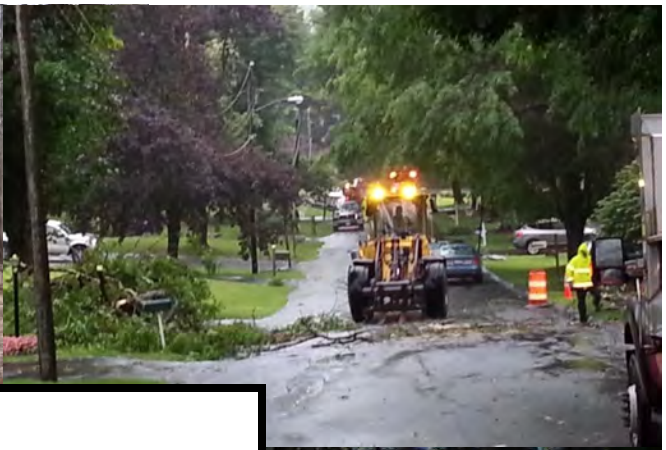
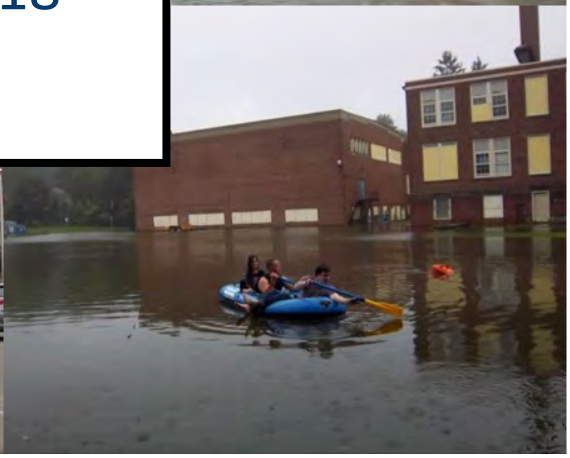




DALTON
MULTI-HAZARD MITIGATION PLAN
UPDATE 2018

Town of Dalton,
Massachusetts
December 2018



Acknowledgements

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The Town of Dalton would like to Dalton Emergency Management Advisory Council, who served as the Advisory Committee for the plan update, particularly Danial Filiault, Emergency Management Director and Chairman of the Council, who oversaw the planning process and completion of the plan update. The Berkshire Regional Planning Commission provided technical assistance to the Advisory Council throughout the planning process.

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SECTION 1. INTRODUCTION AND BACKGROUND

1.1. Purpose of the Dalton Multi-Hazard Mitigation Plan

According to FEMA a hazard is defined as "an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or the types of harm or loss."   Hazard mitigation is defined as a "sustained action taken to reduce or eliminate the long-term risk to people and property from hazards and their effects."

The Federal Disaster Mitigation Act of 2000 mandated that all localities prepare local hazard mitigation plans to be eligible for future FEMA funding from the newly established Pre-disaster Mitigation (PDM) grant program and for the existing post-disaster Hazard Mitigation Grant Program (HMGP), the latter of which is a mainstay of the FEMA grant programs.

This Multi-Hazard Plan is an update of the *Berkshire County Hazard Mitigation Plan*, dated November 5, 2012, a regional plan in which the Town of Dalton was included with 18 other Berkshire County municipalities. Geographically this current plan update is a plan involving a single municipality, the Town of Dalton, Massachusetts. During the development of this plan other hazard mitigation plans in the region were consulted, including the neighboring communities of Cheshire, Lanesborough, Hinsdale and Pittsfield.

The Plan is designed to serve as a tool to help town officials identify hazard risks, assess the town's vulnerability to hazardous conditions, consider measures that can be taken to minimize hazardous conditions, and develop an action plan that can reasonably be implemented to mitigate the impacts of hazards in the region. This plan should be used in conjunction with other local and regional plans, specifically other hazard mitigation plans, the *Town of Dalton Master Plan of 2016, Complete Streets Policy Plan,* and a soon-to-be drafted open space and recreation plan. It is expected that this updated plan will be a foundation upon which to build a Municipal Vulnerability Preparedness Plan, which the Town expects to undertake in 2018-19.

1.2. Background

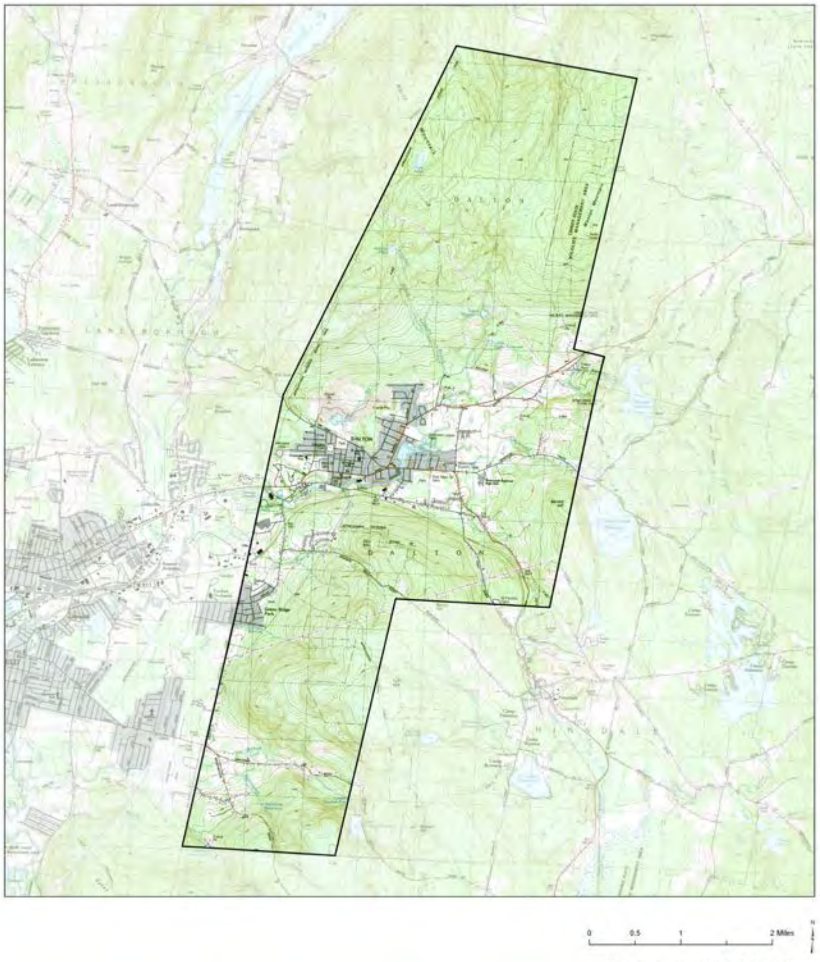
The Town of Dalton is located in central Berkshire County, Massachusetts. Settled in 1755, Dalton is bordered by the City of Pittsfield and Town of Lanesborough to the west, the Town of Cheshire to the northwest, Towns of Windsor and Hinsdale to the east, and Washington to the south. The Town is located along the East Branch of the Housatonic River, which bisects the Town at its center. The Town is characterized by a forested, mountainous landscape historically suited to the development of water-powered mill industries, along the swift-moving Housatonic river and its tributaries.   The well drained, glacial soils provide rich farmland to the Town's interior, and the many tributaries, flood plains, reservoirs and wetland areas provide the Town with natural beauty, recreational opportunities and access to ample water resources. These same positive attributes also provide increased risk for flooding hazards, property damage and increased vulnerability in the more heavily populated areas, if not properly assessed, monitored and mitigated.

As noted in the Town's Master Plan and according to the U.S. Census Bureau's American Communities Survey, in 2013 Dalton had a year-round population of approximately 6,744 persons, making it the 6th largest community in the County. Census data indicates that the town population decreased from 7,155 to 6,756 residents between 1990 and 2010. This amounts to a 5.6% decrease in population over the 20-year period. Additionally, Dalton's population is projected to decrease in the future. The Donahue Institute at UMass Amherst projects that Dalton will shrink by roughly 300 residents over the next two decades, approaching 6,379 year-round residents by 2035.

The median age of Dalton residents is 46.9 years old. Between 2000 and 2013, the number of residents below the age of 45 decreased, while the number over the age of 45 increased. The town is expected to lose population over the next two decades, by about 365 residents. The aging and decline of the population follows a region-wide trend, that is expected to continue for the next four decades.

According to 1999 land use, Dalton is largely forested (76% land use coverage), with a mix of urban and suburban residential uses accounting for 9.3% of the developed acreage. The balance of acreage is devoted to a mix of institutional, commercial or industrial uses. Historically, development within the town has been concentrated around Main Street and the areas around the mills. These neighborhoods typically contain homes of older building stock. Dense residential neighborhoods radiated out around the town center. In the 1950s/60s modest, suburban developments occurred outside the town center, and in subsequent decades scattered single family homes and neighborhoods of larger lot, less dense residential development has occurred. Land use in Dalton is regulated through the town's zoning bylaws, that includes four residential districts, two business districts and three industrial districts, as well as several overlays governing open space, flood plains and scenic viewsheds.

Figure 1.1. Topographical Map of Dalton



Berkshire Regional Planning Commission

This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

According to the Town's Master Plan, Dalton has approximately 50 miles of roads, of which 2.5 miles are unpaved roads. Of the paved roads, MassDOT maintains approximately 6.6 miles, involving the major transportation corridors that are known as Routes 8 & 9.

SECTION 2. PLANNING PROCESS

2.1. Planning Committee

The Dalton Emergency Management Department took the lead in developing the *Dalton Multi-Hazard Mitigation Plan Update*, creating an advisory committee that consisted of municipal department heads, representatives from various town boards and committees, and representatives from the Central Berkshire Regional School District, the Dalton Fire and Water District, and local businesses. Members of the Dalton Emergency Management Advisory Council are listed below, Table 1. Technical Assistance for the development of this plan were provided by the Berkshire Regional Planning Commission (BRPC).

Table 2.1. Dalton Emergency Management Advisory Council

Name	**Position**
Chief Jeffrey Coe	Dalton Police Department
Bob Benlien	Water District Superintendent
John Roughley	Superintendent, Highway, Cemetery, Sewer Dept.
Chief Jerry Cahalan	Dalton Fire Department
Becky Slick	Town Planner
Dan Filiault	Emergency Management Director
Lysander Bone	Crane Company
Patrick Pettit	Superintendent Building & Grounds/Procurement
Sandra Albano	Town Accountant
Jason Dion	Central Berkshire Regional School District
Brian Duval	Building Inspector

The Advisory Council formally began the planning process for the update of the hazard mitigation plan in September 2017 and submitted its first draft plan for review to MEMA in October 2018. During the convening months the Advisory Council met four times to discuss data provided by BRPC, to gather more detailed and site-specific information, to discuss opportunities for improved preparedness and mitigation, and to begin to identify potential action strategies. All Council meetings were open to the public and complied with the Massachusetts Open Meeting Law. Town officials and the public were kept informed of the planning process through a variety of media, including posting of all meetings and meeting minutes on the Town’s website, and periodic updates were posted on the Emergency Management Department’s facebook page. The Emergency Management Director made periodic update reports to the Dalton Select Board, the meetings of which are televised on the local community television station. Additionally the EMD spoke to senior residents about emergency preparedness and the hazard mitigation planning process twice, one of which was televised.

To garner further public input, the Advisory Council held a public forum to unveil the formal public review process for the draft plan. The forum, held on June 12, 2018, provided the public with an overview of the types of natural hazards that were evaluated, cited the hazards of most concern for the Town of Dalton, and the listed the draft actions of highest priority. Copies of the Draft Action Table were distributed. The forum was televised and broadcast on community television, which is broadcast to the Dalton neighboring communities of Pittsfield, Cheshire and Hinsdale. The public was asked to review the draft plan and provide input to the Advisory Council by June 29th. The draft plan was posted on the BRPC’s website, with a direct link from the Town of Dalton’s website and facebook page.

Comments on the plan were received by Advisory Council members, the Hinsdale Emergency Management Director, a former Dalton Selectboard member who has experience in emergency management, and Crane Company. Meeting materials and public forum materials can be found in Appendix C.

The *Dalton Multi-Hazard Mitigation Plan* is a compilation of data collected by BRPC, information gathered from the Advisory Council during meetings, and interviews conducted with key stakeholders outside of working meetings. Interviews were specifically held with the Dalton Emergency Management Director, Dalton Council on Aging, and staff at the Dalton Fire and Water District, Central Berkshire Regional School District and Crane Company.

Edits to the draft plan reflect comments provided by the Hazard Mitigation Committee, local officials and citizens, MEMA and FEMA.

2.2. Coordination with Existing and Developing Planning Efforts

There are several documents and efforts that identify and address emergency and environmental concerns for Dalton. The Town of Dalton has updated its Comprehensive Emergency Management Plan (CEMP), including the input of all critical facilities into a GIS format, which outlines an emergency management program for planning and response to potential emergency or disaster situations. The CEMP assigns responsibilities and functions, which will provide for the safety and welfare of its citizens against the threat of natural, technological, and national security emergencies and disasters. The plan addresses the Mitigation, Preparedness, Response and Recovery aspects of emergency management organizations, programs, protective actions, and specific hazards. Critical infrastructure and vulnerable populations were identified and verified using the CEMP and drawing on local first responder knowledge. This Plan is available in print form and at the town website.

Regionally, Dalton is an active member of the Central Berkshire Regional Emergency Planning Committee (CBREPC), which is made up of 13 towns in the central Berkshire region. The CBREPC's priority is to minimize the risk to public safety, health and property through the development of a Regional Hazardous Materials Emergency Response Plan and a database of resources, equipment, and personnel that can be drawn on upon in an emergency. Although the primary responsibility of the CBREPC is to address hazardous materials, the organization has taken a broad emergency planning role that includes the full range of emergency and disaster planning and response.

More specifically this Hazard Mitigation Plan draws upon information found in the following plans:

- Dalton Master Plan (2016)
- Berkshire County Hazard Mitigation Plan (FEMA approved 2013)
- Hazard mitigation plans of neighboring Pittsfield, Cheshire, Lanesborough and Hinsdale
- Massachusetts State Hazard Mitigation Plan (FEMA approved 2013)
- Dalton Fire and Water District Plan
- Massachusetts Climate Adaptation Plan
- Pandemic Preparedness Plans (through Berkshire County Boards of Health Association [BCBOHA])
- The Central Berkshire Regional Shelter Plan (developed through WRHSAC, CREPC and BCBOHA)
- Regional Evacuation Plans (developed through WRHSAC)
- Town of Dalton Capital Improvement Plan

2.3. Plan Maintenance and Updates

The Dalton Department of Emergency Management is the steward of the *Dalton Multi-Hazard Mitigation Plan of 2018*. Although several of the mitigation measures from the Town's previous Hazard Mitigation Plan have been implemented, since that Plan was adopted there has not been an ongoing local process to guide hazard mitigation implementation. Such a process is needed over the next five years for the implementation of this Plan update and will be structured as described below.

After approval of the plan by FEMA, the Dalton Emergency Management Advisory Council will continue to meet and function as the Hazard Mitigation Implementation Team, with the Emergency Management Director designated as the coordinator. Additional members could be added to the local implementation team from businesses, non-profits and institutions.

It has determined that the Plan should be reviewed and revised as appropriate every two years with the Dalton Emergency Management Advisory Council. When the Plan is in its third or fourth year, the Department will begin the process of updating the Plan to ensure continuity and retain the Town’s eligibility to apply for and receive FEMA and other relevant funding.

The Town will encourage public participation during the next five-year planning cycle. As updates and a review of the Plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town’s web site and Town facebook pages, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with Town and state open meeting laws.

SECTION 3. NATURAL HAZARD RISK ASSESSMENT

3.1. Identifying Hazards

As defined by FEMA, a natural hazard is a source of harm or difficulty created by a meteorological, environmental or geological event. Vulnerability is defined as the characteristics of community assets that make them susceptible to damage from a given hazard. A risk assessment is a produce or process that collects information and assigns values to risks for the purpose of informing priorities, developing or comparing courses of action, and informing decision making (FEMA 2013). This section of the plan discusses the natural hazards that have been determined to impact the Town of Dalton. The Town chose to investigate the 17 natural hazards that are identified and discussed in the *Commonwealth of Massachusetts State Hazard Mitigation Plan*. Two of the hazards, Coastal Hazards and Tsunami, do not occur in the Town because it is a land-locked community within Berkshire County, approximately 140 miles from the Massachusetts coast and more than 100 miles from the Long Island Sound. The other 15 hazards are grouped in nine categories that best fit their weather pattern and impact upon the Town (see Table 1).

To determine which natural hazards have the greatest potential to impact the town, the hazards were analyzed for their Area of Impact, Frequency of Occurrence and Severity. Refer to Table 3.1. for a matrix displaying the natural hazards and their ranking. In addition to natural hazards, this multi-hazard mitigation plan also analyzes the potential risk for hazardous materials spills and contamination.

Table 3.1.1. Natural Hazards that Impact Dalton

Hazard	Category
Flood (Including Ice Jam)	Flood
Dam Failure	Dam Failure
Hurricane / Tropical Storm	Hurricane
Nor’easter	Severe Winter Weather
Snow & Blizzard	Severe Winter Weather
Ice Storm	Severe Winter Weather
Thunderstorm	Severe Weather
High Winds	Severe Weather
Tornado	Severe Weather
Drought	Drought
Extreme Temperature	Severe Weather
Wildland Fire	Fire
Major Urban Fire	Fire
Earthquake	Earthquake
Landslide	Landslide
Coastal Hazards	Not Included
Tsunami	Not Included

Table 3.1.2. Hazards that have the greatest potential to impact Dalton

Hazard	Area of Impact Rate	Frequency of Occurrence Rate	Magnitude / Severity Rate	Hazard Ranking
	1=small 2=medium 3=large	0 = Very low frequency 1 = Low 2 = Medium 3 = High Frequency	1=limited 2=significant 3=critical 4=catastrophic	
Dam Failure	3	0	4	**7**
Flooding (include Ice Jam, Beaver Activity)	2	3	2	**7**
Severe Winter Event (Ice Storm, Blizzard, Nor'easter)	3	2	2	**7**
Severe Storms (High Wind, Tornado, Extreme Temperature)	3	2	2	**7**
Hurricane & Tropical Storms	3	2	2	**7**
Drought	3	1	1	**5**
Tornado	1	0	4	**5**
Earthquake	2	0	2	**4**
Urban & Wildfire	2	1	1	**4**
Landslide	1	0	1	**2**
Area of Impact				
1=small	isolated to a specific area of town during one event			
2=medium	occurring in multiple areas across town during one event			
3=large	affecting a significant portion of town during one event			
Frequency of Occurrence				
0=Very low frequency	events that have not occurred in recorded history of the town, or that occur less than once in 1,000 years (less than 0.1% per year0			
1=Low frequency	events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year)			
2=Medium frequency	events that occur from once in 10 years to once in 100 years (1% to 10% per year)			
3=High frequency	events that occur more frequently than once in 10 years (greater than 10% per year)			
Magnitude/Severity				
1=limited	injuries and/or illnesses are treatable with first aid; minor" quality or life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%			
2=significant	injuries and/or illnesses do not result in permanent disability; shutdown of several critical facilities and services for more than one week; property severely damaged < 25% and > 10%			
3=critical	injuries and/or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged < 50% and > 25%			
4=catastrophic	multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged> 50%			

Source: Table developed by BRPC 2005.

3.2. Flood Hazards

3.2.1. General Background

As noted in the Massachusetts SHMP, floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss — 75% of federal disaster declarations are related to flooding. Property damage from flooding totals over $5 billion in the United States each year. The high costs of flood response and reparations are the reason that the National Flood Insurance Program has been established. Flooding is the result of several types of natural hazards, the impacts of which can be acerbated by development and local land-use practices, which is why it is so important that communities review and consider the effectiveness of their land use regulations and policies as part of their hazard mitigation planning process. (MEMA, 2013)

As part of this 2018 update, the Town of Dalton has gathered the most updated and best available data, including historical occurrences, the severity and/or recurrence interval information where available, and potential trends into the future. This gathering of information also includes that provided by local data provided by emergency responders, public works staff, local officials, business leaders and long-time residents. This update also looked at flood claims and repetitive losses in Dalton. HAZUS has been utilized to aid in analyzing risk, potential losses, and damages. Taken together this information helps town officials and emergency management personnel gauge the scope of natural hazard events and assess their likeliness of reoccurring.

Common Types of Floods

The hazards that produce local or regional flooding in the region include hurricanes, tropical storms, heavy rain events, winter rain-on-snow, thunderstorms, and beaver activity. Storms coinciding with spring melt are historically common, with winter cycles of snow followed by rain becoming more common. Flash flood regimes are common in the region due to the hilly terrain and thin soil that supports headwater streams and rivers. Stream and riverine flooding often occurs after heavy rain events, filling steeply sloped stream channels that rapidly discharge into larger streams and the Housatonic River. Naturally occurring accelerated runoff occurs when soils are not able to absorb rainfall such as when soils are already saturated or when the ground is frozen. (MEMA, 2013)

Man-made accelerated runoff occurs where development has created impervious surface areas, most particularly where runoff has been channeled and discharged into streams and rivers that are already swollen from natural runoff. Channeling and discharging runoff bypasses the natural processes whereby vegetated cover and uncompacted soils attenuate some portion of surface runoff through infiltration and uptake. Capturing, channeling and discharging runoff results in higher volumes of water reaching streams and river in an accelerated timeframe, causing greater stream and riverbank erosion, and higher debris and sediment loads.

Flooding of land also occurs when stream and river channels, bridge spans, culverts or drainage channels cannot accommodate the volume of water flowing through their system. Undersized culverts and bridge spans constrict flood waters, causing them to back up and flood properties upstream of the constriction. Flooding due to constriction occurs at High Street and Orchard Road. Water and sewer lines can be threatened by floodwaters and flood-borne debris when the bridges that carry them across stream and river crossings are flooded, such as the Main Street Bridge at Center Pond.

Urban flooding can occur when the amount of heavy snowmelt and/or rain events is too great to flow through storm drain systems. Backup and ponding of water can flood streets and properties, and manhole covers can be lifted out of position. Discharge of stormwater into rivers and streams can be blocked by floodwaters if the storm drain outlets themselves are under water, and in some instances stream/river water can flow back up into drainage systems and flood the urban areas served by the storm drain system. Flooding of some roadways can isolate homes and neighborhoods, and emergency response and evacuations routes can become impassable. (MEMA, 2013)

Beaver activity can cause flooding in a variety of ways due to their instinct to create ponding and to react to flowing water. Damming streams and wetland outlets cause flooding that can expands areas of inundation upstream and outward, which can threaten the built environment. If the impoundment impacts a drinking water supply, it can threaten human health. Beavers can also cause flooding due to their propensity to block culverts, threatening not only the road crossing but possibly properties upstream. (MEMA, 2013)

Measuring Floods

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. The 100-year flood elevation or discharge of a stream or river has a 1% chance of occurring or being exceeded in any given year. In this case the statistical recurrence interval would be 100 years between the storm events that meet the 100-year discharge/flow. Such a storm, with a 1% chance of occurrence, is commonly called the 100-year storm. Similarly, the 50-year storm has a statistical recurrence interval of 50 years and an “annual flood” is the greatest flood event expected to occur in a typical year. It should be understood, however, that these measurements reflect statistical averages only; it is possible for two or more floods with a 100-year flood discharge to occur in a short time period.

The extent of the area of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood), most commonly termed the 100-year floodplain area, is a convenient tool for assessing vulnerability and risk in flood-prone communities. The 100-year flood boundary is used as the regulatory boundary by many agencies, including FEMA and MEMA. It is also the boundary used for most municipalities when regulating development within flood-prone areas. The FEMA Flood Insurance Rate Maps (FIRM) developed in the early 1980s for Berkshire County, typically serve as the regulatory boundaries for the National Flood Insurance Program (NFIP) and municipal floodplain zoning. A structure located within a the 100-year flood area on the NFIP maps has on average a 26% percent chance of suffering flood damage during the term of a 30-year mortgage. (MEMA, 2013). However, as noted in the FIRMs, the areas shown within the 100-year flood boundaries are for flood insurance only; they do not necessarily show area in a community subject to flooding.

