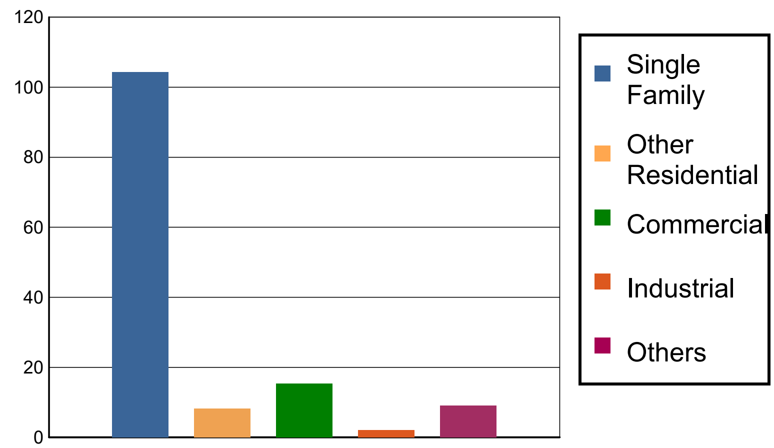


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.1027	1.4681	0.0398	0.6341	2.2447
	Capital-Related	0.0000	0.0438	1.6025	0.0224	0.0269	1.6956
	Rental	2.4348	0.2535	0.5134	0.0070	0.1089	3.3176
	Relocation	8.1261	0.5117	0.6833	0.0398	0.5746	9.9355
	Subtotal	**10.5609**	**0.9117**	**4.2673**	**0.1090**	**1.3445**	**17.1934**
Capital Stock Losses							
	Structural	17.1391	1.4448	1.6032	0.2238	1.2008	21.6117
	Non_Structural	62.1237	4.7967	6.4976	1.0628	4.2282	78.7090
	Content	14.4839	1.1123	2.9609	0.5668	2.3203	21.4442
	Inventory	0.0000	0.0000	0.0556	0.1184	0.0335	0.2075
	Subtotal	**93.7467**	**7.3538**	**11.1173**	**1.9718**	**7.7828**	**121.9724**
	Total	**104.31**	**8.27**	**15.38**	**2.08**	**9.13**	**139.17**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	73.8357	0.0000	0.00
	Bridges	52.0919	34.4628	66.16
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**125.9276**	**34.4628**	
Railways	Segments	7.4190	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**7.4190**	**0.0000**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**133.35**	**34.46**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	6.9957	7.6894	109.92
	Subtotal	**6.9957**	**7.6894**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	4.1974	3.8626	92.02
	Subtotal	**4.1974**	**3.8626**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	2.7983	1.3233	47.29
	Subtotal	**2.7983**	**1.3233**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**13.99**	**12.88**	

Appendix A: County Listing for the Region

Berkshire,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Berkshire	1,444	160	16	177
Total Region		**1,444**	**160**	**16**	**177**

APPENDIX D

Plan Adoption

APPENDIX E

FEMA Approval