Table 3.2.1. Recurrence Intervals and Probabilities of Occurances

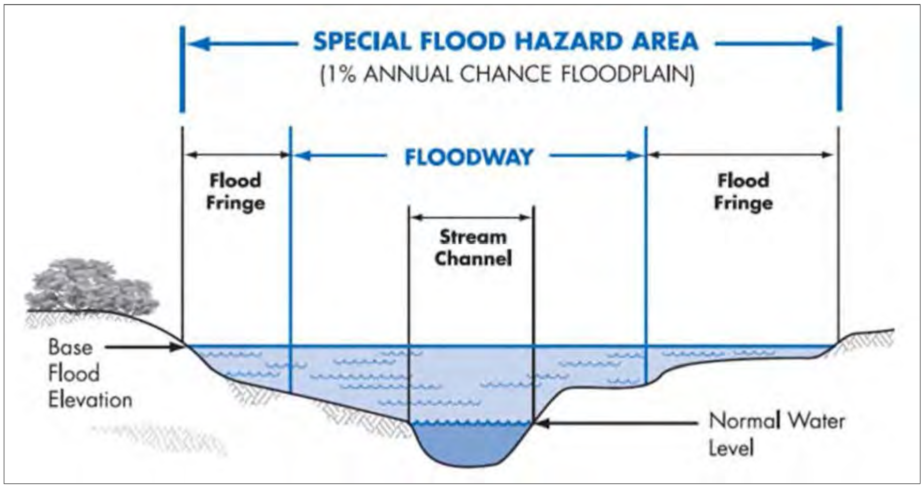
Recurrence interval,	Probability of occurrence	Percent chance of
500	1 in 500	0.2
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Flood flows in Massachusetts are measured at numerous USGS stream gages, with the closest one to Dalton being located on the Housatonic River near the Dalton Avenue / Hubbard Avenue intersection. Typically, in the aftermath of a flood event, USGS will determine the recurrence interval of the event using data from the gage's period of historical record.

Floodplains and Wetlands

A floodplain or floodway is the area adjacent to a stream, river, or lake that becomes inundated during a flood. In the Berkshires these areas most often flood during spring melt and during high rain events, and inundation is often fairly common and expected, and are equal to a 50% or 100% (annual) chance of recurrence. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a deep channel. In general, flooding can be defined as a rising and overflowing of a body of water onto normally dry land. In some areas it is fairly easy to identify floodway floodplains due to the terrain, soils and vegetation. Floodplain forests and wetland ecosystems may occupy these areas, serving to buffer the impacts of floods by absorbing and storing water and tempering flowing waters. Backup of floodwaters occurs when structures are built in this floodway/floodplain area that constricts or impede flows, such as when roads cross this area and bridges and culverts are undersized. Figure 3.2.1. depicts the floodway and 100-year flood hazard areas of a floodplain. (MEMA, 2013)

Fig. 3.2.1. Flood-Prone Areas Typically Associated with Streams and Rivers



Source: (MEMA, 2013)

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments known as alluvium (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. (MEMA, 2013)

Floodplains are among the most species-rich ecosystems in the world. The biodiversity of a natural floodplain is extraordinary, due to the mix of soils, hydrologic regimes and vegetated habitats that occupy these areas. Floodplains are the habitat that connects the truly aquatic ecosystems with the truly upland ecosystems, providing the habitats needed many aquatic-based and terrestrial-based wildlife. They have historically been converted to agricultural uses due to their often fertile and deep soils and relatively level terrain. Further floodplain lands were developed as flowing waterways provided the power needed by industrial uses and the towns and cities that developed around them. (MEMA, 2013)

As a result, Massachusetts' flood plains tend to be relatively heavily developed and highly populated. Human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain if steps are taken to mitigate the activities' adverse impacts on floodplain functions. (MEMA, 2013). It is for these reasons that maintaining riverine floodplains in an undeveloped and natural state is so important to flood control.

Secondary Hazards

In the Berkshire region rivers and streams tend to be dynamic systems, with stream channel and bank erosion common in both headwater streams and in the level, meandering floodplains of the Housatonic and Hoosic Rivers. Fluvial Erosion is the process where the river undercuts a bank, usually on the outside bend of a meander, causing sloughing and collapse of the riverbank. Fluvial erosion of stream and riverbanks can creep towards the built environment and threaten to undercut and wash away buildings, roads, and bridges. Many roads throughout the region follow streams and rivers, having been laid in the floodplain or carved along the slopes above the bank. Older homes, barns and other structures were also built in floodplain or just upgradient of stream channels in both rural and urban areas. Fluvial erosion can also scour and downcut stream and river channels, threatening bridge pilings and abutments. This type of erosion often occurs in areas that are not part of a designated floodplain. (MEMA, 2013)

Flood waters can increase the risk of the creation of and dislodging of ice dams during the winter months. Blocks of ice can develop in streams and rivers to create a physical barrier or dam that restricts flow, causing water to back up and overflow its banks. Large ice jam blocks that break away and flow downstream can damage culverts, bridges and roadways whose openings are too small to allow passage. (MEMA, 2013)

Electrical power outages can occur during flood storm events, particularly when storm events are accompanied by high winds, such as during hurricanes, tropical storms, thunderstorms and micro-bursts. Fortunately, most flooding in the Berkshire region is localized and have resulted in few wide spread outages in recent years, and where it occurs service has typically been restored within a few hours.

Landslides on steep slopes can occur when soils are saturated and give way to sloughing, often dislodging trees and boulders that were bound by the soil. The damage from Hurricane Irene in 2011 to Route 2 in the Florida/ Charlemont area was a combination of fluvial erosion from the Cold and Deerfield Rivers and a landslide on the upland slope of the road.

Dam failures, which are defined as uncontrolled releases of impounded water due to structural deficiencies in the dam, can occur due to heavy rain events and/or unusually high runoff events. (MEMA, 2013). Severe flooding can threaten the functionality or structural integrity of dams. In addition to the 10 dams in Dalton, the town is in the inundation area for at least another 4 dams in other communities. A more thorough discussion of the Town of Dalton’s risks due to dam failure are discussed Section 3.5 of this plan.

Flooding of wastewater treatment facilities can not only inflict costly damages to buildings and other structures, it can cause the release of untreated effluent into receiving waters. Storm drain systems that direct high volumes of runoff into the sewer system during storm events can overwhelm the capacity of the receiving treatment facility, causing the release of untreated or undertreated effluent. (MEMA, 2013). There is not a municipal wastewater treatment plant in Dalton because all waste from the town is directed and treated at the Pittsfield Wastewater Treatment Plant. However, studies confirm that the town discharges higher volumes of water to the Pittsfield plant during times of high runoff and high groundwater levels. Crane Company does operate an industrial wastewater treatment plant off Crane Avenue, which is in the 100-year floodplain but is elevated.

Flooding of homes and businesses can impact human safety health if the area of inundation is not properly dried and restored. Wood framing can rot if not properly dried, compromising building structure and strength. Undetected populations of mold can establish and proliferate in carpets, duct work, wall board and almost any surface that is not properly dried and cleaned. Repeated inundation brings increased risks of both structural damage and mold. Vulnerable populations, such as those whose immune systems are compromised by chronic illness or asthma, are at higher risk of illness due to mold.

Severity

In general, the severity level of flood damage is affected by flood depth and flood velocity. The deeper and faster flood flows become, the more power they have and the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. (MEMA, 2013) However, flood damage to homes and buildings can occur even during shallow, low velocity flows that inundate the structure, its mechanical system and furnishings.

Climate Change Impacts

Based on data gathered from the Northeast Climate Science Center (NECSC), the yearly precipitation total for Berkshire County has been experiencing a gradual rise over the last 70 years, rising from 40.1 inches in the 1960's to 48.6 inches in the 2000's. According to projections from the NECSC, the county is projected to experience an additional 3.55 inches by the 2050's and 4.72 inches by the 2090's. (Northeast Climate Science Center, 2018)

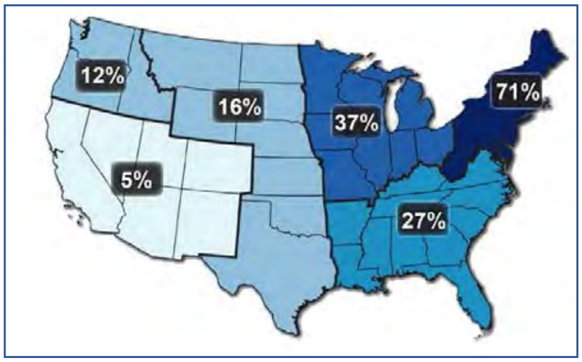
The scientific community is largely in agreement that climate change is altering the weather and precipitation patterns of the northeastern region of the U.S. The Intergovernmental Panel on Climate Change report of 2007 predicts temperature increases across the U.S., with the greatest increase in the northern states and during the winter months. The Northeast Climate Adaptation Science Center predicts that annual increases of 3.1° to 6.7° F will occur in the Housatonic River Watershed by mid-century, with the greatest increases in the winter season. [1] More mid-winter cold/thaw weather patterns events could increase the risk of ice jams. Many studies agree that warmer late winter temperatures will result in more rain-on-snow storm events, leading to higher spring melt flows, which typically are already the highest flows of the year.

Studies have also reported increases in precipitation in both developed and undeveloped watersheds across the northeast, with the increases being observed over a range of precipitation intensities, particularly in categories characterized as heavy and extreme storm events. These events are expected to increase both in number and in magnitude. Some scientists predict that the recurrence interval for extreme storm and flood events will be significantly reduced. One study concluded that the 10-year storm may more realistically have a recurrence interval of 6 years, a 25-year storm may have a recurrence interval of 14 years and the 100-year storm may have a recurrence interval of 49-years. The same study predicts that if historic trends continue that flood magnitudes will increase, on average, by almost 17%. (Walter & Vogel, 2010)

Data from at USGS streamflow gages across the northeast show a clear increase in flow since 1940, with an indication that a sharp "stepped" increase occurred in the 1970s. This is despite the fact that much of the land within many New England watershed has been reforested, and this type of land cover change would tend to reduce, rather than increase, flood peaks (Collins, 2008).

Climate change will likely alter how the region receives its precipitation, with an increase of it falling in the form of severe or heavy events. The observed amount of precipitation falling in very heavy events, defined as the heaviest one percent of all daily events, has increased 71% in the Northeast between 1958-2012.[2]

Fig. 3.2.2. Increase in Precipitation Falling in Top 1% Extreme Precipitation Events 1958-2012 Engineering



Source: NOAA, adapted from Karl, et al, 2009.

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[1] Northeast Climate Adaptation Science Center, 2018. *Massachusetts Climate Change Projections*, MA EOEEA, Boston, MA.

[2] *NOAA - https://toolkit.climate.gov/image/762, adapted from Karl et al.*

The NECSC also predicts that the region will see an increase in the number of days with at least 1 inch of precipitation from 4.5 days in the 1960s, to 5.1 days in the 2000s to 6.6 days in 2050s and 7.1 days in 2090s. (Northeast Climate Science Center, 2018) Already observed in Massachusetts, the number of extreme precipitation events, those defined as more than two inches in one day, has increased since the the 1980s, with the greastest increase in the past decade (see Fig. 3.2.3)[3].

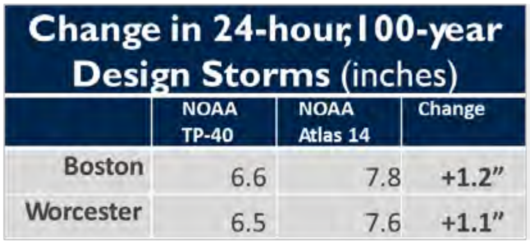
Fig. 3.2.3. Number of Extreme Precipitation Events of 2" or more in 1 Day

Source: https://statesummaries.ncics.org/ma

This trend has direct implications on the design of municipal infrastructure that can withstand extreme storm and flood events, indicating that all future designs must be based on them most updated precipitation and stream gauge information available. It is not unusual for stormwater management systems to be 50-100 years old, or older, and new infrastructure systems are being designed to have at least a 20-50-year lifespan. Thus, the vast infrastructure systems in place today will probably not accommodate the increased flows that are predicted.

Already the engineering and regulatory sectors have recognized the increase in precipitation. The long-used TP-40 method for sizing stormdrain system has been replaced by NOAA Atlas 14 and other methods. As shown in Fig. 3.2.4, the design for a 24-hour 100-year storm event has been increased to accommodate a greater amount of water.

Fig. 3.2.4. Engineering Standard Changes



Change in 24-hour, 100-year Design Storms (inches)

	NOAA TP-40	NOAA Atlas 14	Change
Boston	6.6	7.8	+1.2"
Worcester	6.5	7.6	+1.1"

It may be prudent, therefore, to slightly overdesign the size of new stormwater management and flood control systems so that they have the capacity to accept the increase in flow or volume without failing. For many piped systems, such as culverts, drainage ditches and swales, the slight increase in size may provide a large increase in capacity, and for very little increase in cost. If space is available, an increase in the capacity of retention/detention ponds may also be cost effective. Bioretention cells can be engineered so that they can increase their holding capacity for extreme storm events with little incremental cost. The size of the engineered soil media, which is a costly component of the system, may remain the same size as current designs call for, but a surface ponding area surrounding the central soil media is increased to serve as a holding pond.

Local public works superintendents are reporting an increase in road failures due to overwhelmed culverts, road washouts, eroding ditches, undercut road bases, and overtopped bridges. This information is not clearly documented, so it is not possible at this time to predict historic trends.

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[3] *https://statesummaries.ncics.org/ma*

3.2.2. Hazard Profile

Location

The town is bisected by the East Branch of the Housatonic River, which runs through the town center. There are also several small ponds in town, including Egypt Reservoir and Little Egypt Reservoir, which are backup water supplies for the town, Duncan Brook Pool, Gore Pond and Anthony Pond. There are several streams in town that eventually lead to the Housatonic River, including Anthony Brook, Egypt Brook, Duncan Brook, Wahconah Falls Brook, Cleveland Brook, Walker Brook, Barton Brook, Brattle Brook, Sackett Brook and Hathaway Brook.

The Town of Dalton has relatively little floodplain areas. The floodplains of note are associated with the Housatonic River and its tributaries Cleveland, Wahconah Falls and Anthony Brooks. Having descended hilly terrain, the three streams enter a broad open area of floodplain and wetland. Floodplains are present on Wahconah Golf Course where Cleveland Brook joins the East Branch Housatonic River.

The Center Pond floodplain/wetland complex is surrounded by residential development, most densely on the west and southern boundaries. Center Pond itself is an impoundment within the East Branch Housatonic River, the result of a dam owned by Crane Company. The pond is owned by Berkshire Natural Resources Council, a regional land trust.

Center pond is the area where the confluence of the Housatonic River and the Cleveland, Wahconah Falls and Anthony Brooks join together. Developed properties along North Main Street and East Deming Street experience periodic flooding. When large precipitation events are predicted, dam owners upstream in all of these watersheds release water in advance of the storms to create storage capacity. Although precautionary in nature, this release of water can create flood conditions downstream if water levels in waterways are already high from spring melt or previous precipitation events. Releases can come from dam owners at Lake Ashmere, Plunkett, Belmont and Cleveland Reservoirs in Hinsdale, Windsor Reservoir in Hinsdale/Windsor.

From Center Pond the Housatonic River flows through a steeply incised channel that lacks a floodplain until it reaches the South Street/Crane Avenue area. There are also floodplain areas along the lowlands of Sackett Brook near Washington Mountain Road and to the north of Crane Avenue.

Previous Occurrences

Between 1936 and 2017, four flood events equaling or exceeding the 1% annual chance flood have been documented the Berkshire County region: 1938, 1949, 1955 and 2011. Not all these were documented to a 1% chance storm for the Town of Dalton, with the most recent flood event, T.S. Irene in 2011 being determined to be a 2% chance storm according to the Housatonic River stream gage in Coltsville. The more notable recent flood events that impacted the Town of Dalton were in 2005 and 2011. Refer to Table 3.2.2. for a list of flood events impacting the region

Table 3.2.2. Previous Flooding Occurrences in the Berkshire County region

Year	Description of Event
1936	Widespread flooding occurs along the northern Atlantic in March 1936. Widespread loss of life and infrastructure. Many flood stages are discharges highest of record at many USGS stream gages, including Coltsville in Pittsfield.[4]
1938	Large rain storm hit the area. This storm was considered a 1% annual chance flood event in several communities and a .2% annual chance flood event in Cheshire. The Hoosic River flooded downtown areas of densely-developed Adams and North Adams, with loss of life and extensive damage to buildings. Other communities were not as severely impacted by it.
December 31, 1948 - January 1, 1949	The New Year's Flood hit our region with many of our areas registering the flood as a 1% annual chance flood event.
1955	Hurricanes Connie and Diane combined to flood many of the communities in the region and registering in 1% -0.2% annual chance flood event (100-500-year flood event) (FEMA 1977-1991).
May 1984	A multi-day storm left up to 9" of rain throughout the region and 20" of rain in localized areas. This was reported as an 80-year flood for most of the area and higher where the rainfall was greater (USGS, 1989).
September 1999	The remnants from Hurricane Floyd brought over between 2.5-5" of rain throughout the region and produced significant flooding throughout the region. Due to the significant amount of rain and the accompanying wind, there were numerous reports of trees down.
December 2000	A complex storm system brought 2-4" of rain with some areas receiving an inch an hour. The region had numerous reports of flooding.
March 2003	An area of low pressure brought 1-2" of rain, however this and the unseasonable temperatures caused a rapid melting of the snow pack.
August 2003	Isolated thunderstorms developed that were slow moving and prolific rainmakers. These brought flooding to the area and caused the evacuation of the residents of the trailer park along Wahconah Falls Road. This storm caused the Dalton Fire & Water District to shut down its entire water system from Windsor Reservoir due to the large amount of silt and gravel that was washed into the reservoir.
September 2004	The remnants from Hurricane Ivan brought 3-6" of rain. This, combined with saturated soils from previous storms, caused flooding throughout the region and caused damage to the spillway of the dam on Plunkett Reservoir in Hinsdale.

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[4] Grover, Nathan C., 1937. *The Floods of March 1936, Part 1. New England Rivers*. USGS, Wash. DC.

October 2005	A stationary cold front brought over 6” of rain and caused widespread flooding throughout the region. In Dalton, this was approximately a 50-year flood.
November 2005	Widespread rainfall across the region of 1-1.5”, which was preceded by 1-2 feet of snow, resulted in widespread minor flooding.
September 2007	Moderate to heavy rainfall occurred, which lead to localized flooding.
March 2008	Heavy rainfall ranging from 1-3” impact the area. Combined with frozen ground and snowmelt, this led to flooding across the region.
August 2008	A storm brought very heavy rainfall and resulted in flash flooding across parts of the region.
December 2008	A storm brought 1-4” of rain to the region, with some areas reporting ¼ to 1/3 of an inch an hour of freezing rain., before changing to snow. Moderate flooding and ponding occurred throughout the region. In Dalton, this was approximately a 2-5 year flood.
June 2009	Numerous slow-moving thunderstorms developed across the region, bringing very intense rainfalls and upwards of 6” of hail. This led to flash flooding in the region.
July 2009	Thunderstorms across the region caused heavy rainfall and flash flooding.
August 2009	An upper level disturbance moved across the region during the afternoon hours and triggered isolated thunderstorms which resulted in roads flooding.
October 2009	A low-pressure system moved across region bringing a widespread heavy rainfall to the area; 2-3” of rain was reported across the region.
March 2010	A storm brought heavy rainfall of 1.5-3” across the region, with roads closed due to flooding.
October 2010	The remnants from Tropical Storm Nicole brought 50-60 mph winds and 4-6” of rain resulting in urban flooding.
March 2011	Heavy rainfall, combined with runoff from snowmelt due to mild temperatures, resulted in flooding of rivers, streams, creeks, roads, and basements.
July 2011	Scattered strong to severe thunderstorms spread across the region resulting in small stream and urban flooding.
August 2011	Two distinct rounds of thunderstorms occurred producing heavy rainfall and localized flooding of roads.
August 2011	Tropical Storm Irene tracked over the region bringing widespread flooding and damaging winds. Riverine and flash flooding resulted from an average of 3-6 inches of rain and upwards of 9”, within a 12-hour period. Widespread road closures occurred throughout the region. In Williamstown this event was a 1% annual chance flood event, and in Dalton it was approximately a 2% chance flood.

September 2011	Remnants of Tropical Storm Lee brought 4-9” of heavy rainfall to the region. Due to the saturated soils from Tropical Storm Irene, this rainfall lead to widespread minor to moderate flooding on rivers as well as small streams and creeks. In Dalton, this was approximately a 2% chance flood.
August 2012	Remnants from Hurricane Sandy brought thunderstorms developed repeatedly bringing heavy rains over areas of the region. Upwards of 4-5” of rain occurred and flash flooding caused the closure of numerous roads.
May 2013	Thunderstorms brought wind and heavy rainfall caused flash flooding and road closures in areas.
August 2013	Heavy rainfall repeatedly moved across the region causing more then 3 inches of rain in just a few hours resulting in streams and creeks to overflow their banks and resulting in flash flooding. Roads were closed as a result of the flooding and water rushed into some basements.
September 2013	Showers and thunderstorms tracked over the same locations and resulted in persistent heavy rain, flash flooding and road closures.
June 2014	Slow moving showers and thunderstorms developed producing very heavy rain over a short period of time. This lead to some flash flooding and road closers, especially in urban and poor drainage areas.
June 2014	Showers and thunderstorms repeatedly passed over the same locations, leading to heavy rainfall and significant runoff, which caused flash flooding in some areas. Many roads were closed due to the flooding and some homes were affected by water as well.
July 2014	A cluster of strong to severe thunderstorms broke out causing heavy rainfall and flash flooding with 3-6” of rainfall occurring. The thunderstorms also caused a EF1 tornado in Dalton causing damage to trees and homes.
May 2016	Bands of slow-moving showers and thunderstorms broke out over the region. Due to the slow movement of these thunderstorms, heavy rainfall repeatedly fell over the area resulting in flash flooding and some roads were temporarily closed.
August 2017	Widespread rain moved through the area resulting in isolated flash flooding.
August 2017	Severe thunderstorms developed resulting in flash flooding.

Source: BRPC 2018 (unless otherwise noted)
***Bolded** events are in the top 15 events that caused the Housatonic River to flow above flood stage at the Coltsville USGS gage (5’)*

There is not a USGS stream gage located in the Town of Dalton, but the Coltsville USGS stream gage #01197000 is located on the Housatonic River on the Dalton/Pittsfield municipal border, and reflects the flood event that the Town of Dalton has experienced. According to the data from the Coltsville gage, which provides data from 1936 to the present, and the NOAA National Weather Service, there have been 15 flood events that exceeded flood stage, which at this site is five feet. The flood event of record, with the highest water level, was the flood of 1938, with a peak level of almost 11 feet. It may be worth noting that seven out of the 15 events have occurred since the 1970s and five of the 15 have occurred since 2000, indicating a trend that confirm the suspicions from many local public works superintendents that flood events seem to be occurring more often in recent years. The flood events above flood stage, listed according to peak water levels, are found below, with a few events also listing discharge data to provide some perspective as to flood velocity.

(1) 10.80 ft on 09/21/1938
(2) 10.38 ft on 12/31/1948
(3) 10.14 ft on 03/18/1936
(4) 8.20 ft on 08/28/2011
(5) 8.14 ft on 10/09/2005
(6) 7.77 ft on 03/12/1936
(7) 7.18 ft on 10/16/1955
(8) 7.05 ft on 09/12/1960
(9) 6.87 ft on 04/05/1960
(10) 6.65 ft on 08/19/1955
(11) 5.95 ft on 04/23/1993
(12) 5.41 ft on 09/07/2011
(13) 5.39 ft on 04/03/2005
(14) 5.32 ft on 04/14/1994
(15) 5.14 ft on 06/07/2000

Source: NOAA, NWS, 2018.

To provide some perspective on the power and velocity of flood waters at this site, the discharge volume at the Coltsville gage was approximately 6,800 cubic feet per second (cfs) during the October 2005 flood and T.S. Irene in 2011, which had peak flood levels of slightly more than 8'. Typically this site would have a median daily discharge of 20-50 cfs during those time frames.

Probability of Future Occurrences

Using the past as a guide, Dalton will continue to be impacted by floods. With six to eight flood events that approached or exceeded a 50-100-year interval in the region in the last 100 years, we can assume that a flood event will impact the region every 12-15 years, if not more frequently, and receive minor flooding at least once a year. In addition to this, the upward trend for increased precipitation, combined with existing development in or near floodplain areas, indicated that flooding will persist in some areas. Efforts to flood proof or relocate high-risk properties within the floodplain, along with efforts to prohibit or limit new development, will decrease the potential for expanded damage and losses. The Town's effort to control new sources of stormwater runoff and upgrade stormwater drainage systems should also help to alleviate flooding in certain areas, particularly road stream crossings.

Secondary Hazards

Severe flooding can threaten the functionality or structural integrity of dams. In addition to the 10 dams in Dalton, the town is in the inundation area for at least another four dams in other communities. A more thorough discussion of the Town of Dalton's risks due to dam failure are discussed Section 3.5 of this plan.

Flood waters and the debris that is moved or carried can damage or destroy bridges and the infrastructure attached to them. For instance, critical water, sewer, communication and gas lines can be attached to bridges.

Flood waters can increase the risk of the creation of and dislodging of ice dams during the winter months. According to the Ice Jam Database, maintained by the Ice Engineering Group at the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL), there have been no ice jams in Dalton. However, ice jams are known to occur and spread block of ice over the banks of the Housatonic River on the golf course at Wahconah Country Club. No buildings are threatened in this area. The most recent such occurrence was in January 2018, when two inches of rain and an unusually warm weather of 50+ degrees Fahrenheit, which followed a period of prolonged and unusually cold weather, caused flooding from snow and ice melt across Berkshire County. This same weather pattern caused an ice jam in Kitchen Brook in the neighboring town of Cheshire, which subsequently flooded and deposited large chunks of ice on Route 8, a major north-south arterial road in the county. The same event caused the Town of Stockbridge to declare a local disaster due to concerns that a massive buildup of ice and rising flood water could damage the Route 7 bridge over the Housatonic River and/or the natural gas main pipeline that serves as the only gas supply to the neighboring town of Great Barrington (pop. ~7,000) (Zollshan, 2018).

Fig. 3.2.5. Ice Jam on Housatonic River, Rt. 7 Stockbridge Jan. 2018

Source: Berkshire Eagle, 1-18-18.

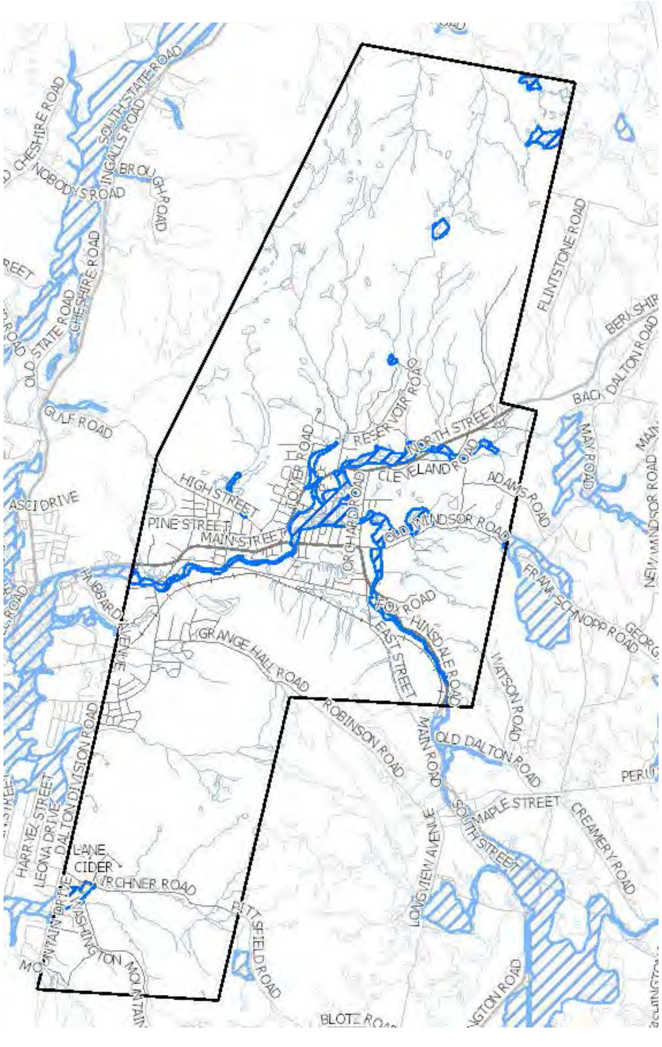
Warning Time

The State Hazard Mitigation Plan states that, due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Notice of potential flood conditions for developing storm systems is generally available five days in advance, with warning times for floods between 24 and 48 hours ahead of time. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. NOAA's Northeast River Forecast Center provides flood warning for Massachusetts, relying on monitoring data from the USGS stream gage network, of which the closest is the gage on the Housatonic River at the Dalton/Pittsfield line. State agency staff monitor river, weather, and forecast conditions throughout the year. Notification of potential flooding is shared among state agency staff and the National Weather Service provides briefings to state and local emergency managers, as well as notifications to the public via the media and social networking. MEMA also distributes information regarding potential flooding to local Emergency Managers, the press, and the public. (MEMA, 2013)

The total number of injuries and casualties resulting from typical riverine flooding is generally limited based on advance weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warning and precautions are in place. The exception is where the warning time is limited due to fast-developing events such as flash flooding from unpredicted severe thunderstorms or dam failures, or where earthquakes or landslides cause instantaneous earth movement. Populations without adequate warning of the event are highly vulnerable to this hazard. The historical record from 1993 to 2011 indicates there have only been two fatalities associated with a flood event in the state (occurring in May 2006) and five injuries associated with two flood events (occurring within two weeks of each other in March 2010). (MEMA, 2013). In Dalton the event of most concern with little or no warning time is dam failure, particularly that of the Cleveland Reservoir dam. Dalton has a CodeRed emergency notification system that would be effective in most predicted flooding circumstances, with the exception of a large, instantaneous dam breach.

Exposure

Fig. 3.2.6. 100-yr Floodplain Areas



Source: BRPC 2017.

Due to historic development patterns that occurred before the town's zoning and floodplain management regulations, there are several homes and businesses that are located within the floodplain. In addition, there are more properties that located along the FIRM delineated boundaries. Development impacts, most particularly the removal of natural vegetation and addition of impervious surface area within a watershed or drainage area, increases the risk of accelerated high peak flows in waterways, which can lead to flooding, bank erosion and ban subsidence. The same development impacts within the floodplain affects the floodplains' ability to absorb, detain and store water during flood events.

An analysis of the FIRM flood hazard area maps indicates that there is a total of 464.4 acres of 100-year floodplain within the town. This amounts to 3.3% of the total town. Most floodplain areas in the town are associated with the East Branch Housatonic River and its tributaries as they flow into the river (refer to Fig. 3.2.6 for floodplain areas). Based on additional analysis, 57.6 acres (12.4%) of the floodplain are developed. This leaves 406.8 acres that are potentially developable under current zoning (Berkshire Regional Planning Commission, 2017). The town does have a floodplain bylaw, protecting zones A and A1-30 as shown on the FIRM. Currently there are 3 commercial buildings (4.5% of commercial stock), 2 industrial (11.7% of industrial stock) and 83 residential buildings (3.7% of residential stock) within the floodplain (Berkshire Regional Planning Commission, 2017). Residential buildings include only main buildings, not detached garages or other accessory structures.

Table 3.2.3. Number of Buildings in Floodplain

Buildings in the 100-year Floodplain in Dalton							
Residential		**Commercial**		**Industrial**		**Total**	
No. Bldgs.	Percent Res. Bldgs.	No. Bldgs.	Percent Com. Bldgs.	No. Bldgs.	Percent Ind. Bldgs.	No. Bldgs.	Percent Total Bldgs.
83	3.7%	3	4.5%	2	11.7%	90	3.9%

Source: Berkshire Regional Planning Commission, 2017

An area of great concern is Walker Brook, which used to flow through a natural channel into the East Branch of the Housatonic River. The brook has been captured in underground pipes beginning at High Street, from where it flows underground until shortly before its confluence with the Housatonic at Main Street. The High Street area where Walker Brook goes underground periodically floods due to the pipe being undersized. The flooding will cross High Street and occasionally flood Field Street Extension. The Old High School building and the Senior Center are impacted by flooding from Walker Brook.

The Town of Dalton is actively working to mitigate flooding in this area. A proposed mitigation project is at 25% design, with an estimated cost of more than $1.2 million. The design has been submitted to MEMA and FEMA, and as of October 2017 has been in review by FEMA for approximately one year. Without financial assistance the Town will not be able to implement the design. A separate but related project is the fate of the Old High School building, which has a history of flooding. Although the Town had hoped for a successful reuse of the building for housing, a more recent proposal is to demolish the building and create an area of open space, perhaps in conjunction with the drainage improvements for Walker Brook.

Chamberlain Park, off of Chamberlain Avenue, occasionally floods. Flooding at this site is acerbated by beaver activity. Periodic trapping of beavers alleviates the amount of flooding, but the playground area continues to flood during severe rain storms. Other areas prone to flooding are scattered across the town, the majority of which are road stream crossings. The Orchard Road crossing of the East Branch Housatonic occasionally floods. Old Windsor Road had two road crossings that flooded. The first was an undersized culvert that kept washing out, but this has been repaired. The second is the bridge near Wahconah High School, which has a low clearance over the Housatonic River, and is threatened with high flood flows and ice jams.

There are several areas in Dalton where flooding occurs in areas that are not floodplain areas. The fields and parking lot of Wahconah High School occasionally floods. The school itself has not been flooded, but flood waters have come close to the building. Likewise, some flooding has occurred on portions of Nessacus Middle School property, but the school has not experienced flooding. North Street at Brayburn occasionally floods. Kirchner Road where it crosses Sackett Brook in two areas upstream of the brook's floodplain occasionally floods.

3.2.3. Vulnerability

People, property and infrastructure located in or near floodplains, near waterways where floodwaters are known to overflow their banks, where stormdrain systems fail, or those located in areas of high groundwater tables are vulnerable to the impacts of flooding. The town has had 11 flood insurance claims since 1978 for a total of $46,552.58 (MEMA, 2017). This includes two repetitive flood loss properties, which have filed seven claims for a total of $32,717.61 (MEMA, 2017). Of the 90 properties in the flood plain, there are only eight active flood insurance policies in Dalton covering $1,704,900 (MEMA, 2017).

Infrastructure and critical facilities that have been built in, over or under floodways are vulnerable to damage due to the power of high volumes of water and from the debris that those flows can carry or dislodge. Infrastructure from flood waters that are of most concern to the Town of Dalton include the water, sewer and gas lines that are attached to the Main Street bridge at Center Pond.

Population

Based on the population of 6,624 in the Town and the estimate that 3.7% of housing in the floodplain, it is expected that upwards of 245 residents may be impacted in a 1% flood event based on the percent of residential buildings in town in the floodplain. (Berkshire Regional Planning Commission, 2017) Using the number of 83 residential homes in the floodplain, with the average of 2.2 persons per household for Berkshire County[5], the number of people impacted would be 183 residents.

Of the population exposed, the most vulnerable populations typically include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to need medical or other special attention, which may not be available due to isolation during a flood event. They may also have more difficulty evacuating due to mobility issues. People with pets are also less likely to evacuate if they are not allowed to bring their pets with them (MEMA, 2013). Pomeroy Manor is an affordable housing complex owned by the Dalton Housing Authority. Flooding of the complex is a concern during severe weather events that involve heavy precipitation. Water has inundated part of the facility on many occasions. Dalton first responders reported that many seniors were reluctant in evacuating Pomeroy Manor during the flooding that occurred from Hurricane Irene in 2011. Residents from four or five units were actually evacuated during this event.

Severe Repetitive Loss Data

A severe repetitive loss is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program within any rolling ten-year period, since 1978 (FEMA, 2018). The town of Dalton has two repetitive loss buildings, both of which are single family homes. One property had four flood claims in the 1980s, with the last occurrence being in 1987. The total claims for building and contents for this property amount to $20,645. The second property has had two flood claims (2003, 2005), with a total paid amount for damages to the building $12,073 (no claims for building content). The flooding at this property coincides with documented severe flood events that hit the region in August 2003 and October 2005 (see Table 2). Flood event documentation for the 1980s is not as complete as that of the early 2000s, so although flood event dates of the North Main Street property do not coincide with documented events listed in Table 2, it is possible that the damages experienced were also due to severe rain events such as thunderstorms or stalled rain weather patterns.

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[5] *ACS 2012-2016*

Critical Facilities

Dalton does not currently have any critical communications or command center facilities within the floodplain. However, there are several public facilities that are located along the edge of the 100-year floodplain boundary, some of which have experienced flooding in recent storm events.

- The land around the Senior Center on Field Street Extension floods. The center itself has not flooded, but water encroached on the building during Hurricane Irene in 2011, prompting the town to create sandbags as preparation. As this building is being considered as a cooling center, surrounding flooding could limit access to the building and its use for sheltering.
- Wahconah Regional High School and Nessacus Middle School are located outside of but near the floodplain boundaries. Flooding has occurred on school properties such as athletic fields and portions of parking lots, but to date the buildings themselves have not been flooded. Conditions such as frozen ground with heavy rain increases the likelihood that the grounds flood. Nessacus serves as the Town's primary local shelter, so flooding of the site is a concern. To date a 100-year flood event has not occurred in the Town since the construction of the building, so it has not been tested for its viability during such an event.
- The mobile home park off of Route 9 was evacuated in 2005 due to heavy rain and additional release of water from Windsor Reservoir due to the poor condition of the dam. The park continued to be at risk of flooding due to an undersized road crossing on Wahconah Falls Road. Replacement of the road crossing has reduced the threat to this neighborhood.
- Pomeroy Manor, a public housing complex owned by the Dalton Housing Authority, has experienced flooding several times since it was built in the 1960s. The most recent and severe was in 2011 during Hurricane Irene. Two of the units took on water and the residents had to be evacuated. Flood waters encroached on other units and ultimately electricity had to be shut off for safety. Many residents were reluctant to evacuate despite the risk. There was another flood event post-Irene, and again in the winter of 2017 water was again almost to the door of one of the buildings.
- Stream and river road crossings, and the infrastructure attached to bridges, are at risk across the town. Although the MassDOT inspects bridges on a rotating basis, they do not assess the infrastructure attached to the bridges unless there were notable problems. The Town of Dalton recently allocated $16,000 to hire an engineer to inspect the infrastructure and supplement the reports generated by MassDOT. Undoubtedly the costs of repairs will outpace local funding, and this effort will aid the Town in prioritizing engineering and construction projects.

According to data from MassDOT, Dalton has 12 bridges that cross water bodies. There are three bridges that are considered at risk to flooding due to having high scour scores in the MassDOT bridge database. These bridges include the South Street/East Branch Housatonic River bridge, and two bridges that cross Wahconah Falls Brook on North Street. (MassDOT, 2018). All three of these bridges are stable, however action is required to protect the exposed foundations from effects of additional erosion and corrosion.

High flood waters area an ongoing concern at the bridge on Main Street crossing Center Pond, at the Bryon Wesson dam. This bridge carries the town's major water supply from Cleveland Reservoir, the main sewer pipe from Hinsdale and parts of Dalton, and a natural gas line. The bridge was flooded and overtopped during T.S. Irene (2011).

The sediment build-up in Center Pond, which is an impoundment of the East Branch Housatonic River caused by the Byron Wesson dam, is an issue of great concern to town officials. Center Pond has historically served as a recreational asset, with a small beach and access for canoeing/kayaking. Over time sediment build up has caused the pond to become much shallower, leaving little room for flood water storage. Flooding of properties along the perimeter of the pond seems to have increased, which is believed to be due to the reduction in storage capacity. Due to water expanding beyond its traditional banks, large trees are beginning to topple into Center Pond. One large willow at the Main Street bridge has topped into the pond, and if dislodged could damage the bridge and, possibly, damage or break any of the three infrastructure pipes located along the bridge. Although the Town has actively tried to work with MassDOT and Mass. Dept. of Environmental Protection to determine a strategy to remove the downed tree, regulatory restrictions are acting as barriers to removal.

Crane Company, which owns the dam, has a 5-foot pipe directing water through the adjacent mill to provide electricity. The company has a history of working with town officials to increase flow to alleviate back up of flood waters at the dam. Main Street in this area was overtopped during Hurricane Irene, which was estimated to be a 50-year storm event, but fortunately there was no infrastructure damage in this area.

Flooding can occur due to failure of water or sewer lines. The City of Pittsfield owns a 24” main water line that travels through Dalton from Cleveland Reservoir in Hinsdale. This is the main line that serves approximately 2/3 of the City of Pittsfield, which is downgradient of Dalton. The line is highly pressurized and is a concern for Dalton public works and first responder officials, due to the potential injury to people and property if it were to rupture. The line is a reinforced concrete line that is known to be weeping in the vicinity of Wahconah High School. When a small break in this line occurred in May 2014 on Housatonic Street in Dalton, it was discovered that there are no control valves in Dalton to isolate and control water through this line. It took the Town of Dalton and the City of Pittsfield five hours to shut down the water to a level that crews could approach the pipe for repairs. Water users in both municipalities were asked to restrict water use to maintain the water supply. Luckily in this instance the break occurred on the edge of the pipe that was away from the road, limiting damage to the road and the amount of asphalt and other debris that was distributed from the rupture (see Fig. 3.2.7.)

Fig. 3.2.7. Water Line Break on Housatonic St.

Source: iBerkshires 8-4-14

Economy

According to the State Hazard Mitigation Plan, economic losses due to a flood include, but are not limited to damage to buildings and infrastructure, agricultural losses, business interruption, and impacts on tourism, and the tax base. Damage to buildings can be estimated using the exposure analysis above. Other economic components such as loss of facility use, functional downtime, and social economic factors are less measurable with a high degree of certainty. (MEMA, 2013)

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur, and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and roadblocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges, and the removal and disposal of debris can also be an enormous cost during the recovery phase of a flood event

Damage to buildings can affect a community's economy and tax base. As part of this hazard mitigation plan update, the total loss of buildings and their content within the floodplain was calculated to demonstrate the worst-case scenario of potential losses if a 1% chance flood event were to occur. This calculation took into consideration the value of all buildings within the floodplain, as determined with assessor records, and multiplied an additional percentage to represent the contents of the properties, totaling a potential loss of $48 million. This represents complete destruction of buildings and contents within the floodplain. It should be noted that historical records indicate that total loss of buildings and content has never occurred in Dalton, and is very rare in the region. It is more likely that flooding would result in partial damages or loss of a building and its content, as demonstrated through past flood insurance claims in Dalton and the region. To determine a more likely scenario of damages from a 1% chance flood event, the HAZUS-MH modeling program was utilized (see following section). The HAZUS-MH model took into account and calculated not only the number of buildings within the floodplain, but also potential losses to agriculture, business interruption and other economic impacts.

Table 3.2.4. Property Valuation within the 100-year Floodplain ($ millions)

Residential Property	Residential Contents (50% Property Value)	Commercial Property	Commercial Contents (100% Property Value)	Industrial Property	Industrial Contents (125% Property Value)	Total Loss Estimate
$12.4	$6.2	$1.1	$1.1	$12.1	$15.1	$48.0

Source: Berkshire Regional Planning Commission, 2017

Aside from damage to buildings, flooding could effect some portion of the businesses and public institutions in Dalton that serve as major employers. As noted in Table 3.2.3., 4.5% of all commercial and 12% of industrial buildings in Dalton are within the 100-year floodplain. Businesses located in Dalton currently employ approximately 1,725 people, so up to 279 employees could be impacted in the event of a 1% chance of occurrence flood event, based on the percentage of commercial and industrial businesses in the floodplain (Berkshire Regional Planning Commission, 2017). Although not all employees are Dalton residents, the economic repercussions of a prolonged factory shutdown would reverberate throughout the central Berkshire County region.

Crane Company is a major regional employer, with a current employee roster of approximately 360 people, 310 of which work in currency production and 40 of which are in related departments (finance, procurement, human resources, etc). Crane Company, which until 2018 has been a family owned corporation, has been manufacturing paper in Dalton for more than 200 years, and continually supplied paper for U.S. currency since 1879. The company creates the paper on which the U.S. currency is printed and currently owns four paper manufacturing facilities. Crane Company paper mills were located purposely along the Housatonic River in the 18th century to take advantage of hydropower and later to also take advantage of the railroad. Of the company's five major facilities within Dalton, one mill and its wastewater treatment facility are located within the 100-year floodplain, while its three other mills are within the 300-year floodplain (Bone, 2018). One of the company's four dams, the Byron Weston #2 Dam, continues to provide hydropower to the company.

To protect facilities, employees and production, Crane Company has stated that the company monitors the river water levels and flow 24-hours a day. When water levels reach various flood stage thresholds, specific emergency personnel are alerted and emergency procedures are set in motion. The company has several emergency plans in place, including evacuation plans for personnel safety.

HAZUS

To further assess the Town's vulnerability to flood hazard, HAZUS-MH was run using a 1% chance flood event. HAZUS-MH is an extension to ArcGIS that allows for the modeling of storm events and calculates the impact of the storm. HAZUS-MH delineates a floodplain differently than the current FEMA Floodplain maps by modeling where flooding may occur, rather than mapping that was conducted in the 1970's and 1980's. According to HAZUS, based on a 1% chance flood event, more commonly referred to as the 100-year flood event, up to 143 households and 182 individuals may seek shelter during a flood event (HAZUS-MH, 2017). Using slightly different data, from the American Community Survey, Dalton has a household size of 2.2 people[6], indicating a higher number of 315 individuals could be displaced from the 143 households. These figures are of course estimates, based upon FEMA modeling and with rough local estimates of the number of homes identified within the MassGIS floodplain boundaries. The numbers should only be used to determine potential impacts and evaluate potential sheltering capacity during a 1% chance flood event.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. Based on the HAZUS-MH analysis, the town could potentially experience a loss of $15,060,000 during a 1% chance flood event. (Table 3.2.5). (HAZUS-MH, 2017) For more details about the impacts of a 1% chance storm event, see the full HAZUS-MH report in Appendix B.

Table 3.2.5. Damage Estimate from HAZUS ($ millions)

	Residential Property	Residential Contents	Commercial Property	Commercial Contents	Industrial Property	Industrial Contents	Total Loss Estimate
Building Loss	$6.6	$2.9	$0.74	$2.2	$0.40	$0.61	$15.04
Bus. Interruption	0	NA	0.01	NA	0.01	NA	0.02

Source: HAZUS-MH, Berkshire Regional Planning Commission, 2017

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[6] *ACS 2012-2016*

Tropical Storm Irene – Profile of a Flood Event in Dalton

Background

Tropical Storm Irene started out as an Atlantic hurricane that traveled up the eastern seaboard through North Carolina, the Mid-Atlantic states and inland New England August 26-28, 2011, impacting the Berkshires August 27-28.

The hardest hit areas were in Vermont, in the Hoosic River Watershed in Berkshire County and in the Deerfield River watershed in Franklin County. Vermont considers the storm the worst natural disaster since the floods of 1927. A total of 2260 road segments, 289 bridges, and 963 culverts were damaged, destroyed, or blown-out as a result. The total damage to infrastructure was estimated at between $250 and $300 million dollars, all for a state of just over 600,000 residents[7]

Fig. 3.2.8 Cold River Bridge Florida/Savoy

In Shelburne Falls, MA the Deerfield River was flowing at 38,000 cubic feet per second (cfs), well above the typical August flow of 800-1,000 cfs. The area received more than 8.5-10" over the course of two days. The Green River destroyed the Greenfield, MA dam and water pumping station. While the amount of rain in New England is less than more southern states received, the hilly and rocky terrain and the fact that the rain came atop soils already saturated were factors contributing to the severe flooding. Many streams and rivers were several feet above flood stage, flooding properties, washing out roads and forcing evacuations. Route 2 in Florida and Charlemont was severely damaged due to a combination of the wash out of the road by the river and heavy deposition of mud, trees and debris from a landslide caused by steep slopes and oversaturated soils. Several other major travel routes across Western Massachusetts were closed, including Rt. 91 in Deerfield (due to fear that a bridge over the Deerfield River was unsafe), Routes 20 and 23 in the southern hilltowns of Becket, Chester and Otis. Farmers in the Deerfield watershed sustained heavy damage to crops, some losing their year's crop. Statewide almost 600,000 people were without power.[8] Although deaths in New England are attributed to flooding from Tropical Storm Irene, there are no reported deaths in Berkshire County. The State of Massachusetts declared disasters for Berkshire and Franklin Counties.

Fig. 3.2.9. Flooding of The Spruces, Williamstown

The most devastating damages that occurred in Berkshire County are in Williamstown, where the storm was determined to be a 1% chance of occurrence storm.

[7] *(http://www.georgetownclimate.org/resources/vermont-culvert-rebuilding-after-tropical-storm-irene).*

[8] *http://www.masslive.com/news/index.ssf/2011/08/tropical_storm_irene_deluges_a.html*

Water level in the Hoosic River in Williamstown rose from ~6' in depth to almost 14' in about seven hours. The Spruces Mobile Home Park was fully evacuated, and 75% of the homes were declared uninhabitable by the town building and health inspectors. Damage was so complete and widespread that the entire park was demolished and subsequently closed forever. More than 220 homes were lost. The Town of Williamstown, social service organization and charities aid residents in relocating and, with FEMA funding, the site is being redeveloped into a public park.

T.S. Irene in Dalton

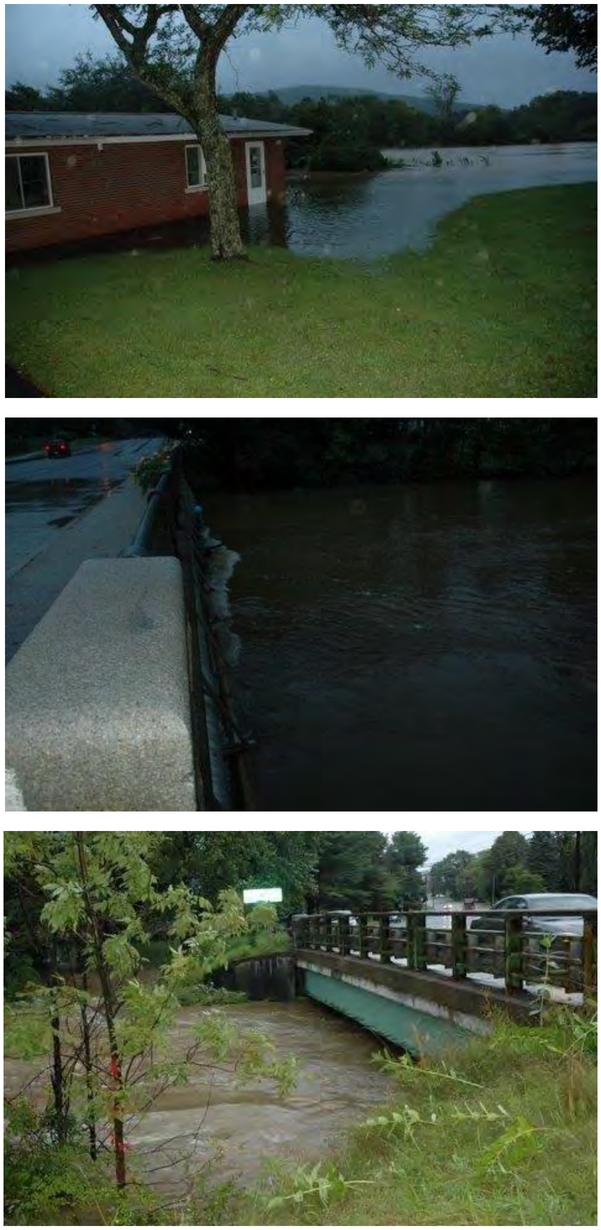
Due to widespread reports of flooding, the Town of Dalton opened and ran an Emergency Operations Center on August 28th.

In Dalton several areas were flooded, including residential properties and roads. Pomeroy Manor, the Dalton Housing Authority's housing for the elderly, was of greatest concern, with floodwaters from Legion Pond entering Units 4 and 5 and was threatening others. For safety the electricity was shut off at the complex and residents advised to leave. Wahconah Falls Road was flooding and residents along sections of North Street, Anthony Road and Orchard Road advised to evacuate. A home on North Street was flooded, deemed unsafe, and residents evacuate; water in the basement was up to the floor rafters of the basement and the oil tank ruptured; becomes hazardous materials site. Most residents sheltered with family, but a few are transported to and shelter at regional shelter at Reid Middle School in Pittsfield.

The High Street bridge over Walker Brook flooded the road, water threatened the Senior Center, and water entered the old high school building. Center Pond was rising, so Crane Company agreed to open the spillways for the Weston dam #1 and others downstream to relieve floodwaters; the Pittsfield EOC informed of released water.

Water was released from Windsor Reservoir to relieve pressure on dam; the reservoir refilled in eight hours. Roads that had to be rebuilt included Wahconah Falls, Fox and Johnson Roads. T.S. Irene is listed as a 50-year recurrence interval at the Coltsville stream gage on the Housatonic River.

Fig. 3.2.10. Dalton Flooding Pomeroy Manor (top); Main St. Bridge (center); North Street Bridge (bottom)



3.2.4. Existing Protections Against Increased Risk of Flooding

The Town of Dalton has already numerous existing protections in place to help protect it from increasing the risk of future flooding, along with protections to alert vulnerable populations. Due to the prevalence of flooding as a risk of high concern, the Town has developed this detailed table of existing protections. Other natural hazards existing protections measures are described in less detail.

Table 3.2.6. Existing Protections

Type of Existing Protection	Description	Area Covered	Effectiveness	Improvements Needed
Town participates in the National Flood Insurance Program (NFIP)	Provides flood insurance for structures located within the floodplain	FEMA flood zones	Effective	None
Floodplain zoning district ordinance in place	Floodplain ordinance requires all development, including structural and nonstructural activities, be in compliance with state building code requirements for construction in floodplain	Covers FIRM zones Zone A and A1-30	Generally effective for new construction, but many older structures pre-date ordinance	None
Building Code	The town enforces the state building code	Entire Town	Effective	None
Stormwater System	The town has an extensive system of stormwater control.	Entire town	Mostly effective	Replace/maintain drainage system where flooding occurs.
Stormwater Management Bylaw	Stormwater management permit required for land disturbance ≥ 1 acre and 200 sf if on slopes ≥15%	Entire Town	Effective for new construction	None
Open Space Residential Design and Cluster Development Zoning	Encourage preservation of natural land cover and minimize land disturbance	R-1 Zone	Effective for new construction	R-1 only; this is an option, not mandatory for large development projects

Scenic Mountain Act	Limits some uses on steep slopes on mountains >1500’ in elevation	Overlay District on elevations >1,500 ‘	Effective for new construction	
Sluice gates	Crane Company operates sluice gates at the Byron Weston Mill and the Government Mill dams	Housatonic River and surrounding area	Effective	None
Sluice gates	Sluice gates at Egypt Reservoir	Berkshire Trail and surrounding area	Effective	None
Sluice gates	Sluice gates at Windsor Reservoir	Majority of town	Effective	None
USGS gage at Coltsville on Housatonic River	Monitoring to predict flood stages	Housatonic River in town center	Effective in predicting safety procedures	None
Emergency communications systems	Regional school district and Town (Code Red) have communication systems in place	Residents who are enrolled	Effective	Pursue full enrollment
Emergency Preparedness	Dalton Fire Dept. annual conducts yearly drill with Pomeroy Manor residents	Pomeroy Manor Apartments	Effective	None
Emergency & preparedness communication	EMD web and Facebook pages – posts emergency and preparedness information to the public	Residents who follow the postings	Somewhat effective	Encourage more residents to follow postings

3.2.5. Actions

Actions in italic are from expired Hazard Mitigation Plan

Actions in regular text are new actions.

ACTION	BENEFITS
Design and implement solutions to Walker Brook-related flooding	*Reduced risks to High St., Field St. Extension, Senior Center* (informal cooling/warming center)*, old high school property*
Upgrade road crossings at Orchard St., Rt. 9 at Housatonic River	*Reduce flooding of road and properties*
Perform engineering study of Kirchner Rd. bridge	*Reduce flooding of road and properties*
Monitor and clean out Kirchner Rd. and other problematic stream crossings	Reduce flooding of road and property
Review town stormwater bylaw for potential to strengthen requirements for on-site retention of stormwater runoff	Reduce increased risk of flooding from new development
Remind residents of the hotline call-in number to report flooding or clogged culverts	Proactively reduce flood risks
Investigate options to remove built-up sediment in Center Pond	Reduce flood risk in vicinity, reduce stress on dam, and increase flood storage capacity
Consider structural options to reduce flood risks to Pomeroy Manor	Reduce flood risk to vulnerable population
Work with Dalton Fire District to ensure Windsor Dam is in good condition	*Reduce flood risk from dam failure*
Work with City of Pittsfield to maintain Cleveland Reservoir dam	*Reduce risk of flooding, which would be catastrophic if full dam breach*

Hold evacuation exercise at Pomeroy Manor	Reduce risk to residents and first responders during evacuation
Evaluate potential for using Craneville Elem. School as primary shelter; possible feasibility/cost study; possible wiring of building for portable generator	Improved availability of shelter space during extreme flood event or hazardous material spill
Document all towns costs associated with response to flood events, including staff time, materials, equipment value and fuel	Identify flooding trends for improved pre-disaster prep; record costs for potential reimbursement from grants or disaster disbursements
Continue to implement beaver controls at Legion Pond, Chamberlain Pk.	*Reduced flood risk and possible health risks at Pomeroy Manor and Chamberlain Pk.*
Incorporate floodproofing as part of the redesigning of Wahconah High School; consider flood retention on school grounds	Reduced risk of flooding and use of building; reduced risk of losing school days
Identify historic properties located in hazard-prone areas	*Enable facility owners to better prepare for hazards and prevent their loss*
Increase enrollment in Code Red	Keep residents informed before and during severe storm events

3.3. Tropical Storm and Hurricane Hazards

3.3.1. General Background

A tropical storm system is characterized by a low-pressure center and numerous thunderstorms that produce strong winds and heavy rain. The term “tropical” refers both to the geographical origin of these systems, which usually form in tropical regions of the globe, and to their formation in maritime tropical air masses. Hurricanes begin as tropical storms over the warm moist waters of the Atlantic. As the moisture evaporates, it rises until enormous amounts of heated, moist air are twisted high in the atmosphere. The winds begin to circle counterclockwise north of the equator or clockwise south of the equator. Tropical depressions, tropical storms, and hurricanes) form over the warm, moist waters of the Atlantic, Caribbean, and Gulf of Mexico.

- A tropical depression is declared when there is a low-pressure center in the tropics with sustained winds of 25 to 33 mph.
- A tropical storm is a named event, defined as having sustained winds from 34 to 73 mph.
- If sustained winds reach 74 mph or greater, it becomes 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. Hurricanes are categorized based on sustained winds; wind gusts associated with hurricanes may exceed the sustained winds and cause more severe localized damage. (MEMA, 2013)

Tropical storms and tropical depressions, while generally less dangerous than hurricanes, can be deadly. The winds of tropical depressions/storms are usually not the greatest threat; rather, the rains, flooding, and severe weather associated with the tropical storms are what customarily cause more significant problems. Serious power outages can also be associated with these types of events. After the passing of Hurricane Irene through the region as a tropical storm in late August 2011, many areas of the Commonwealth were without power for in excess of 5 days. (MEMA, 2013)

The official hurricane season runs from June 1st to November 30th. However, August, September, and the first half of October are when the storms most frequently occur for New England. This is due, in large part, to the fact that it takes a considerable amount of time for the waters south of Long Island to warm to the temperature necessary to sustain the storms this far north. Also, as the Region progresses into the fall months, the upper level jet stream has more dips, meaning that the steering winds might flow from the Great Lakes southward to the Gulf States and then back northward up the eastern seaboard. This pattern would be conducive for capturing a tropical system over the Bahamas and accelerating it northward. (MEMA, 2013)

The Saffir/Simpson scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. This scale is used to give 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 the slope of the continental shelf and the shape of the coastline, in the landfall region. All winds are using the U.S. 1-minute average, meaning the highest wind that is sustained for one minute. The Saffir/Simpson Scale described in Table 1. gives an overview of the wind speeds and range of damage caused by different hurricane categories. (MEMA, 2013)

Table 3.3.1. Saffir/Simpson Scale

Scale No. (Category)	Winds (mph)	Potential Damage
Tropical Depression	< 38	NA
Tropical Storm	39-73	NA
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 is severe, there are extensive glass failures, and entire buildings could fail.

3.3.2. Hazard Profile

Location

The entire Town of Dalton is vulnerable to hurricanes and tropical storms. The heavy rains often associated with tropical storms and hurricanes can result in flooding conditions, combined with high winds to create risks to people and property. Floodplain areas are especially at risk for flooding, as are flashy, steeply sloped stream channels that can become flooded, causing stream channel erosion.

NOAA's Historical Hurricane Tracks tool is a public interactive mapping application that displays Atlantic Basin and East-Central Pacific Basin tropical cyclone data. This interactive tool tracks tropical cyclones from 1842 to 2017. Between 1842 and 2017, the region has experienced more than 240 tropical cyclone events. These events occurred within 100 miles of Berkshire County.

Previous Occurrences

The National Oceanic and Atmospheric Administration (NOAA) has been keeping records of hurricanes since 1842 (Table 1). From 1842 to 2017, the community have had five (5) Tropical Depressions, five (5) Tropical Storms, one (1) Category 1 Hurricane and one (1) Category 2 Hurricane pass directly through the County. The following table lists these storms, and Fig. 1 shows the paths of these storms. Although none of these storms traveled directly through Dalton, flooding and wind impacts were experienced to some degree.

Table 3.3.1. Tropical Depressions, Storms, and Hurricanes Traveling Across Berkshire County

Name	Category	Date
Not Named	Tropical Depression	8/17/1867
Unnamed	Tropical Storm	9/19/1876
Unnamed	Tropical Depression	10/24/1878
Unnamed	Category 1 Hurricane	8/24/1893
Unnamed	Tropical Storm	8/29/1893
Unnamed	Tropical Depression	11/1/1899
Unnamed	Tropical Depression	9/30/1924
Unnamed	Category 2 Hurricane	9/21/1938
Able	Tropical Storm	9/1/1952
Gracie	Tropical Depression	10/1/1959
Doria	Tropical Storm	8/28/1971
Irene	Tropical Storm	8/28/2011

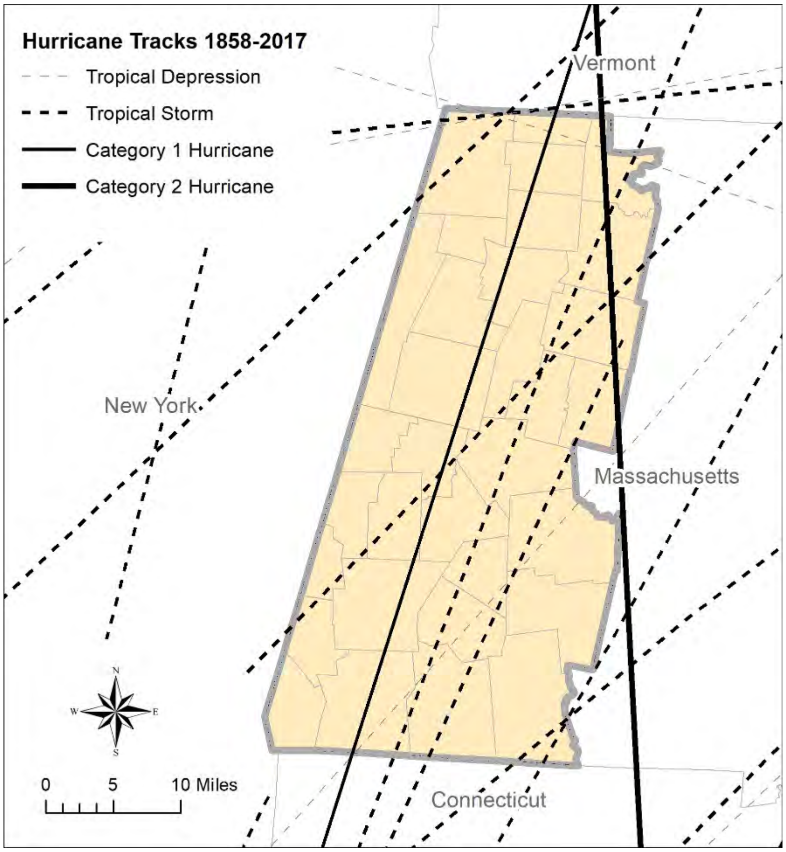
Source: NOAA, 1842-2017

The effects of hurricanes and tropical storms however are often felt much farther away from the direct path. During this same period, an additional thirty-eight (38) Tropical Depressions, eighty-six (86) Tropical Storms, fourteen (14) Category 1 Hurricanes and five (5) Category 2 Hurricanes have passed within 100 miles of the region.

According to NOAA, tropical storm season lasts from June 1 to November 30, and an average of 10 tropical storms develop along the eastern seaboard each year. On average, five of these 10 become hurricanes. In Berkshire County, Hurricanes and Tropical Storms are generally limited to the months of August, September, and October, with a few storms arriving in May, June, July or November.

The historic storm of most note in Berkshire County is the New England Hurricane of 1938 (or Great New England Hurricane or Long Island Express or simply The Great Hurricane of 1938). The storm formed near the coast of Africa, becoming a Category 5 hurricane before making landfall as a Category 3 hurricane on Long Island on September 21. To date this storm remains the most powerful, costliest, and deadliest hurricane in New England history. The majority of the storm damage was from storm surge and wind. Damage is estimated at $6 billion (2004 USD), making it among the most costly hurricanes to strike the U.S. mainland. It is estimated that if an identical hurricane struck today it would cause $39.2 billion (2005 USD) in damage. The eye of the storm followed the Connecticut River north into Massachusetts, where the winds and flooding killed 99 people. In Springfield, the river rose 6 to 10 feet above flood stage, causing significant damage. Up to six inches of rain fell across western Massachusetts, which combined with over four inches that had fallen a few days earlier produced widespread flooding.

Fig. 3.3.1. Tropical Depressions, Storms and Hurricanes Across Berkshire County



Source: BRPC 2017.

Locally the Great Hurricane of 1938 remains one of the most memorable historic storms, with almost seven inches of rain falling over a three-day period. The flooding from the Hoosic River caused severe damages in the northern Berkshire communities of Adams and North Adams. According to an *iBerkshires* article highlighting the damages, two deaths occurred, many other people were injured, and 300 people were left homeless. The West Shaft Road bridge in North Adams was lost, as was the Wally Bridge in Williamstown.[1] The damages from this storm, following devastating flooding and damages from events in 1901, 1922, 1927 and 1936, and combined with that from a severe rain event in 1948, led to the construction of the flood control chutes on the Hoosic River in Adams and North Adams.

Hurricane Gloria caused extensive damage along the east coast of the U.S. and heavy rains and flooding in western Massachusetts in 1985. This event resulted in a federal disaster declaration (FEMA DR-751). In October 2005 the remnants of Tropical Storm Tammy followed by a subtropical depression produced significant rain and flooding across western Massachusetts. It was reported that between nine and 11 inches of rain fell. The heavy rainfall washed out many roads in Hampshire and Franklin Counties. The Green River flooded a mobile home park in Greenfield, with at least 70 people left homeless. Following these events, the mobile home park was demolished, and the site was turned into a town park. Localized flooding in Berkshire County was widespread, with several road washouts. This series of storms resulted in a federal disaster declaration (FEMA DR-1614) and Massachusetts received over $13 million in individual and public assistance. (MEMA, 2013)

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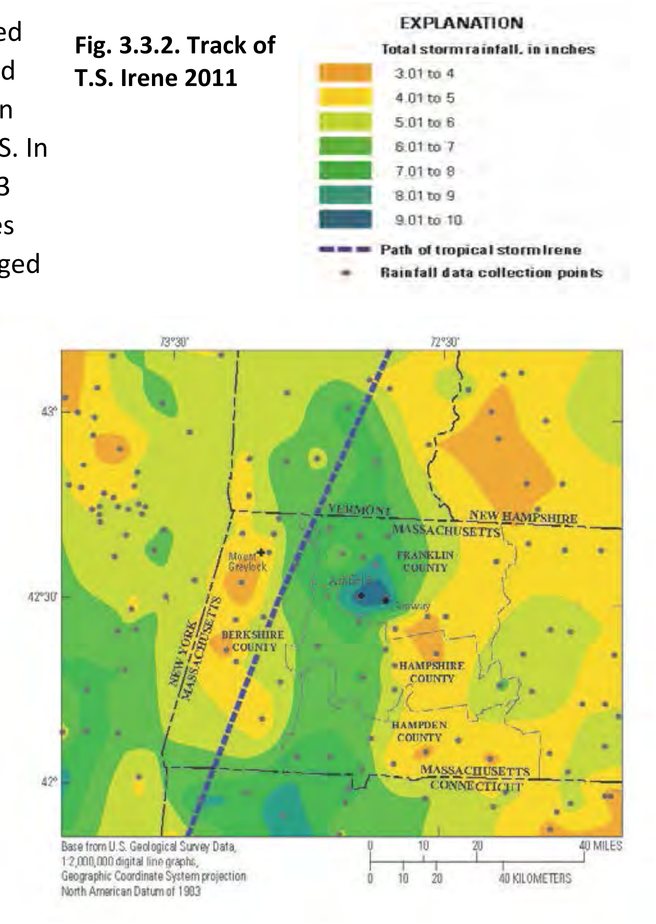
[1] Ennis, Tom, 2-11-04. "Before the Chutes, Hoosic Floods Raged," *iBerkshires.com*.

Tropical Storm Irene (August 27-29, 2011) produced significant amounts of rain, storm surge, inland and coastal flooding, and wind damage across southern New England and much of the east coast of the U.S. In Massachusetts, rainfall totals ranged between 0.03 inches (Nantucket Memorial Airport) to 9.92 inches (Conway, MA). Wind speeds in Massachusetts ranged between 46 and 67 mph. These heavy rains caused flooding throughout the Commonwealth and a presidential disaster was declared (FEMA DR-4028). The Commonwealth received over $31 million in individual and public assistance from FEMA. (MEMA, 2013)

Locally, TS Irene (DR-4028-MA) is the most memorable storm event in recent history due to the flooding that occurred in northern Berkshire and Franklin Counties in Massachusetts, and in southern Vermont. In Williamstown 225 mobile home households, many elderly and low income, permanently lost their homes in the Spruces Mobile Home Park. Extensive flooding in the Deerfield River watershed caused, among other damages, the closing of Route 2 in Florida/Charlemont (due to collapse of the road and a landslide) and damages to structures in Shelburne Falls. In Dalton, where the storm was rated as a 2% chance storm, flood waters required the evacuation of residents from Pomeroy Manor and threatened the Main Street bridge and its infrastructure.

Fig. 3.3.2. Track of T.S. Irene 2011



Source: Gardner, et al, 2016.

Probability of Future Occurrences

Based on past reported hurricane and tropical storm data, the region can expect a tropical depression, storm or hurricane to cross the region every 14.5 years. However, the community may also be impacted by a tropical event whose path is outside of the region every 0.75 years. Based on past storm events and given that the center of the county is approximately 85 miles to the Long Island Sound and 115 miles to Boston Harbor, the Berkshires will continue to be impacted by hurricanes and tropical storms.

The NOAA Hurricane Research Division published a map showing the chance that a tropical storm or hurricane (of any intensity) will affect a given area during the hurricane season (June to November). This analysis was based on historical data from 1944 to 1999. Based on this analysis, the community has a 20-40% chance of a tropical storm or hurricane affecting the area each year. (MEMA, 2013)

Severity

The severity of a hurricane is categorized by the Saffir-Simpson Hurricane Scale. This scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. This is used to give 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. In Berkshire County flooding tends to be the impact of greatest concern because hurricane-force winds here occur less often. Historical data show that most tropical storms and hurricanes that hit landfall in New England are seldom of hurricane force, and of those most are a category 1 hurricane. The category hurricanes that stand out are those from 1938 and 1954.

Warning Time

Warning times for the majority of tropical storms and hurricanes are generally broadcast well in advance of landfall in New England. The National Weather Service issues a hurricane warning when sustained winds of 74 mph or higher are *expected* in a specified area in association with a tropical, subtropical, or post-tropical cyclone. A warning is issued 36 hours in advance of the anticipated onset of tropical-storm-force winds. A hurricane watch is announced when sustained winds of 74 mph or higher are *possible* within the specified area in association with a tropical, subtropical, or post-tropical cyclone. A watch is issued 48 hours in advance of the anticipated onset of tropical storm force winds (NWS, 2013). In general, MEMA suggests that local and regional preparations should be complete by the time the storm is at the latitude of North Carolina. (MEMA, 2013)

Secondary Hazards

Precursor events or hazards that may exacerbate hurricane damage include heavy rains, winds, tornadoes, insufficient flood preparedness, and levee or dam breach or failure. Potential cascading events include health issues (mold, mildew); increased risk of fire hazards; hazardous materials, including waste byproducts; compromise of levee or dam; isolated islands of humanity; increased risk of landslides or other types of land movement; disruption to transportation; disruption of power transmission and infrastructure; structural and property damage; debris distribution; and environmental impact. (MEMA, 2013)

Climate Change Impacts

The Northeast has been experiencing more frequent days with temperatures above 90°F, increasing sea surface temperatures and sea levels, changes in precipitation patterns and amounts, and alterations in hydrological patterns. According to the Massachusetts Climate Change Adaptation Report, large storm events are becoming more frequent. Although there is still some level of uncertainty, research indicates the warming climate may double the frequency of Category 4 and 5 hurricanes by the end of the century and decrease the frequency of less severe hurricane events. More frequent and intense storm events will cause an increase in damage to the built environment and could have devastating effects on the economy and environment. As stated earlier, cooler water temperatures along the Northeast Atlantic Ocean help to temper the strength of tropical storms, but if the ocean continues to warm, this tempering force could be lessened, leading to greater intensity of storms that make landfall in New England.

Exposure

To understand risk, the assets exposed to the hazard areas are identified. For the hurricane and tropical storm hazard MEMA has determined that the entire Commonwealth of Massachusetts is exposed to extensive winds and rains. Storm surge from a hurricane/tropical storm poses one of the greatest risks to residents and property. (MEMA, 2013) Berkshire County is landlocked, so no community in the region is at risk of storm surge. Damages from a hurricane can be broken into two general categories of direct impacts: flooding and high winds. Flooding damage for the Town of Dalton has been assessed and discussed in the flooding section of this plan and is not discussed here. For wind-based damage, the hurricane simulation model for Dalton was run in HAZUS-MH, using a probabilistic 100-year (1% annual chance) storm using default HAZUS value. The 100-year storm was used to be comparable to the storm event used in the flooding model.

3.3.3. Vulnerability

Population

High winds from tropical storms and hurricanes can knock down trees, limbs and electric lines, can damage buildings, and send debris flying, leading to injury or loss of life. Economically distressed, elderly and other vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. HAZUS-MH was run to estimate the sheltering needs of Dalton residents should a 100-year event occur. According to HAZUS-MH, no residents may be displaced or require temporary to long-term sheltering due to wind damages. It should be noted that Hazus-MH utilizes 2000 Census data, and therefore, the totals will vary slightly. However, as reported in the flooding section of this plan, 182-315 residents could be displaced and seek shelter during this 100-year flooding event.

Critical Facilities

Critical facilities are mostly impacted during a hurricane by flooding, and these impacts are discussed in the flooding section of this plan. Wind-related damages from downed trees, limbs, electricity lines and communications systems would be at risk during high winds. There are very few areas where power lines are buried underground. HAZUS-MH predicted that no critical facilities would be impacted by wind-related damages.

Economy

Hurricane/tropical storm events can greatly impact the economy, including loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. HAZUS-MH estimates the total building-related economic loss associated with each storm scenario (direct property damages and business interruption 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.

Damage to buildings can impact a community's economy and tax base. HAZUS-MH analysis determined that there is $493,200 of exposure due to the potential wind damage. The statistical data reports that some minor property damages could be sustained within Dalton, and that residential buildings would be most likely to suffer such damages. No buildings would sustain moderate or severe damages. (HAZUS-MH, 2017)

Table 3.3.2. HAZUS-MH Results for Hurricane Winds (in dollars)

		Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	323,280	6,740	12,990	2,720	345,730
	Content	147,360	-	-	-	147,360
	Inventory	-	-	-	-	-
	Subtotal	*470,640*	*6,740*	*12,990*	*2,720*	*493,090*
Business Interruption						
	Income	-	-	-	-	-
	Relocation	110	-	-	-	110
	Rental Income	-	-	-	-	-
	Wage	-	-	-	-	-
	Subtotal	*110*	-	-	-	*110*
Total		**470,750**	**6,740**	**12,990**	**2,720**	**493,200**

Source: HAZUS-MH, 2017)

HAZUS-MH also estimates the amount of debris that may be produced a result of wind events. The debris produced is estimated to be approximately 696 tons, the vast majority (89%) of which would be tree debris. (HAZUS-MH, 2017) Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur.

3.3.4. Existing Protections

- Massachusetts Building Code dictates building construction in Dalton
- Regional School District and Town has emergency communications systems in place
- Emergency Management Director posts emergency preparedness and emergency weather notices on its Facebook page

3.3.5. Actions

- Continue to encourage all town residents to enroll in Code Red

3.4. Severe Weather Hazards

3.4.1. General Background

There are several severe weather events that impact the Berkshire County region and the Town of Dalton, some of which occur suddenly and with little warning times. The severe weather hazards being discussed in this section of the plan are atmospheric in nature and are:

- High Winds, Thunderstorms and Tornados
- Extreme Cold and Heat Temperatures

3.4.2. Severe Weather Hazard Profiles

Wind is air in motion relative to surface of the earth. Effects from high winds can include downed trees and/or power lines and damage to roofs, windows, etc. High winds can cause scattered power outages. Massachusetts is susceptible to high wind from several types of weather events: before and after frontal systems, hurricanes and tropical storms, severe thunderstorms and tornadoes, and Nor'easters. Winds measuring less than 30 mph are not considered to be hazardous under most circumstances. Sometimes, wind gusts of only 40 to 45 mph can cause scattered power outages from trees and wires being downed. This is especially true after periods of prolonged drought or excessive rainfall, since both are situations which can weaken tree root systems and make them more susceptible to the winds' effects. (MEMA, 2013)

A thunderstorm is a storm with lightning and thunder produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain, and sometimes hail. Frequently during thunderstorm events, heavy rain and gusty winds are present. Less frequently, hail is present, which can become very large. Tornadoes can also be generated during these events. (MEMA, 2013)

Rising, warm moist air is the foundation for thunderstorms. If this warm air is forced to rise and is channeled upward by hills or mountains, or areas where warm/cold or wet/dry air collide, it can become unstable and charged. Sometimes strong downdrafts of cool air, known as downbursts, can cause tremendous wind damage, similar to that of a tornado. A small (< 2.5-mile path) downburst is known as a "microburst". (MEMA, 2013)

Tornadoes are fierce phenomena which generate wind funnels of up to 200 mph or more, and occur in Massachusetts usually during June, July, and August. A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The visible sign of a tornado is the dust and debris that are caught in the rotating column made up of water droplets. Tornadoes can form from individual cells within severe thunderstorm squall lines orfrom an isolated super-cell thunderstorm. They can be spawned by tropical cyclones or even their remnants that are passing through. (MEMA, 2013) Tornadoes are the most violent of all atmospheric storms and are historically the deadliest of weather events in Berkshire County.

Massachusetts has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those that are far outside the normal ranges. According to MEMA the average temperatures for Massachusetts are:

- Winter (Dec-Feb) Average = 22.5ºF
- Summer (Jun-Aug) Average = 65.8ºF

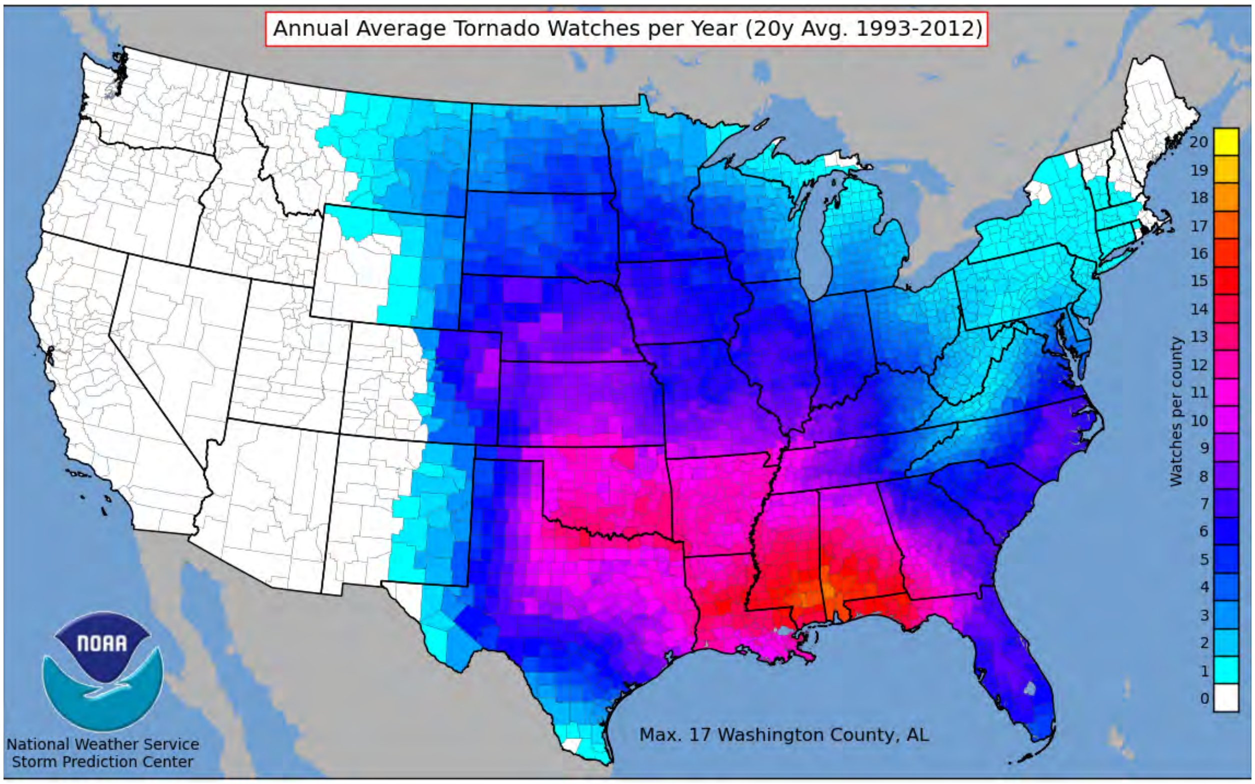
Extreme heat events impact the health of human beings, livestock and wildlife, and can impact the ability of people to function at home or work. Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, who work outside or who are stranded or who live in homes that are poorly insulated or without heat.

Impacts from severe storm events can be as widespread as effecting all of the Northeast, such as a hurricane or nor'easter. Impacts can occur along narrow paths of Berkshire County where weather fronts collide and deliver high winds and rain or where tornado touchdowns have carved a path of destruction. Alternately impacts from these storms can be concentrated, such as when microbursts suddenly hit an area. In general, the high percentage of forest cover across Berkshire County, including most of Dalton, tends to disrupt wind flows, although conversely trees can create high hazard conditions near buildings and utility lines. Areas of impact from tornados and microbursts are unpredictable.

Severe storms can occur anywhere in the Town of Dalton. Thunderstorms affect relatively small areas, rather than large regions much like bands of winter storms and hurricane events.   The community is in an area that would experience between 15 and 20 thunderstorm days each year.

The location of tornado impact is totally unpredictable. However, the county is located in a lower risk area with an average of 1 tornado watch per year (see Fig. 3.5.1).

Fig. 3.5.1. Annual Average Tornado Watches



Source: National Weather Service Storm Prediction Center 2018

Secondary Hazards

The most significant secondary hazards associated with severe local storms are falling and uprooted trees and broken branches, downed power lines, and possible flooding and landslides. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. (MEMA, 2013) Possible long-term power outages and closed transportation systems can threaten human health and disrupt businesses.

The Berkshires are currently a moderately temperate climate, but an increase in summer temperatures will create higher peak summer electricity demands for cooling, including an increase in the number of air conditions units being installed. The current cooling degree days (CDD) with a base of 65°F for the summer season in the Housatonic River basin is 231 (for years 1971-2000). By mid-century the summer season CDD is projected to increase an additional 169-473, an increase of 73-205%, and by the 2090s the summer CDD is projected to increase an additional 239-931, an increase of 104-403%. (MA Climate Change Projects for Housatonic Watershed, 2018). It is unknown how well prepared the electric grid is for the increased peak season and daily demand.

Previous Occurrences

Based on all sources researched, known severe weather events that have affected the region and were declared a FEMA disaster are identified in Table 3.4.1, which provides detailed information concerning the FEMA declarations for the Commonwealth. (MEMA, 2013)

Table 3.4.1. FEMA Severe Weather Event Declarations Including Berkshire County 1954 to Present

Incident Period	Description	*Declaration Number*
3/30/87 – 4/13-87	Severe storms and flooding; 8" in some areas of state with already high river conditions	*DR-790*
10/7/05-10/16/05	Severe storms and flooding throughout Berkshire County	*DR-1614*
4/15/07-4/25/07	Severe storms and flooding; snow and ice in higher elevations	*DR-1701*
1/29/2011	Severe Storm	*EM-3343*
10/29/11-10/30/11	Severe storm and Nor'easter; at peak 665,000 residents state-wide without power; 2,000 people in shelters statewide	*DR-4051*

Source: MEMA, 2013; BRPC 2017

The Storm Prediction Center maintains a severe weather database that contains information regarding hail, tornado, and damaging events. The damaging wind reports include data from 1996 to 2017. According to the Storm Prediction Center database, over the course of the last 20 years, the region has experienced 40 damaging wind events, with an annual frequency of two per year (NOAA, 2017). The events from the past 20 years caused over $348,000 in property losses.

Fig. 3.4.2 Microburst in Cheshire 7-18-16

Southern New England typically experiences 10 to 15 days per year with severe thunderstorms. An average thunderstorm is 15 miles across and lasts 30 minutes, although severe thunderstorms can be much larger and longer. (Massachusetts Emergency Management Agency, 2013) Microbursts occur throughout Berkshire County, downing trees, utility lines and sometimes causing damage to property. In the Berkshires microbursts are often accompanied by heavy rainfall that can cause additional damage from flooding. According to news media reports, several recent thunderstorm/microburst events have caused damages in the communities of Williamstown, North Adams, Cheshire, Lanesborough, Pittsfield, Lee, and Stockbridge. An event that struck Pittsfield and other central Berkshire communities in July 2011 caused extensive damage and was responsible for the death of a man in Hinsdale who was struck by a falling utility pole. WMECO called in 339 out-of-state work electric crews and 14 out-of-state tree crews to remove trees and repair damaged lines[1].

On Sunday, June 1, 2016 an afternoon thunderstorm stalled for two hours over Lee and Stockbridge, flooding streets, basements and ground floors, including the ground floor of Stockbridge Town Hall. Stockbridge received almost 5” of rain while 4.5” fell at the Lee water treatment plant. Another inch of rain fell the next evening in another storm.[2]

According to the MA State Hazard Mitigation Plan, there have been several damaging severe storms that have included Berkshire County.

- A pair of spring storms occurring within a few days of one another in March and April 1987 combined with snowmelt to produce record flooding in Massachusetts, Maine, and New Hampshire. The events brought over 8 inches of rainfall to some areas of Massachusetts (FEMA DR-790).
- On October 9, 2005, the remnants of Tropical Storm Tammy produced significant rain and flooding across western Massachusetts. It was reported that between nine and 11 inches of rain fell. On October 15, a low-pressure system, combined with tropical moisture, resulted in heavy rain and flooding across Massachusetts. This series of storms resulted in a federal disaster declaration (FEMA DR-1614) and Massachusetts received over $13 million in individual and public assistance.
- An intense coastal storm (April 15-16, 2007) brought three to six inches of wet snow, sleet, and rain to parts of western Massachusetts. The storm was primarily a rain event due to warmer temperatures, but higher elevations experienced significant snow and ice accumulations. This

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[1] *McKeever, Andy, 1-27-11. “Pittsfield Slammed by Surprise Microburst Storm,” iBerkshires.*

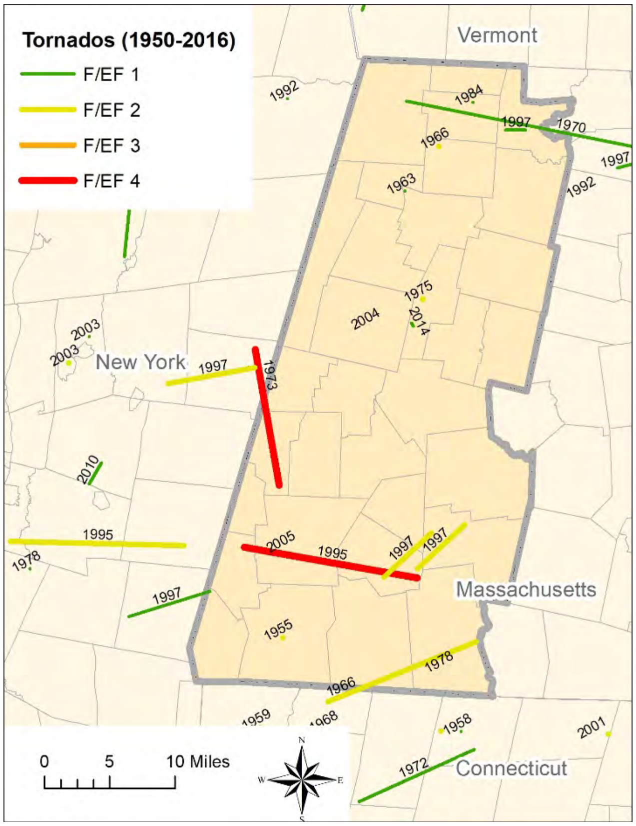
[2] *Lindsay, Dick, 6-1-16. “Weekend deluge swamps roads, homes in Stockbridge, Lee,” Berkshire Eagle.*

event resulted in a federal disaster declaration (FEMA DR-1701), with those counties included in this disaster receiving over $8 million in public assistance from FEMA.

- Between August 19 and 21, 2011, Berkshire, Hampshire, Essex, Middlesex, Suffolk, Franklin, Norfolk, and Worcester Counties experienced severe thunderstorms that produced quarter-sized hail and damaging winds. The strong winds knocked down numerous trees and power lines in the affected areas, causing nearly $100,000 in property damage.
- A rare October Nor'easter brought heavy snow to portions of southern New England on October 29, 2011. Snowfall accumulations of one to two feet were common in the Monadnocks, Berkshires, Connecticut Valley, and higher elevations in central Massachusetts. Up to 31 inches of snow was reported in Plainfield, MA. The accumulation of the heavy, wet snow on trees and power lines resulted in widespread tree damage and power outages across central and western Massachusetts. At the peak, approximately 665,000 customers in Massachusetts were without power. Six fatalities occurred during and in the aftermath of the storm. (FEMA DR-4051).

Typically, there are one to three tornadoes somewhere in southern New England per year, with Massachusetts experiencing an average of one tornado event annually between 1991 and 2010. Starting in 2007, tornados are rated based on the Enhanced Fujita Tornado Scale; prior to 2007 tornados were based on the Fujita Tornado Scale. Of the 18 tornados that have occurred in Berkshire County between 1950 and 2016, only one has occurred since 2007, an EF1 in July 2014 in Dalton. Four tornados occurred during a single storm on July 3, 1997. These have resulted in over $29 million in damage, seven deaths, and 60+ injuries. (NOAA, 2017).

Fig. 3.4.3. Tornados in the Berkshire Region and their



Source: Midwest Regional Climate Center, 2018

NOAA records indicate that a F2 tornado struck Dalton on a Sunday in July of 1973 or 1975. Local residents remember a storm event that landed on the Berkshire Bridge property, bounced across East Main Street, through Wahconah Country Club property and up to North Street (Rt 9) before heading towards Windsor. John Boyle, Dalton resident and Selectman, recalled that the sky was a greenish color and that noise that sounded like a train accompanied the tornado. The tornado landed on the Berkshire Bridge property behind the Boyle's home and bounced across East Main Street and through the Wahconah Country Club property to North Street (Rt. 9). This event destroyed a garage and outdoor swing set, moved a 300+-pound concrete bench, and caused some damage to Anne's Mahogany Room restaurant.[3]

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[3] *Boyle, personal communication, Sept. 2018.*

In July 2014 an EF-1 tornado and microburst touched down in the Greenridge section of Dalton, causing downed trees and powerlines across the area, and temporarily closing local roads. The tornado caused structural damage on at least one home and cut a path through the woods behind Greenridge Park. A home on Norwich Drive sustained extensive damage, as the tornado lifted the roof off the house, shifted the chimney and ripped vents and siding. At this same house a large tree smashed through the back of the house and broke windows. Other local homeowners suffered minor damages.[4]

The most memorable tornados in recent history occurred in West Stockbridge in August of 1973 (category F4) and in Great Barrington, Egremont, and Monterey in May of 1995 (category F4). In the West Stockbridge tornado four people died and 36 were injured, and in Great Barrington three people died and 24 were injured. The signs of the tornados destruction are still visible today in Great Barrington from Rt. 7. The hill to the east is scarred where the tornado uprooted and toppled trees – they lie scattered on the hillside like matchsticks

Most tornados occur in the late afternoon and evening hours, when the heating is the greatest. This is true for the Dalton tornado which occurred around 5 pm. In Berkshire County the majority of tornados occur in the month of July and to a lesser degree in August, but tornadoes have it the county as early as March (in Adams in 1966) and as late as October (in Cheshire in 1963). (MEMA, 2013)

Probability of Future Occurrences

Severe storms comprising of thunderstorms, high winds, and hail will continue to affect the community. While these events may occur during any month, they most likely will occur between May and August. FEMA has developed Wind Zones for the U.S. based on 100 years of hurricane data and 40 years of tornado data, and according to the maps generated the Berkshires is listed as a Special Wind Region within the Hurricane-susceptible Region of a Wind Zone II (up to 160 mph winds). See Fig. 3.4.4. Based on this historical data the Town of Dalton can expect to continue to experience at least the same number and severity of wind-related weather events into the future. Some scientists project that the number and severity of events will increase as a result of climate change.

Lightning strikes primarily occur during the summer months. According to NOAA, there has been one fatality and 43 injuries as a result of lightning events from 1993 and 2012 in the Commonwealth (NCDC, 2012). Although thunderstorms with lightening may increase due to a more volatile atmosphere, the chance of death or injury is likely to remain low.

According to the National Climatic Data Center, since 1950, there have been 13 tornados that have touched down or moved in a path across Berkshire County. As shown in Fig. 3.4.3, there are several others that occurred in adjacent counties and states in the region. The most recent of these was in July 2014 when a tornado struck in Dalton. This averages to one tornado striking the county approximately every five years. Of these, only two have been of a severity of an EF4, which indicates that such a severe tornado has a statistical recurrence rate of one in every 33 years. (NOAA, 2017)

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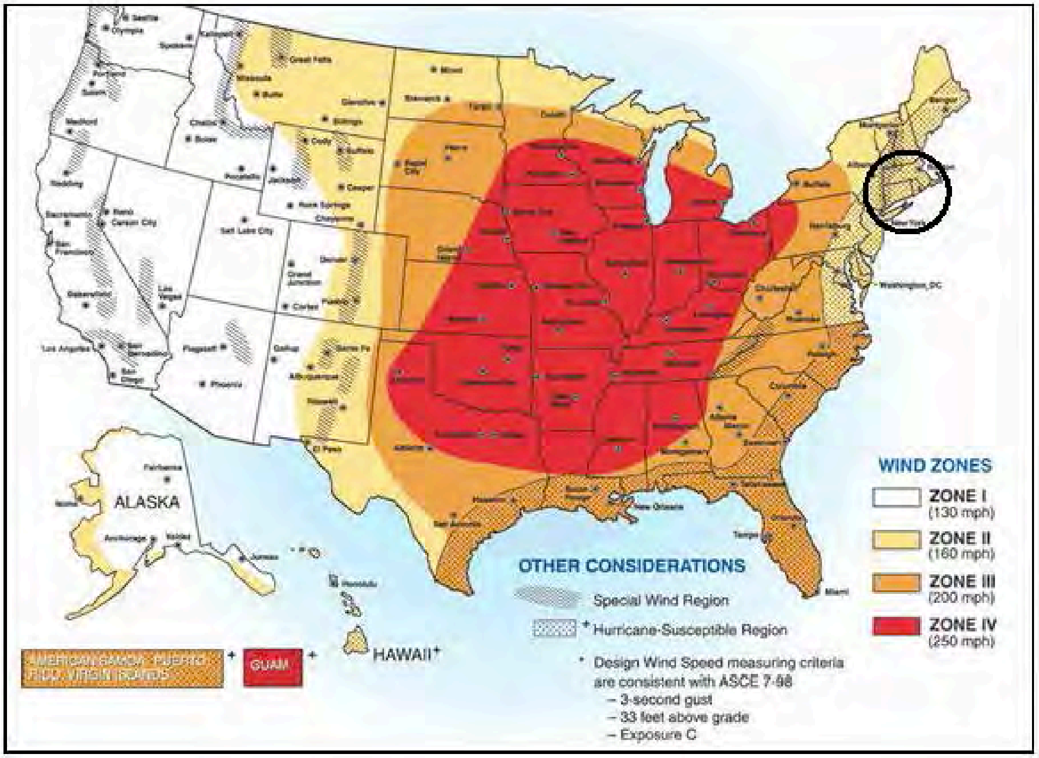
[4] *http://www.berkshireeagle.com/stories/national-weather-service-confirms-tornado-touch-down-in-dalton,365967*

Fig. 3.4.4. Wind Zones in the U.S.



Source: MEMA 2013.

Since 2000, there have been 24 cold weather events within the Commonwealth, ranging from Cold/Wind Chill to Extreme Cold/Wind Chill events. Since 2000, there have been one warm weather event, Excessive Heat. Detailed information regarding most of these extreme temperature events was not available.

Extreme temperatures will continue throughout the entire county into the future. With global warming, the county should expect more extreme temperatures, both hot and cold. It is projected that the region will experience 11 less days below 0°F. (Northeast Climate Science Center, 2018). According to the Massachusetts Climate Change Projections for the Housatonic River Watershed, a high temperature of above 90°F currently only occurs once per year. By mid-century the number of days it will go above 90°F will range from 4 to 20, and by the 2090s the number will increase to 7 to 57 days per year. The number of days going above 95°F will increase from the current zero days per year to almost 6 days by mid-century and up to 27 days by the 2090s. (MA Climate Change Projections for the Housatonic Watershed, 2018)

Severity

For non-tropical high wind events that occur over land, the National Weather Service (NWS) issues a Wind Advisory (sustained winds of 31 - 39 mph for at least one hour, or any gusts 46 - 57 mph) or a High Wind Warning (sustained winds 40+ mph or any gusts 58+ mph). For tropical systems, the NWS issues a tropical storm warning for any areas that are expecting sustained winds 39 - 73 mph. A hurricane warning is issued for any areas that are expecting sustained winds of 74+ mph. Effective 2010 the NWS modified the hail size criterion to classify a thunderstorm as ‘severe’ when it produces damaging wind gusts in excess of 58 mph, hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Tornado damage severity is measured by the Enhanced Fujita Tornado Scale and it allows surveyors to create more precise assessments of tornado severity. Table 3.4.5. illustrates the EF-scale.

Table 3.4.5. Enhanced EF-Scale

EF Number	3-second gusts (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

In the Berkshires, extreme cold temperatures are those that are well below zero for a sustained period of time, causing distress for vulnerable populations that are exposed to the temperatures when outside and straining home heating systems. The severity of extreme cold temperatures are generally measured through the Wind Chill Temperature Index. Wind Chill Temperature is the temperature that people and animals feel when outside and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. As the wind increases, the body is cooled at a faster rate causing the skin’s temperature to drop. (MEMA, 2013)

The NWS issues a Wind Chill Advisory if the Wind Chill Index is forecast to dip to –15ºF to –24ºF for at least three hours, using only the sustained winds (not gusts). The NWS issues a Wind Chill Warning if the Wind Chill Index is forecast to fall to –25ºF or colder for at least three hours using only the sustained wind. In 2001 the NWS implemented a Wind Chill Temperature Index to more accurately calculate how cold air feels on human skin and to predict the threat of frostbite. According to the calculations, people can get frostbite in as little as 10 minutes when the temperature is -10 degrees and winds are 15 miles per hour. (MEMA, 2013)

The following are some of the lowest temperatures recorded in the Berkshire region for the period from 1895 to present. (National Climatic Data Center, 2017)

- Lanesborough, MA –28°F
- Great Barrington, MA –27°F
- Stockbridge, MA –24°F
- Pittsfield, MA -19°F

Extreme heat temperatures are those that are 10°F or more above the average high temperature for the region and last for several hours. The following are some of the highest temperatures recorded for the period from 1895 to present, showing Boston and three Berkshire County locations. (National Climatic Data Center, 2017)

- Boston, MA 102°F
- Great Barrington, MA 99°F
- Adams, MA 95°F
- Pittsfield, MA 95°F

It should be noted that temperature alone does not define the stress that heat can have on the human body – humidity plays a powerful role in human health impacts, particularly for those with pre-existing pulmonary or cardio-vascular conditions. The NWS issues a Heat Advisory when the Heat Index is forecast to reach 100°-104°F for two or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105°F or more for two or more hours.

Warning Times

Meteorologists can often predict the likelihood of a severe thunderstorm outbreaks with several days of lead time. However, they can only pin this down to portions of states and cannot predict the exact time of onset or severity of individual events. Other storms, such as a well-organized squall line, can yield lead times of up to an hour from the time a Severe Thunderstorm Warning is issued to the time that severe criteria are observed. Some severe thunderstorm events may develop quickly, with only a few minutes of advance warning times. Doppler radar and a dense network of spotters and amateur radio operators across the region have helped increase warning lead time across southern New England. (MEMA, 2013) In Berkshire County the hilly and sometimes steeply sloped terrain facilitates cumulonimbus cloud development, creating very localized thunderstorms. These can develop quickly and dissipate quickly, with damages caused by wind, rain and sometimes hail.

Tornado watches and warnings are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead-time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible. (MEMA, 2013) According to the Dalton Emergency Management Director, who monitors weather advisories, there was no tornado warning for the Town prior to the tornado striking the Greenridge area in 2014. The only warning issued was a severe weather warning, with possible high winds.

Meteorologists can accurately forecast extreme temperature event development and the severity of the associated conditions with several days lead time. Excessive heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. Excessive heat warning/advisories are issued when an excessive heat event is expected in the next 36 hours. (MEMA, 2013)

The severe weather warnings issued for Berkshire County are generated out of the National Weather Service out of Albany NY, not from that in Boston. Also, residents in most of Berkshire County rely on weather reports from Albany NY television stations rather than from stations within the Commonwealth. This is because the county is listed as being in the Albany designated marketing area for cable and satellite companies. Also, given that the prevailing winds are from the west, Albany is often a good barometer for Berkshire weather. Fortunately, Albany TV stations include Berkshire County when they issue storm watches and warnings, and storm systems are easily tracked live online via the radar displays of all three major Albany television stations. Albany and local radio stations also issue warnings.

Climate Change

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data show that the probability for severe weather events increases in a warmer climate. (MEMA, 2013) Warming ocean temperatures are a source of increased evaporation and resulting precipitation, and warmer air masses can create more volatile atmospheric conditions, particularly if they interact or collide with cooler air masses. Any severe storm event could have significant economic consequences.

Extreme temperatures are among the most dangerous impacts associated with climate change. Extreme heat is among the most harmful to public health and safety, particularly for populations made more vulnerable due to existing chronic medical conditions or lower economic status. Additional impacts pose serious threats to public health and safety of urban areas, rising sea levels, and decreases in natural biodiversity.

Exposure

Whereas risk from some hazards can be somewhat dependent on locating development and infrastructure in higher risk areas (i.e. floodplain areas, dam inundation areas or proximity to forest and grasslands), the hazards described in this section are less dependent on location. In some localized areas wind speeds can increase across wide expanses of open, unforested areas, such as pasture or crop lands.

Temperature extremes can occur throughout the entire region and the Town of Dalton. Colder temperatures are more common in the higher elevations of the community, such as the higher elevations of Grange Hall Road at Barrett Hill, but the entire community is susceptible. Areas that are more prone to heat include the lower elevations in the downtown area and developments that are surrounded by parking lots. To understand risk, the assets exposed to the hazard areas are identified, and for the purposes of this plan the entire Town of Dalton is considered to be at risk for all the severe weather hazards discussed in this section.

3.4.3. Vulnerability

Population

The following populations are more vulnerable to a severe wind storm or tornado (MEMA, 2013):

- communities without or having ineffective early warning systems;
- the elderly and functional needs populations are considered most vulnerable because they require extra time or outside assistance to seek shelter and are more likely to seek or need medical attention which may not be available due to isolation during and/or after an event;
- economically disadvantaged populations;
- those with a language barrier unable to following warning messages;
- those in mobile homes;
- people in automobiles at the time of a tornado.

Severe storm events such as wind and rain storm events can impact people across Berkshire County and the Town of Dalton. Overall the greatest concern to human health from the hazards discussed in this section arise out of the potential for wide spread, long-term electricity outages, particularly during extreme temperature events that would expose people to severe cold due to lack of heat and severe heat due to lack of fans or air conditioning. People with pre-existing illnesses who need electricity for oxygen, dialysis or other equipment, and those who need moderate temperatures and humidity to reduce stress on pulmonary or cardiac systems are more vulnerable to electricity outages. The elderly are typically more vulnerable due to chronic illness, and given the trend of an increasing elderly population, mitigation and preparing for electricity outages should be a high priority. The additional trend of helping seniors age in place, including the more rural areas of Dalton, could mean that elderly residents become isolated during severe weather events.

Massachusetts ranks 35th among states for frequency of tornadoes, 14th for the frequency of tornadoes per square mile, 21st for injuries, and 12th for cost of damage. (MEMA, 2013) On June 1, 2011, seven tornadoes traveled through the Connecticut River Valley. destroying large sections of Springfield and other towns in the region, killing three people, injuring 300 in Springfield alone, and leaving at least 500 people homeless. The F3 tornado traveled a 39-mile path from Westfield to Brimfield and Monson, the latter small towns of which suffered the greatest damages. With winds of up to 160 mph, it destroyed 1,400 homes and 78 businesses.[5]

According to available data tornados are the single deadliest natural hazard in Berkshire County in recent decades, with two tornadoes killing seven people and injuring at least 60 (other deadly hazards have historically been floods and dam failures). So far tornado-caused deaths have been relatively low because none of the stronger tornados struck an area within one of the county's more densely populated areas such as a town center, village or subdivision. If a tornado where to strike a densely populated area it is likely that local and regional sheltering would be required.

Fig. 3.4.6. Path of the Great Barrington Tornado 1995

All residents in the Town of Dalton are vulnerable to the health effects of extreme temperatures, with those who work outside directly at a greater risk. Others at greater risk are those individuals who have pre-existing medical conditions that impair their ability to regulate their body temperatures, or whose homes or work places are inadequately heated or cooled.

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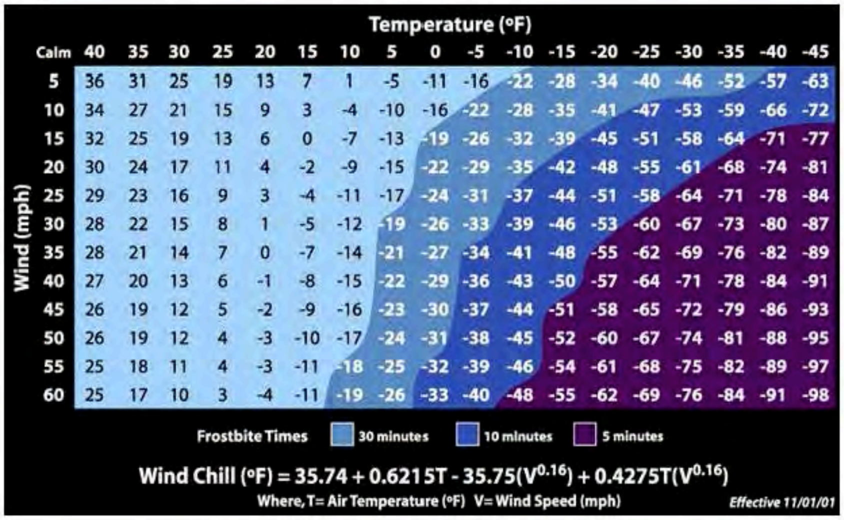
[5] *http://boston.cbslocal.com/2016/06/01/springfield-tornado-5-year-anniversary-3-killed-millions-damage/*

The NWS Wind Chill Temperature Index calculates how cold air feels on human skin, showing where temperature, wind speed and exposure time will cause frostbite to exposed human skin. Fig. 3.4.7. illustrates the relationship.

Fig. 3.4.7. Wind Chill Temperature Index and Frostbite Risk



Wind (mph)	Temperature (°F)																	
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

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

Populations especially vulnerable to extreme heat are the elderly and those with pre-existing health conditions such as cardiovascular disease, Type II diabetes and other chronic ailments. Hot humid conditions have been found to make breathing more difficult for those suffering from impaired respiratory and pulmonary systems. Societal factors most associated with heat related health risks were a lack of air-conditioning, lower social economic status, socially isolated individuals and a higher percentage of elderly (DPH 2014).

Based on the criteria for heat stress forecasts developed by the National Weather Service (NWS), watches or warnings are issued when thresholds of daytime high and nighttime low heat index (Hi) values are exceeded for at least two consecutive days (Fig. 3.4.8.). That number provides a temperature that the body feels. It is important to know that the Heat Index values are devised for shady, light wind conditions. Exposure to full sunshine can increase heat index values by up to 15°F. In Boston more than 50 people die each year due to heat-related illnesses. (MEMA, 2013) When interviewed in 2016 about projected climate change impacts, local ambulance crews reported no increase in heat-related calls in recent years, but Pittsfield Fire Chief Czerwinski did note that his department and Berkshire Medical Center staff are coordinating more closely about when to open cooling centers in Pittsfield for vulnerable populations (BRPC & BCBOHA, 2016) .

Fig. 3.4.8. Heat Index Chart and Human Health Impacts

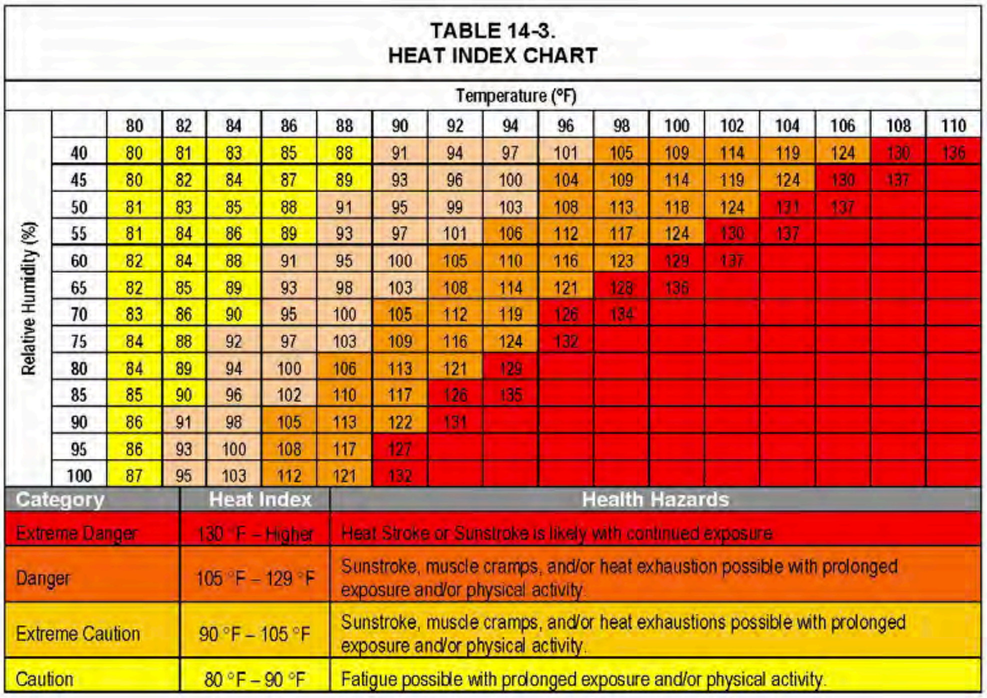


TABLE 14-3.
HEAT INDEX CHART

Temperature (°F)

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

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

Source: MEMA 2013

Nationally more than half of heat-related deaths occurred in homes where there was little or no air conditioning. Although the temperatures in the Berkshires do not equate to those in the southern portion of the country, the proportion of residents here without air conditioning is likely much higher than down south, indicating increased risk if the region were to experience a severe and prolonged heat wave. Air quality, which tends to be more degraded in urban areas, adds additional stress. Populations living in urban heat cores are more vulnerable to heat stress, particularly those without access to air conditioning and those with existing health conditions more susceptible. There are no urban core areas in Dalton.

What may be more concerning is the trend for higher nighttime temperatures. Warm nights are those where the minimum temperature stays above 70°F. Since 1950 the number of warm nights in Massachusetts has steadily increased since the mid-1990s with the highest number since 1950 occurring between 2010 and 2014. Refer to Fig. 3.4.9., where the dark horizontal line represents the long-term average.

Fig. 3.4.9. Observed Number of Warm Nights in MA 1950-2014

Source: https://statesummaries.ncics.org/ma

Historically the cooler evening temperatures in the Berkshires has allowed residents to cool their body temperatures in the night air and to cool their homes by opening windows and using fans to bring in the cooler air. Warmer nighttime temperatures will make it increasingly difficult to bring the temperataure down and cool homes that are not equipped with air conditioning.

Extreme heat temperatures and heat waves have historically been rare in Berkshire County, with temperatures that are cooler than the Hudson and Connecticut river valleys, ranging from 5°F cooler in the valley communities and 10°F cooler in the hilltowns. This is due largely to the slightly higher elevations of the Berkshires when compared to other regions in southern New England. Due to the rarity, this is a natural hazard for which communities and individuals are largely unprepared for. While most work places and increasingly more houses are being equipped with air conditioning, many residents across the county still rely on fans or inefficient window air conditioning units to cool their homes.

According to the *Berkshire Communities for Climate Change* report, the Massachusetts Department of Public Health survey taken by local boards of health across the state, in which less than 20% of local boards reported dealing with heat waves. Thirteen of the 17 Berkshire towns that answered the survey reported not having taken any steps to plan for cooling centers. Local schools are often designated as an emergency shelters and in the western region only 38% of respondents reported having at least partially available air conditioning in their schools. (BCBOHA, 2016). The Dalton Senior Center currently unofficially serves as the Town of Dalton's cooling center, with the capacity to hold approximately 130 people. [6]

Critical Facilities

All critical facilities in the Town of Dalton are exposed to severe weather events such as high winds and thunderstorms and tornados. The most common problem associated with severe weather is loss of electricity and possibly communications systems. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to flash or urban flooding. (Massachusetts Emergency Management Agency, 2013)

All critical facilities are exposed to the extreme temperatures hazards. Extreme cold temperature events can damage buildings and infrastructure through freezing/bursting pipes and freeze/thaw cycles. The Dalton Water and Fire District has been working with the Dalton Public Works department to replace aged water pipes when road work is planned. As recent example of this was when the District was able to upgrade water pipes along Housatonic Street when the road was reconstructed in 2017. There are still areas that the District would like to focus on updating. For example, the water lines in the Greenridge neighborhood south of South Street are the originals that were installed in the 1950s when the subdivision was established.

Extreme heat that occurs in the Berkshires generally does not impact buildings or other structures, but damages can be associated with overworking of HVAC systems, particularly those that are older or undersized. There is some concern that increased temperatures can reduce the transmission capacity of electric power lines during summer heat waves, which is exactly the time when peak demand for electricity will be highest due to air conditioning. In general, the demand for electricity continues to

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[6] *Kelly Pizzi, Director, Dalton Council on Aging, personal communications 2018.*

rise, and the electric grid may have increasing difficulty meeting demand during the highest peak periods, leading to potential brown out or failures. Backup power sources will be all the more important for critical facilities such as key public buildings (for continuity of operations) and cooling centers.

Economic Vulnerability

Wind storms, thunderstorms, and tornado events may impact the economy, including loss of business function, water supply system damage, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Loss of key transportation routes may also occur. Agricultural losses can be devastating due to lightning and resulting fires. Because of differences in building construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. (MEMA, 2013) Mobile homes are the most vulnerable to damage, even if tied down, and offer little protection to people inside. The total structural replacement cost value for residential buildings in the community is greater than $353 Million or approximately 77-percent of all occupancy classes. (Berkshire Regional Planning Commission, 2010)

Many small businesses suffer disproportionately than larger industries – if small businesses cannot open the business than they may struggle to make payroll and other expenses – and the longer the closure the deeper the impacts.

3.4.4. Existing Protections

The Town of Dalton adheres to the Massachusetts state building code, which as of 2018 was the Ninth Edition of the State Building Code. Part of that code requires buildings to withstand specific wind loads and adhere to energy efficiency standards.

The Town of Dalton is also a Green Community, which requires that new construction adhere to the state’s Stretch Energy Code, requiring new buildings to more energy efficient and the building envelopes tighter than the state’s underlying code. The more heavily insulated building envelope will add in maintaining temperate interior temperatures against extreme exterior cold and heat. The MassSave Program offers free energy audits to residential and business customers who request them and, based on the results of the audits, offers financial incentives for building owners to become more energy efficient and better insulated.

Regarding electricity outages, town officials across Berkshire County have reported an improvement in response from the electric companies since the ice storm in 2008. Additionally, the electric utility companies have created special community liaison staff who work more directly with municipal first responders during emergency incidents.

In the event of a large-scale power outage the local mass shelter for the Town of Dalton is Nessacus Middle School, which does have air conditioning in the auditorium. The building has a generator, although it runs only part of the building (emergency lights, refrigerator, boiler room), not including the auditorium. There is no formal MOU between the Town and the Central Berkshire Regional School District, which owns and maintains the building.

The Dalton Senior Center is a great asset. The Senior Center seldom closes, even during severe weather events because residents may be in need of assistance. Since many staff live locally, someone is always able to get to the center. The Town has established an informal cooling center at the Dalton Senior Center as the building does have air conditioning. However, the building does not have a generator and is not wired to accept one, and could not therefore serve as a shelter, cooling/warning/recharge space or as a community gathering place if there were an electricity outage.

Code Red is utilized by emergency personnel when severe weather events are predicted; it is also utilized during and post-storm to inform residents of resulting road closures, power outages and other safety instructions.

The Emergency Management Director posts severe weather warnings on the Town website and on the EMD Facebook.

3.4.5. Actions

- Retrofit Senior Center with backup power to serve as heating or cooling center, or shelter if needed.
- Continue to encourage enrollment in Code Red.
- Encourage homeowners to get energy audits, improve insulation and proper attic ventilation to prepare against extreme heat.

3.5. Dam Failure Hazards

3.5.1. General Background

A "dam" is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water. Dam failure is a catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam
- Deliberate acts of sabotage
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep

(MEMA, 2013)

The Massachusetts Department of Conservation and Recreation (DCR) Office of Dam Safety maintains an inventory of all the known dams in the state. A synopsis of this inventory is presented in the following pages. The BRPC has been unable to obtain an updated database from DCR for this 2018 plan, so the data has not changed since the 2005 regional plan, unless updated information was known by the community on the removal or repair of dams. The dam regulations are governed by Massachusetts General Law chapter 253, § 44. The height of the dam is determined by the height of the dam at the maximum water storage elevation. The storage capacity of the dam is the volume of water contained in the impoundment at maximum water storage elevation. Size class may be determined by either storage or height, whichever gives the larger size classification.

The classification for potential hazards pertain to potential loss of human life or property damage in the event of failure or improper operation of the dam or appurtenant works. Probable future development of the area downstream from the dam that would be affected by its failure shall be considered in determining the classification. Even dams which, theoretically, would pose little threat under normal circumstances can overspill or fail under the stress of a cataclysmic event such as an earthquake or sabotage.

Dam owners are legally responsible for having their dams inspected on a regular basis. High Hazard dams must be inspected every two years, Significant Hazard dams must be inspected every five years, and Low Hazard dams must be inspected every 10 years. In addition, owners of High Hazard dams must develop Emergency Action Plans (EAPs) that outline the activities that would occur if the dam failed or appeared to be failing. Owners of Significant Hazard dams are strongly encouraged to also develop EAPs. The Plan would include a notification flow chart, list of response personnel and their responsibilities, a map of the inundation area that would be impacted, and a procedure for warning and evacuating residents in the inundation area. The EAP must be filed with local and state emergency agencies.

Factors that contribute to dam failure include design flaw, age, over-capacity stress and lack of maintenance. Maintenance, or the lack thereof, is a serious concern for the community. By law, dam owners are responsible for the proper maintenance of their dams. If a dam were to fail and cause flooding downstream, the dam owner would be liable for damages and loss of life that were a result of the failure. Local officials are largely unaware of the age and condition of the dams within their communities.

3.5.2. Hazard Profile

Location

There are eight public and privately-owned dams located throughout Dalton. A summary of these dams and their hazard and size class can be found in Table 3.5.1. These dams range in age from the Byron Weston Dam #1 built in 1875, to the Ashley Reservoir (Lower) dam built in 1960, and in capacity from the Byron Weston Dam #1 impounding 200 acre-feet to Ashley Reservoir (Lower) dam impounding 12 acre-feet (Office of Dam Safety, 2004) It should be noted that the Old Berkshire Mill dam has been breached no longer impounds water, so this dam has been removed from the inventory.

Additionally, there are 6 dams upstream and out of the town boundaries that could impact the town if they were to fail. In fact, the potential damages from a few of these dams are far greater than from the dams located within town boundaries. To differentiate the dams located outside the town borders, these are listed in italics in Table 1. The potential impacts from inundation are discussed in more detail in the Vulnerability section.

Table 3.5.1. Dams that could Inundate Dalton

Name	Municipality	Owner	Classification	Size Class	Condition
Byron Weston #1	Dalton	Crane Co.	Significant Hazard	Intermediate	Satisfactory
Bryon Weston #2	Dalton	Crane Co.	Significant Hazard	Unknown	Satisfactory
Upper Pioneer Pond	Dalton	Crane Co.	Low Hazard	Small	Fair
Bay State Pond	Dalton	Crane Co.	Low	Non-Jurisdictional	Fair
Sackett District	Dalton	City of Pittsfield	Low	Non-Jurisdictional	Poor
Dalton Water Supply Dam #1	Dalton	Dalton Fire & Water District	N/A	Small (impoundment dry)	Unknown
Egypt Reservoir	Dalton	Dalton Fire & Water District	High	Intermediate	Good
Ashley Lower Reservoir*	Dalton	City of Pittsfield	Low	Intermediate	Good
*Cleveland Reservoir**	*Hinsdale*	*City of Pittsfield*	*High*	*Large*	*Satisfactory*
*Lake Ashmere**	*Hinsdale*	*Commonwealth of MA*	*High*	*Large*	*Satisfactory*

*Plunkett Reservoir**	*Hinsdale*	*Town of Hinsdale*	*High*	*Large*	*Fair*
*Windsor Reservoir**	*Windsor*	*Dalton Fire District*	*High*	*Large*	*Good*
Belmont Reservoir	*Hinsdale*	*Town of Hinsdale*	*High*	*Large*	*Good*
*Upper Sackett Reservoir**	*Hinsdale*	*City of Pittsfield*	*High*	*Large*	*Poor*

Source: Office of Dam Safety 2004, except for: Crane Co. where information has been provided by dam owner 2018; dams with asterisk(*) provided by Dalton Fire District 2018.

Table 3.5.2. Dam Size Classification

Category	Storage (acre-feet)	Height (feet)
Small	>= 15 and <50	>= 6 and <15
Intermediate	>= 50 and <1000	>= 15 and <40
Large	>= 1000	>= 40

Table 3.5.3. Dam Hazard Potential Classification

Hazard Classification	Hazard Potential
High Hazard (Class I):	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 Hazard (Class II):	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 of relatively important facilities.
Low Hazard (Class III):	Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

Previous Occurrences

Historically, dam failure has had a low occurrence in Berkshire County. However, it is one of the few natural hazards that have taken human lives in Berkshire County. The dam failure events of most note in Berkshire County are:

- On April 20, 1886, the Mud Pond Dam in East Lee, MA, failed and heavy damaged or destroyed approximately 12 shops and industries along Greenwater Brook. This failure killed seven people. The cause of the failure was unknown. (Massachusetts Emergency Management Agency, 2013)
- August 19-20, 1901, Basset Reservoir and Dean’s dams fail after a two-day rain event (Ennis, 2004). It is unclear if any injuries or deaths are attributed to the dam failures.
- On March 24, 1968, the Lee Lake Dam near East Lee, Massachusetts failed, destroying six homes, damaging 20 homes and one manufacturing plant. The failure caused two fatalities. The cause of the failure was unknown. (MEMA, 2013)

While no dam failures have occurred in recent decades that impacted Dalton, in September 2004 an incident occurred at the Plunkett Reservoir dam in Hinsdale. The first few weeks of September were unusually wet as the region received residual rain from three hurricanes. On September 18, 2004, after the effects of Hurricane Ivan dropped more than three inches of rain on the area in 24 hours, the flash boards at the Plunkett Reservoir dam gave way. The Emergency Management Director for Hinsdale calculated that approximately eight million gallons of water flooded the Housatonic River downstream of the lake, causing some minor flooding. There was no permanent damage or real estate damage, but the CSX rail line was undermined in the Hinsdale Flats area in Hinsdale. This was largely due to beaver activity, where culverts were partially plugged; impeding and redirecting flood waters. The Town of Hinsdale has recently completed the first phase of maintenance work on the Plunkett Lake dam, and are looking for funds to complete the next phase of work.

Probability of Future Occurrences

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides, excessive rainfall, and snowmelt. A factor to consider is that many of the dams within the region are more than 100 years old, and some are approaching 200 years old, and many dam owners struggle to properly maintain their dams. There is a “residual risk” associated with dams. Residual risk is the risk that remains after safeguards have been implemented. For dams, the residual risk is associated with events beyond those that the facility was designed to withstand. However, the probability of any type of dam failure is low in today’s regulatory and dam safety oversight environment.

Secondary Hazards

The sudden and potentially extreme volumes of water that are released during dam failures can result in ecological damage both upstream and downstream of the dam. River channels downstream of the dam can experience severe scouring, banks can experience erosion and mass wasting, and boulders can become dislodged and move downstream by high and powerful water volumes. Trees and other vegetation can become uprooted and add to the debris moved by floodwaters, potentially clogging and threatening the integrity of culverts and bridges. Upstream of the dam the former impoundment could become partially or completely dewatered, altering, and potentially destroying aquatic habitat. If the impoundment behind the dam were a drinking water supply, the loss of stored water could threaten public health and the economy of the town. (MEMA, 2013)

As many of the impoundments in and upstream of Dalton serve as drinking water supplies for Dalton and Pittsfield, the latter being Berkshire County’s largest municipality, the loss of a significant reservoir could have long-lasting repercussions. Cleveland Reservoir is the major source of drinking water for the City of Pittsfield and the Town of Dalton. In Dalton alone, the Dalton Fire District has a contract with the City to withdraw 46 million gallons of water per month, the vast majority of which is used by Crane Company. Other reservoirs that serve as drinking water sources for Pittsfield, and whose dams would cause inundation in Dalton, are Ashley and Sackett.

Other secondary impacts due to dam failure are potential human health impacts from inundation of private drinking water wells and septic systems. Flood waters typically carry higher bacterial counts than normal flows and these could flood directly into or seep through saturated groundwater into well shafts. Additionally, floodwater could become more contaminated if water exchange occurs between wells and nearby septic systems.

Severity

The U.S. Army Corps of Engineers developed the classification system shown in Table 3.5.4. for the hazard potential of dam failures. These classifications help to further explain the potential impacts of that dam failures could cause in Dalton. The Corps of Engineers hazard rating systems is based only on the potential consequences of a dam failure; it does not take into account the probability of such failures. (Massachusetts Emergency Management Agency, 2013)

Table 3.5.4. Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development)	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss of life potential is based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

In Dalton, the dam failure of most concern is Cleveland Reservoir, due to the large aerial extent of the inundation area (which includes Wahconah Regional High School, several entire residential neighborhoods including senior housing complexes, and all Crane Co facilities), the height of the wall of water that would be moving, and the high velocity of that moving water. A full breach of the dam during probably maximum flood conditions would have a very short warning time. The inundation area continues downstream and causes extensive flood damages downstream in Pittsfield.

Climate Change Impacts

According to MEMA, dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If severe rain events cause hygrographic changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. If the number of severe storms increases, or becomes the new norm, early releases of water will impact lands and waterways downstream more often.

Dams are constructed with safety features such as spillways and lower level outlets to allow release of additional water discharges. Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change may not increase the probability of catastrophic dam failure, it may increase the probability of design failures. (Massachusetts Emergency Management Agency, 2013)

If climate change results in a greater number of severe precipitation events and shortens recurrence intervals them, as is predicted, it will require dam operators to become more vigilant in monitoring precipitation and temperature patterns. Individual rain events, particularly if occurring during periods of saturated or frozen soils that cannot absorb rainfall, may require that dam operators open spillways, flashboards and other safety features more often, causing a greater number of high discharge events and possible flooding on properties downstream of the dam.

Warning Time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted, or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours. (MEMA, 2013)

Dam owners are required to have established protocols for flood warning and response to imminent dam failure in the flood warning portion of its adopted emergency operations plan. These protocols are tied to the emergency action plans also created by the dam owners. These documents are customarily maintained as confidential information, although copies are required to be provided to the Commonwealth of Massachusetts for response purposes. (MEMA, 2013)

Exposure

Residents in the town are at risk from several dams, located in Dalton and neighboring Hinsdale and Windsor. Emergency Action Plans, are on file with the Emergency Management Director. Due to the sensitive nature of the contents of these plans, this hazard mitigation plan update will discuss in general terms the risks posed by these dams. As such a detailed risk assessment to quantify potential damages has not be conducted.

3.5.3. Vulnerability

Population

A quantitative vulnerability assessment for property damages, injury or death could not be completed to estimate potential losses from a dam failure event. The towns vulnerability to the dam failure hazard is discussed qualitatively below.

A complete failure of the Cleveland Reservoir dam has the potential to result in a catastrophic disaster, flooding a large swath of land along Old Windsor Road, lands and neighborhoods from East Housatonic Street north to North Street/Route 9, and Orchard Street west to Pleasant Street, with large facilities such as Wahconah Regional High School, and the Crane Company wastewater treatment plant being totally inundated by such an event. The High School would be inundated under 35 feet of water, which is essentially the entire facility, floor to ceiling. The inundation area continues westward into Pittsfield, where even more residential neighborhoods and commercial and industrial facilities would be flooded.

A wet weather complete failure of the Lake Ashmere dam would discharge water into the Housatonic River, inundating Wahconah High School, the Pease Avenue neighborhood and several homes in the vicinity of East Main Street and Hinsdale road. Windsor Reservoir dam would discharge water into Wahconah Falls Brook, inundating homes on North Street, Pomeroy Manor and homes/businesses near Main and Depot Streets.

The severity of dam failures at the Egypt, Ashley and Sackett Reservoirs is far less than that of the other dams discussed above, impacting a much smaller set of homes and populations. The inundation area from Ashley Lake and Sackett Reservoir dams would flood residents in the southern section of Dalton., mostly along Washington Mountain Road, Kirchner Road and part of Dalton Division Road before it heads into Pittsfield.

All populations in a dam failure inundation zone would be exposed to the risk of a dam failure. The potential for loss of life is affected by severity of the dam failure, the warning time, the capacity of dam owners and emergency personnel to alert the public and the capacity and number of evacuation routes available to populations living in areas of potential inundation. The area around Center Pond is a particularly vulnerable area, as it is included in the inundation maps for Cleveland and Windsor Reservoirs and Lake Ashmere.

Table 5 below estimates the number of people who are in the inundation areas of the individual dams in and upstream of Dalton based on inundation maps that are available. It should be noted that the number of people estimated within the inundation areas are a very rough estimate, based on the number of people in each census block that is located at least partially within the inundation areas within Dalton. Estimates have only been done for the dams for which inundation maps could be located. A more accurate estimate on the severity of the risk of damages, injury or death, which would need to be calculated using several criteria such as baseline elevation, flood volumes, depth of the inundation, and warning time, has not been calculated for this plan update. It should also be noted that people who may be congregated in large buildings, such as schools and commercial or industrial buildings, are not included in these estimates.

Table 3.5.5. Dam Inundation in Dalton

Name	Classification	Size Class	Condition	Estimated Population in Inundation Area^	Use
Byron Weston #1	Significant Hazard	Intermediate	Satisfactory	*Unknown*	None
Bryon Weston #2	Significant Hazard	Unknown	Satisfactory	*Unknown*	Industrial hydropower
Upper Pioneer Pond	Low Hazard	Small	Fair	*Unknown*	None
Bay State Pond	Low Hazard	Non-Jurisdictional	Fair	*Unknown*	None
Sackett District	Low Hazard	Non-Jurisdictional	Poor	*Unknown*	None; impoundment dry
Dalton Water Supply Dam #1	N/A	Small	Unknown	*Unknown*	Public Drinking Water
Egypt Reservoir	High Hazard	Intermediate	Good	*Unknown*	Public Drinking Water
Ashley Lower Reservoir*	Low Hazard	Intermediate	Good	173	Public Drinking Water
*Cleveland Reservoir**	*High Hazard*	*Large*	*Satisfactory*	*3,708*	Public Drinking Water
*Lake Ashmere**	*High Hazard*	*Large*	*Satisfactory*	*1,183*	Recreational lake
*Plunkett Reservoir**	*High Hazard*	*Large*	*Good/Fair*	*Unknown*	Recreational lake
*Windsor Reservoir**	*High Hazard*	*Large*	*Good*	*Unknown*	*Public Drinking Water*
Belmont Reservoir	*High Hazard*	*Large*	*Good*	*Unknown*	*Public Drinking Water*
*Upper Sackett Reservoir**	*High Hazard*	*Large*	*Poor*	*288*	*Public Drinking Water*

Source: Office of Dam Safety 2004, except for: Crane Co. where information has been provided by dam owner 2018, and dams with asterisk(*) provided by Dalton Fire District 2018

^Note: Population estimate based on census block information; exact counting of the number of homes or buildings located within the inundation area was not conducted.

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the needed time frame. There is often limited warning time for a dam failure event. While dam failure is rare, when events do occur, they are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event from a television, radio or phone emergency warning system are highly vulnerable to this hazard. This population includes the elderly, young, and large groups of people who may be unable to get themselves out of the inundation area. (Massachusetts Emergency Management Agency, 2013) The inundation area for Cleveland Reservoir includes Wahconah Regional High School, Pomeroy Manor, and River Run apartments, and several large commercial buildings. It also includes entire densely developed residential neighborhoods. Ashmere Lake's inundation area includes both Wahconah High School and Nessacus Middle School.

Critical Facilities

All critical facilities and transportation infrastructures in the dam failure inundation zone are vulnerable to damage. Flood waters may potentially cut off evacuation routes, limit emergency access, and destroy power lines and communication infrastructure. (Massachusetts Emergency Management Agency, 2013) The inundation area for Cleveland Reservoir dam includes the major transportation routes of Main Street, the Main Street bridge, North Street (Rt. 9), Orchard Street and a section of Hinsdale Road (Rt. 8). Widespread damage or destruction of sewer and gas lines that are attached to bridges could occur, and downing of utility poles could disrupt to knock out electricity service and communications. Wahconah High School, the Dalton Water District office, MassWildlife Western District Office, MassDOT facility and all Crane Company facilities will be inundated. Nessacus Regional Middle School is on the delineated edge of the inundation area, but sections of East Housatonic Street and Hinsdale Road are in the inundation area and could limit access to the school if it were needed for sheltering or evacuation.

Route 9 and the Main Street bridge, Wahconah High School and the Dalton Water District office are in the inundation area for the Lake Ashmere dam.

Town EOCs are not in any dam inundation areas.

Economy

Damage to buildings and infrastructure can impact a community's economy and tax base. Buildings and property located within or closest to the dam inundation areas have the greatest potential to experience the largest, most destructive surge of water.

All buildings and infrastructure located in the dam failure inundation zone are considered exposed and vulnerable. Based on the assessed value of buildings in the inundation zones, it is estimated that there is $195 million of building stock exposed to dam failures from the dams for which inundation maps are available. There is additional building contents that are exposed, amounting to $97 million, for a total of $292 million. (Berkshire Regional Planning Commission, 2017)

3.5.4. Existing Protections

The City of Pittsfield has conducted a significant amount of work to maintain and repair their system of dams within the last decade, including work on Ashley and Upper Sackett Reservoirs. Cleveland Reservoir has two spillways that can be utilized to release water during levels of high water. Their

Emergency Action Plans are regularly updated and shared with the Dalton Emergency Management Director. Inundation maps are available upon request of town officials.

The Dalton Fire & Water District has conducted repairs to the Windsor Dam, raising and armoring the bank and repairing seepage, raising the condition rating of the dam from Poor to Good.

Crane Company has breached an unused dam and restored natural river flow, partnering with the Division of Ecological Restoration (former Riverways Program) as one of the first dam removal and river restoration projects in the Commonwealth. They have conducted extensive repairs to the Byron Weston Dam #2, which impounds Center Pond, in 2006-07.

Additionally, the Massachusetts Department of Conservation and Recreation conducted extensive repaires to the Lake Ashmere dam 2008-10. The tables in this plan report data from 2004, which list the dam as being in Fair/Poor condition. It is likely that the condition of the dam has been upgraded due to the work on the dam, but the 2013 Emergency Action Plan for the Lake Ashmere does not list the condition of the dam, and the Town was unable to obtain new information on the dam’s condition from the DCR, the dam owner.

3.5.5. Actions for Dam Failure

- Continue to maintain close working relationships and communications with the City of Pittsfield, DCR and Dalton Fire & Water District to ensure up-to-date Emergency Action Plans and communiciations.
- Consider conducting a dam breach exercise for Cleveland Reservoir, including neighboring Hinsdale and Pittsfield.

3.6. Severe Winter Weather Hazards

3.6.1. General Background

Snow, Blizzards and Nor'easters, Ice Storms

Winter storms are the most common and most familiar of Massachusetts hazards which affect large geographical areas. The majority of blizzards and ice storms are viewed by people in the region as part of life in the Berkshires, an inconvenience and drain on municipal budgets. Residents and town staff expect to deal with several snow storms and a few Nor'easters each winter. However, periodically, a storm will occur which is a true disaster, and necessitates intense, large-scale emergency response.

Snow formation requires temperatures to be below freezing in all or most of the atmosphere from the surface up to cloud level. Generally, ten inches of snow will melt into one inch of water. Sometimes the snow-liquid ratio may be much higher – up to 20:1 or 30:1. This commonly happens when snow falls into a very cold air mass, with temperatures of 20 degrees or less at ground level. (MEMA, 2013)

A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below a quarter-mile. These conditions must be the predominant condition over a three-hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of this definition. However, the hazard created by the combination of snow, wind, and low visibility increases significantly with temperatures below 20ºF. A severe blizzard is categorized as having temperatures near or below 10 °F, winds exceeding 45 mph, and visibility reduced by snow to near zero. (MEMA, 2013)

A Nor'easter is typically a large counter-clockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, and rain. Strong areas of low pressure often form off the southern east coast of the U.S, moving northward with heavy moisture and colliding with cooler winter inland temperatures. Sustained wind speeds of 20-40 mph are common during a nor'easter, with short-term wind speeds gusting up to 50-60 mph or even to hurricane force winds. (MEMA, 2013) The main impacts of Nor'easters in the Berkshires is deep snow depths, high winds and reduced visibility, potentially resulting in the closing of schools, businesses, some governmental operations and public gatherings. Loss of electric power and possible closure of roads can occur during the more severe storms events.

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 criteria 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 pulling down of power lines and trees. (MEMA, 2013)

3.6.2. Hazard Profile

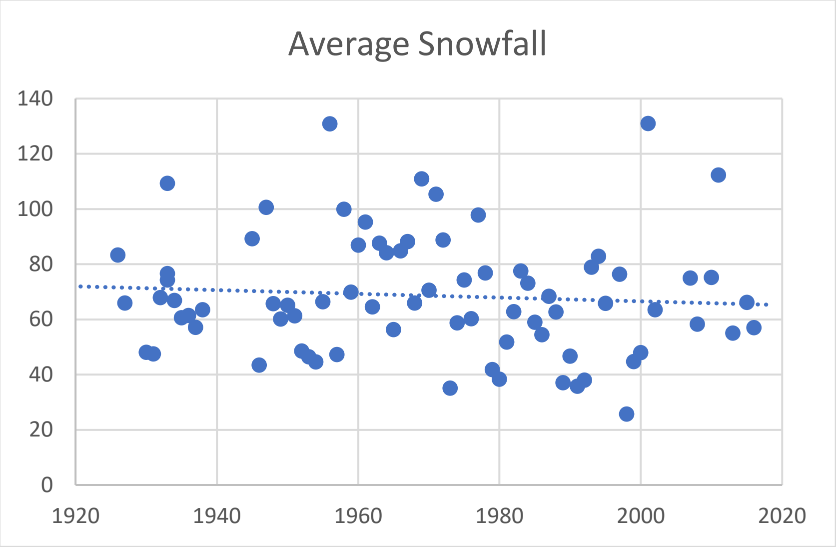
Location

Severe winter storm events generally occur across the entire area of Dalton, although higher elevations have slightly higher snow depths.

Previous Occurrences

Figure 3.6.1. illustrates historic snowfall totals the region has received. Although the entire community is at risk, the higher terrains tend to receive higher snowfall amounts, and these same areas may receive snow when the lower elevations received mixed snow/rain or just rain. (National Climatic Data Center, 2017) In Dalton the higher elevations of Grange Hall Road, Kirchner Road and Washington Mount Road experience more severe snow and ice.

Figure 3.6.1. Average Snowfall in Berkshire County



The National Climatic Data Center, a division of NOAA, reports statistics on severe winter storms from 1993 through 2017. During this 24-year span, Berkshire County experienced 151 severe winter storms, an average of six per winter. This number varies each winter, ranging from one during 2006 to 18 during 2008. Snow and other winter precipitation occur very frequently across the entire region. Snowfall in the region can vary between 26 and 131 inches a year, however it averages around 65 inches a year, down from around 75 inches a year in 1920.

Another tracking system is the one- and three-day record snowfall totals. According to data from the Northeast States Consortium, 99% of the one-day record snowfall events in the region typically yield snow depths in the range of 12”-24”, while the majority of three-day record snowfall events yield snow depths of 24”-36”.

Table 3.6.1. Record Snowfall Events and Snow Depths for Berkshire County

Record Snowfall Event	Snowfall 12” – 24”	Snowfall 24” – 36”
1-Day Record	99%	1%
3-Day Record	36%	64%

Source: (Northeast States Emergency Consortium, 2010).

Since 2000, two severe ice storm events have occurred in the region. The storms within that period occurred in December and January, but ice storms of lesser magnitudes may impact the region from October to April, and on at least an annual basis.

Based on all sources researched, known winter weather events that have affected Massachusetts and were declared a FEMA disaster are identified in the following sections. Of the 18 federally declared winter storm-related disaster declarations in Massachusetts between 1954 to 2018, Berkshire County has been included in 12 of those disasters. The number of disaster declarations for severe winter events in which Berkshire County was included is more than double that of declarations for non-winter, non-flood-related severe storm events.

Table 3.6.2. Severe Winter Weather – Declared Disasters that included Berkshire County 1992-2017

Incident Period	Description	Declaration Number
12/11/92-1213/92	Nor'easter with snow 4'+ in higher elevations of Berkshires, with 48" reported in Becket, Peru and Becket; snow drifts of 12'+; 135,000 without power across the state	DR-975
3/13/93-3/17/93	High winds & heavy snow; generally 20-30" in Berkshires; blizzard conditions lasting 3-6 hrs afternoon of March 13.	EM-3103
1/7/96-1/8/96	Blizzard of 30+" in Berkshires, with strong to gale-force northeast winds; MEMA reported claims of approx. $32 million from 350 communities for snow removal	DR-1090
3/5/01-3/6/01	Heavy snow across eastern Berkshires to Worcester County; several roof collapses reported; $21 million from FEMA	EM-3165
2/17/03-2/18/03	Winter storm with snow of 12-24", with higher totals in eastern Berkshires to northern Worcester County; $28+ million from FEMA	EM-3175
12/6/03-12/7/03	Winter Storm with 1'-2' across state, with 36" in Peabody; $35 million from FEMA	EM-3191
1/22/05-1/23/05	Blizzard with heavy snow, winds and coastal flooding; highest snow falls in eastern Mass.; $49 million from FEMA	EM-3201
4/15/07-4/16/07	Severe Storm and Flooding; wet snow, sleet and rain added to snowmelt to cause flooding; higher elevations received heavy snow and ice; $8 million from FEMA	DR-1701
12/11/08-12/12/08	Major ice storm across eastern Berkshires & Worcester hills; at least ½" of ice accreted on exposed surfaces, downing trees, branches and power lines; 300,000+ customers without power in state, some for up to 3 wks.; $51+ million from FEMA	DR-1813
1/11/11-1/12/11	Nor'easter with up to 2' within 24 hrs.; $25+ million received from FEMA	DR-1959
10/29/11-10/30/11	Severe storm and Nor'easter with 1'-2' common; at peak 665,000 residents state-wide without power; 2,000 people in shelters statewide	DR-4051
2/8/13-2/9/13	Severe Winter Snowstorm and Flooding; $56+ million from FEMA	RE-4110

Source: FEMA 2017.

Probability of Future Occurrences

Severe winter weather is a common occurrence each winter in Massachusetts. According to the NOAA-NCDC storm database, over 200 winter storm events occurred in the Commonwealth between 2000 and 2012. Therefore, the subset of severe winter storms are likely to continue to occur annually (MEMA, 2013). The Town of Dalton's location in Western New England places it at a high-risk for winter storms. While the town may not get the heavy snowfall associated with coastal storms, the severe storms that the county gets are added to the higher annual snowfall the county normally gets due to its slightly higher elevation then its neighboring counties in the Pioneer and Hudson River Valleys.

Using history as a guide for future severe winter storms, it can be assumed that the town will be at risk for approximately six severe winter storms per winter. The highest risk of these storms occurs in January with significant risk also occurring in December through March. The region is getting less snowfall then previous years and can expect less snowfall in future years, however this does not mean the county will not experience years with high snowfall amounts (2010-11 had over 100 inches), but the trend indicates that the yearly snowfall total will continue to go down. It should be noted that although total snow depths may be reduced in the future, warmer winter temperatures will likely increase the number and severity of storms with heavy, wet snow, which can bring concerns for road travel, human injuries linked to shoveling and risk of roof failures.

Severity

The magnitude or severity of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day (e.g., weekday versus weekend), and time of season. (MEMA, 2013)

NOAA's National Climatic Data Center (NCDC) is currently producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the U.S. The RSI ranks snowstorm impacts on a scale from one to five, which is similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. RSI is based on the spatial extent of the storm, the amount of snowfall, and the combination of the extent and snowfall totals with population. Data beginning in 1900 is used to give a historic perspective (MEMA 2013, NOAA 2018).

Table 3.6.3. RSI Ranking Categories

Category	Description	RSI-Value	Approximate Percent of Storms
1	Notable	1-3	1%
2	Significant	3-6	2%
3	Major	6-10	5%
4	Crippling	10-18	25%
5	Extreme	18+	54%

Source: MEMA 2013.

Of the 12 recent winter storm disaster declarations that included Berkshire County (as listed in Table 2), only two events were ranked as Extreme (EM-3103 in 1993 and DR-1090 in 1996), one was ranked Crippling (IM-3175 in 2003) and two were ranked as Major (EM-3191 in 2003 and DR-4110 in 2013). It should be noted that because population is used as a criteria, the storms that rank higher will be those that impact densely populated areas and regions such as Boston and other large cities and, as such, might not necessarily reflect the storms that impact lightly populated areas like the Berkshires. For example, one of the most famous storms in the Commonwealth in modern history was the Blizzard of '78, which dropped over two feet of snow in the Boston area during 65 mph winds that created enormous drifts and stranded hundreds of people on local highways. The storm hit the snow-weary city that was still digging out of a similar two-foot snowstorm 17 days earlier. Although the Berkshires received snow from this storm, the county was not listed in the declaration.

One of the most serious storms to impact communities in the Berkshires was the Ice Storm of December 11, 2008. The storm created widespread downed trees and power outages all across New York State, Massachusetts and New Hampshire. Over one million customers were without electricity, with 800,000 without power three days later and some without power weeks later. Living conditions were acerbated by extremely cold temperatures in the days following the event.

While severe winter weather declarations have become more prominent in the 1990s, we do not believe that this reflects more severe weather conditions than the Berkshires experienced in the years 40+ years prior to the 1990s. Respected elders across Berkshire County comment that snow depths prior to the 1990s were consistently deeper that what currently occurs in the 2010s.

Fig. 3.6.2. Opening Mohawk Trail in Florida MA with Shovels 1926

Source: Stan Brown, Florida, MA

Warning Time

Meteorologists can often predict the likelihood of a severe winter storm. This can give several days of warning time. Schools and businesses usually have at least a 24-hour warning to monitor weather reports and start to plan closings. However, meteorologists cannot predict the exact time of onset or severity of the storm so decisions on closing schools, businesses or events are often made hours earlier. Some storms may come on more quickly and have only a few hours of warning time. (MEMA, 2013)

Secondary Hazards

Secondary impacts for winter events are similar to those experienced in other severe storm events such as high winds or flooding, but with the additional structural risk of damage from snow load, more widespread hazardous driving conditions and greater risk of hypothermia from power outages or shoveling.

Climate Change Impacts

The climate of the region is changing and will continue to change over the course of this century. Since 1900, ambient air temperatures have increased by 0.5°F. This warming trend has been associated with other changes, such as more frequent days with temperatures above 90°F, reduced snowpack, and earlier snow melt and spring peak flows. By the end of the century, under the high emissions scenario of the Intergovernmental Panel on Climate Change, Massachusetts is expected to experience a 5°F to 10°F increase in average ambient temperature with several more days of extreme heat during the summer. Sea surface temperatures are also expected to incase by 8°F. (MEMA, 2013)

Along with rising temperatures, it is expected that annual precipitation will increase by 14%, with a slight decrease in summer totals and a 30% increase in winter totals. Winter precipitation is predicted to more often be in the form of rain rather than snow. This change in precipitation will have significant effects on the amount of snow cover, winter recreation, spring snowmelt and peak stream flows, water supply, aquifer recharge, and water quality. The Commonwealth is located in an area where thresholds between snow and rain are sensitive and reductions in snow would be the largest. Snow is also predicted to fall later in the winter and cease falling earlier in the spring. (MEMA, 2013)

Exposure

For the purposes of this plan, the entire Town of Dalton is considered to be exposed to severe winter weather.

3.6.3. Vulnerability

Population

According to the NOAA National Severe Storms Laboratory, every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion, and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow, and extreme cold temperatures with dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. Injuries and fatalities may occur due to traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. (MEMA, 2013)

Heavy snow can immobilize a region and paralyze a region, shutting down air and rail transportation, stopping the flow of supplies, and disrupting medical and emergency services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. (MEMA, 2013)

The entire population of the community is exposed to the severe winter weather hazard, particularly those that work outside or whose job requires that they respond to the weather, such as shoveling, plowing or clearing snow from building roofs. The elderly are considered most susceptible due to their increased risk of injury and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice, or related to power failures. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). In addition, severe winter weather events can reduce the ability of these populations to access emergency services. Power outages can result in complete loss of heat for those who have electric heat or where electricity is required to run boilers or pellet stoves. Frozen water pipes could burst and threaten the home and the health of the residents who reside there. The ice storm of 2008 was the incident that created the longest power outages in the region in recent memory, but this storm did not impact residents in the Town of Dalton.

Deep and heavy snow depths can weaken building roofs and threaten the structural integrity below them, injuring or killing people inside the building or those standing close to collapsing buildings. The weight of one foot of light fresh snow ranges from three pounds per square foot to 21 pounds per square foot for wet heavy snow.[1] Heavy snow loads in February/March 2015 caused the collapses of at least 210 buildings across the state.[2] Snow loads on buildings and homes with poorly insulated or vented attics are prone to melting and refreezing, causing the snow load to be heavier and making the roof more prone to ice dam damage. Educating building owners about improvements that could be done to protect roofs from snow load and ice dam damage would help to reduce risk from building collapse.

Critical Facilities

All critical facilities and infrastructure in the community are exposed to severe winter weather hazards. Full functionality of critical facilities such as police, fire and medical facilities is essential for response during and after a winter storm event, but these facilities may not be fully operational due to workers unable to travel to ensure continuity of operations pre- and post-event. Fortunately many town critical workers live within a short driving distance and public works and first responder staff levels seldom suffer. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Long-term infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. (MEMA, 2013)

Economy

The entire general building stock inventory in the community is exposed and vulnerable to the severe winter weather hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces. (Massachusetts Emergency Management Agency, 2013) Current modeling tools are not available to estimate specific losses for severe winter events. As an alternate approach, this plan considers a one percent damage of structures that could result from winter storm conditions. This one percent was used by the state in their 2013 State Hazard Mitigation Plan. Table 4 summarizes percent damage that could result from winter storm conditions on the community's total general building stock (structure only). These figures do not include financial losses suffered by businesses due reduced business hours or closures.

Table 3.6.4. Estimated Potential Loss Due to a Severe Winter Storm Event

Number of Buildings	Replacement Cost Value (Structure Only)	1% Loss
2,771	$453,418,875	$4,534,188

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[1] *FEMA, 2013. Risk Management Series, Snow Load Safety Guide, FEMA P-957. Washington, DC.*

[2] *https://www.bostonglobe.com/metro/2015/03/04/partial-roof-collapse-bayside-expo-center-dorchester-fire-officials-say/T3gLvWMMB7Jd7YszVABPDL/story.html*

A specific area that is vulnerable to the winter storm hazard is the floodplain. Snow and ice melt can cause both riverine and urban flooding. At-risk general building stock and infrastructure in floodplains are presented in the flood hazard profile (Section 10). These risks can expect to increase as warmer winter temperatures results in more rain events.

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain municipal and state financial resources due to the cost of staff overtime, snow removal and wear on equipment. Rescheduling of schools and other municipal programs and meetings can also be costly. The potential secondary impacts from winter storms also impact the local economy including loss of utilities, interruption of transportation corridors, and loss of business operations and functions, as well as loss of wages for employees.

3.6.4. Existing Protections

Experiencing snow storms and severe winter weather are considered part of living in Berkshire County. Municipalities budget money for snow plowing, sanding and overtime, and public works road crews plan equipment and materials purchases in preparation for the winter season. Capital improvements often consider new truck or plow equipment. Most snow and severe winter weather events are considered expensive nuisances, with only the most severe blizzard or Nor'easters that threaten human health due to closed transportation routes or services, or those that cause power outages a cause for concern.

The Town of Dalton and the Central Berkshire Regional School Districts have good public communication systems that alert residents to school closings and other emergency conditions.

The Town of Dalton follows the Massachusetts Building Code. In this building code, most of Berkshire County is in a zone that requires new construction to withstand 50 pounds per square foot (psf) of snow load, with a few south county towns having a rating of 40 psf. These are the strongest requirements in the state, with other parts of the state requiring strengths of 25-40 psf, depending on the location of the municipality. The snow load is an important consideration when building owners are considering installing solar panel on homes and businesses.

Properly insulated and sealed homes can maintain warm interior temperatures longer during a winter power outage than those with little or no insulation, reducing health risks to inhabitants sheltering in place and the risk of frozen pipes. Properly insulating and venting attics can help to reduce ice dam damage. The MassSave energy program offers free home audits and provide financial incentives for owners to seal and insulate the building envelopes. Berkshire Community Action Council provides further assistance by aiding low income residents access fuel assistance and home improvement programs, including weatherization and energy-efficient furnaces and appliances. Being able to retrofit homes with little or no insulation is important as 40% of the building stock in the county was constructed before 1940, and 60% is pre-1960.[3]

The Dalton Emergency Management Director posts weather alerts on the Town of Dalton website and on the EMD Facebook.

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[3] *BRPC, 2014. Sustainable Berkshires, a Long-Range Plan for Berkshire Count, Housing and Neighborhoods. Pittsfield, MA*

3.6.5. Actions

- Retrofit the Senior Center for backup power for potential warming center or possible shelter if needed.
- Continue to access disaster funding when available.
- Encourage homeowners to get energy audits and improve wall and attic insulation to buffer against short term power outages.
- Increase enrollment in Code Red.

3.7. Drought Hazard

3.7.1. General Background

Drought is a period characterized by long durations of below normal precipitation. Drought occurs 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. Direct impacts of drought include reduced water supply, crop yield, increased fire hazard, reduced water levels, and damage to wildlife and fish habitat.

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) and the Massachusetts Emergency Management Agency (MEMA) partnered to develop the *Massachusetts Drought Management Plan*, of which 2013 is the most updated version. The state's Drought Management Task Force, comprised of state and federal agencies, was created to assist in monitoring, coordinating and managing responses to droughts and recommends action to minimize impacts to public health, safety, the environment and agriculture (EEA, MEMA, 2013). The MA Department of Conservation Resources staff compile data from the agencies and develop monthly reports to track and summarize current water resource conditions.

In Massachusetts the determination of drought level is based on seven indices: Standardized Precipitation Index, Crop Moisture Index, Keetch-Byram Drought Index, Precipitation, Groundwater levels, Streamflow levels, and Index Reservoir levels. The Standardized Precipitation Index (SPI) reflects soil moisture and precipitation conditions, calculated monthly using Massachusetts Rainfall Database at the Department of Conservation and Recreation Office of Water Resources. SPI values are calculated for "look-back" periods of 1 month, 3 months, 6 months, and 12 months. (EEA, MEMA 2013)

The Crop Moisture Index (CMI) reflects short-term soil moisture conditions as used for agriculture to assess short-term crop water conditions and needs across major crop-producing regions. It is based on the concept of abnormal evapotranspiration deficit, calculated as the difference between computed actual evapotranspiration (ET) and computed potential evapotranspiration (i.e., expected or appropriate ET). Actual evapotranspiration is based on the temperature and precipitation that occurs during the week and computed soil moisture in both the topsoil and subsoil layers.

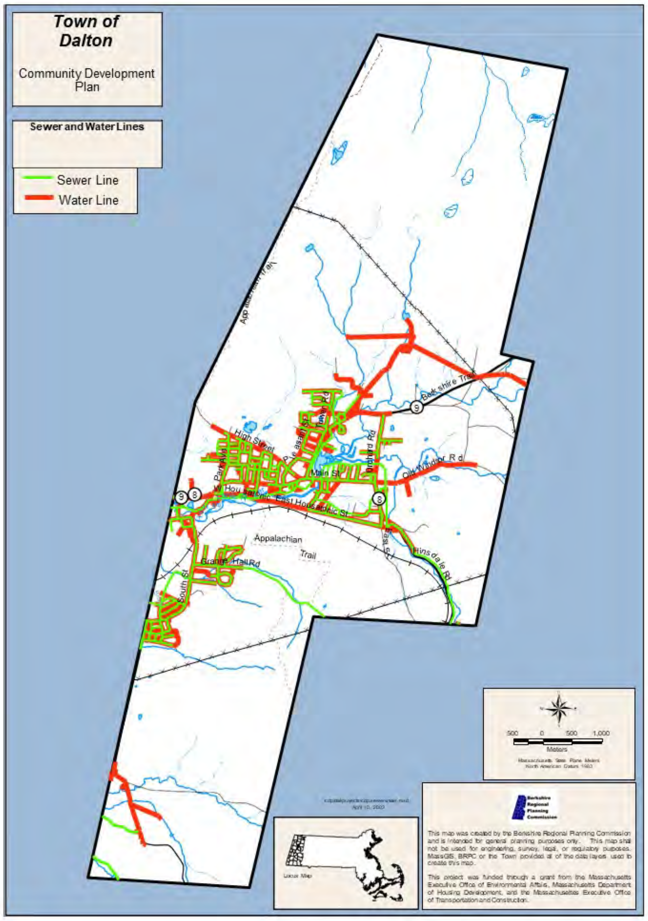
The Keetch-Byram Drought Index (KBDI)is designed specifically for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground. The KBDI attempts to measure the amount of precipitation necessary to return the soil to full field capacity. The inputs for KBDI are weather station latitude, mean annual precipitation, maximum dry bulb temperature, and the last 24 hours of rainfall.

Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on streamflow, water supply, reservoir levels, soil moisture and potential for forest fires. Precipitation is a key factor because it is the overall cause of improving conditions. Groundwater levels respond slowly to improving conditions, so they are good indicators of long-term recovery to normal conditions.

3.7.2. Hazard Profile

Location

Fig. 3.7.1. Public Water Supply in Dalton



For the purposes of tracking drought conditions across the Commonwealth, the state has been divided into six regions, with the Western Region being made up of Berkshire County. For the purposes of this plan, the entire Town of Dalton is at risk of drought.

The Dalton Fire and Water District provides public drinking water to the vast majority of Dalton residents and businesses. Overall the District has approximately 2,800 water connections, of which 2,657 are residential customers and the rest are commercial or industrial. See Fig.1 for the area of the town served by public water.

The District has an agreement with the City of Pittsfield to receive 49 million gallons of water per month from its water supply system, which flows into Dalton from the Cleveland Reservoir in neighboring Hinsdale. At this time approximately 25-30 million gallons are used in the Town per month, with the peak of 30 million gallons used during the summer months. In terms of water delivered, approximately 2/3 of the water is directed to Crane Company for processing in its paper-making factories, with the remaining 1/3 directed to residents and other commercial entities. Windsor Reservoir, also located in Hinsdale and Windsor, is a back up water supply maintained by the District in the event of an emergency. In general, it is believed that residents with private wells are at greater risk of drought, especially if their wells have been dug relatively shallow.

Previous Occurrences

Massachusetts is relatively water-rich, with few documented drought occurrences. According to the state's Hazard Mitigation Plan of 2013, the state has experienced multi-year droughts periods 1879-83, 1908-12, 1929-32, 1939-44, 1961-69 and 1980-83. There have been 13 documented droughts in the state between 1945 and 2002 (see Table 3.7.1.). (MEMA, 2013) The most severe drought occurred during the 1960s, due to both severity and extended duration.

Table 3.7.1. Estimated Droughts Based on the Mass. Standardized Precipitation Index

Year(s)	Duration (Months)	Estimated Drought Level
1924-1925	13	Warning
1930-1931	12	Emergency
1934-1935	15	Warning
1944	11	Watch
1949-1950	15	Watch
1957-1958	12	Warning
1964-1967	36	Emergency
1971	8	Watch
1980-1981	13	Watch
1985	7	Watch
1988-1989	11	Watch
1990-1991	9	Watch
2001-2002	13	Watch

Source: MEMA, 2013

Additional post-2013 information gathered show that droughts occurred in the state 2007-08 and in 2010, although neither of these involved drought conditions in Berkshire County (Western Drought Region). The most recent drought in Massachusetts occurred during a 10-month span in 2016-17. In July 2016 Advisory and Watch drought levels began to be issued for the eastern and central portions of the state, worsening in severity until the entire state was under a Drought Warning status for the months of November-December 2016. Water levels began to recover in February 2017, with the entire state determined to be back to normal water levels in May 2017. The Massachusetts Water Resources Commission stated that the drought was the worst since the state's Drought Management Plan was first issued in 2001, and the most severe since the 1960s drought of record.[1] In general, the central portion of the state faired the worse and Berkshire County faired the best, with the county entering the drought later and emerging from the drought earlier than most of the rest of the state. Berkshire County was under a Watch status for two months and under a Warning status for three months during the height of the drought (see Table 3.7.1. and Fig. 3.7.2. and for the progression of the 2016-17 drought).

During the 2016-17 drought time the Dalton Fire and Water District did not issue a voluntary water restriction. This is because the District follows the City of Pittsfield's lead, and in this instance the City did not issue a voluntary restriction. Town officials reported that a resident with a private well on Yvonne Drive reported that their well dried up during the drought period, but this is the only report that was brought to the Town.

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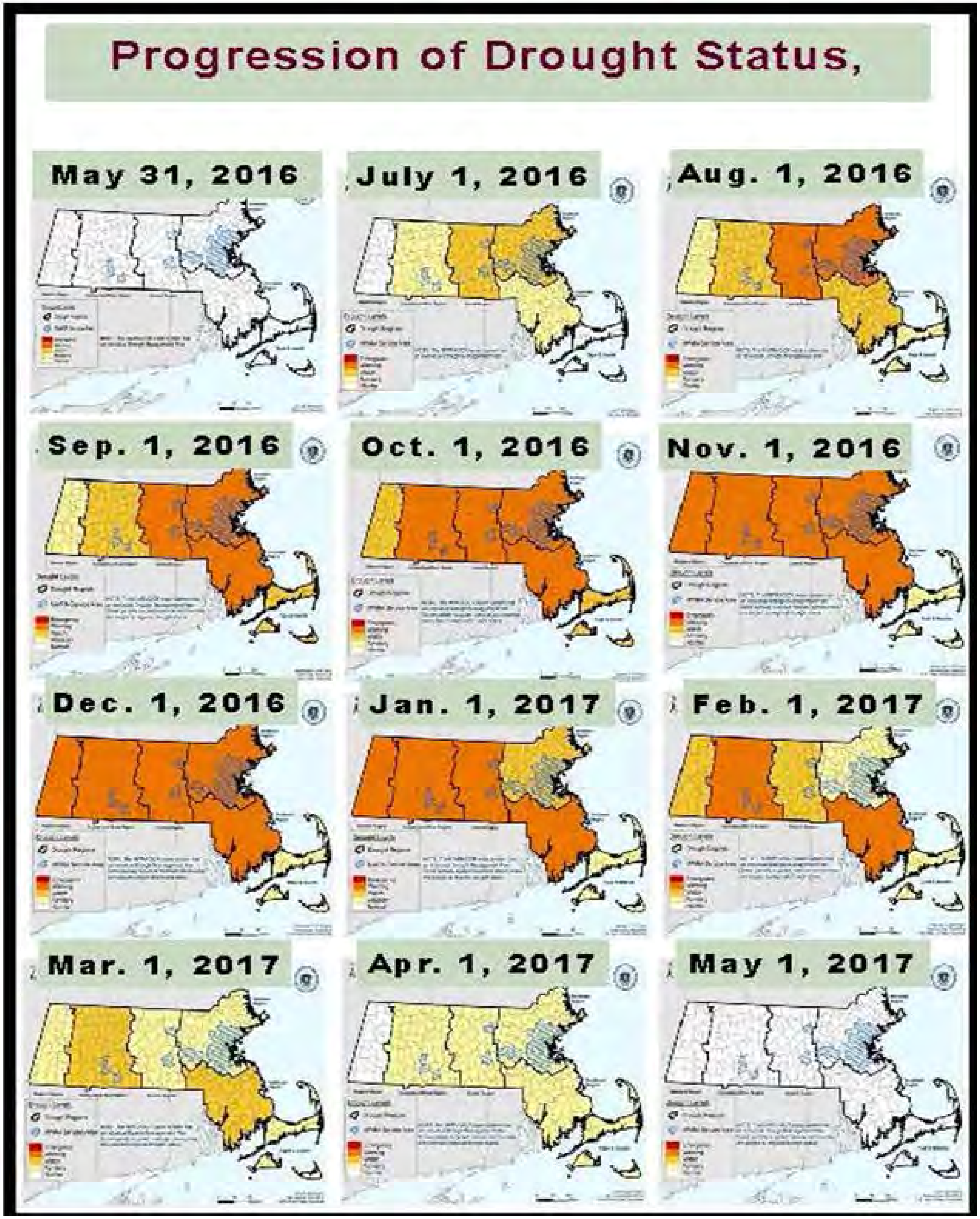
[1] *MA Water Resources Commission, 2017. Annual Report, Fiscal Year 2017. Boston, MA.*

Table 3.7.2. Drought Events and Levels 2001-2017

					Drought Level by Regions				
Year	**Begin Date**	**End Date**	**Comment**	**Western**	**CT River**	**Central**	**Northeast**	**Southeast**	**Cape & Islands**
	12/28/2001	**1/31/2003**							
2001	**12/28/2001**			Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			February 2002	Advisory	Watch	Watch	Watch	Advisory	Advisory
2002			March 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			April 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			May 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			June 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			July 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			August 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			September 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			October 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			December 2002	Normal	Normal	Normal	Normal	Normal	Advisory
2003		**1/31/2003**	As of January 31, 2003	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2007	**3/18/2008**							
2007	**10/1/2007**			Normal	Advisory	Advisory	Advisory	Advisory	Normal
2008		**3/18/2008**	As of March 18, 2008	Normal	Normal	Normal	Normal	Normal	Normal
	8/1/2010	**11/19/2010**							
2010	**8/1/2010**			Normal	Normal	Advisory	Advisory	Normal	Normal
2010			October 2010	Normal	Advisory	Advisory	Advisory	Normal	Normal
2010		**11/19/2010**	As of November 19, 2010	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2014	**11/30/2014**							
2014	**10/1/2014**			Normal	Normal	Normal	Normal	Advisory	Advisory
2014		**11/30/2014**	As of December 1, 2014	Normal	Normal	Normal	Normal	Normal	Normal
	7/1/2016	**4/30/2017**							
2016	**7/1/2016**		June 2016	Normal	Advisory	Watch	Watch	Advisory	Normal
2016			July 2016	Advisory	Watch	Warning	Warning	Watch	Advisory
2016			August 2016	Advisory	Watch	Warning	Warning	Warning	Watch
2016			September 2016	Watch	Warning	Warning	Warning	Warning	Watch
2016			October 2016	Warning	Warning	Warning	Warning	Warning	Advisory
2016			November 2016	Warning	Warning	Warning	Warning	Warning	Advisory
2016			December 2016	Warning	Warning	Warning	Watch	Warning	Advisory
2017			January 2017	Watch	Warning	Watch	Advisory	Warning	Advisory
2017			February 2017	Advisory	Watch	Advisory	Advisory	Watch	Advisory
2017			March 2017	Normal	Advisory	Advisory	Advisory	Advisory	Advisory

Source: https://www.mass.gov/files/documents/2017/09/08/drought-status-history.pdf

Fig. 3.7.2. Progression of the 2016-17 Drought



Source: MA Water Resources Commission, 2017.

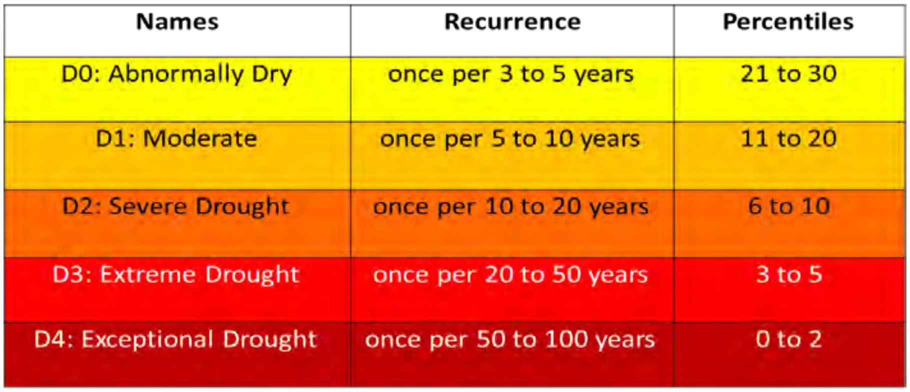
According to staff at the Dalton Fire and Water District, there has not been drought conditions in Dalton in recent memory. The District has issued a few voluntary outdoor-use restrictions in the past few years, but these have only been in accordance with requests from the DEP to do so and when the City of Pittsfield issues a restriction. Actual water supply conditions at local reservoirs were not threatened during these times. The Town does not keep records of residents whose wells run dry, but officials say that a private residential well on Yvonne Drive went dry in 2017-18.

Probability of Future Occurrences

An analysis of historical rainfall data indicated that, based on this index alone, between 1850 and 2012, the Commonwealth experienced drought emergency conditions in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period is viewed as the most severe and longest duration drought to have occurred in Massachusetts. On a monthly basis, there is a 1% chance of the Commonwealth being in a drought Emergency. Drought Warning conditions not associated with drought Emergencies occurred in 1894, 1915, 1930, and 1985. On a monthly basis, there is a 2% chance of the state being in a drought Warning level. Drought Watch conditions not associated with higher levels of drought would have typically occurred in three to four years per decade between 1850 and 1950. The overall frequency of the Commonwealth being in a drought Watch is 8% each month (MEMA, 2013). The drought levels, recurrence interval and state estimated drought level nomenclature is found in Table 3.

Berkshire County was determined to be in Warning drought conditions October 2016 through January 2017. Using the U.S. Drought Monitoring system, this type of drought event could be estimated to reoccur once per 10 to 50 years. Given that the duration was short and that the greatest severity was during the winter months, when water demand is less, water managers in Berkshire County did not suffer a severe threat to their supplies. The relatively low impact of this drought and of others in recent memory may lead water managers in the region towards a false sense of security.

Table 3.7.3. U.S. Drought Monitor Level and Comparable State Level Indices



Names	Recurrence	Percentiles	MA Drought Levels
D0: Abnormally Dry	once per 3 to 5 years	21 to 30	Advisory
D1: Moderate	once per 5 to 10 years	11 to 20	Watch
D2: Severe Drought	once per 10 to 20 years	6 to 10	Warning
D3: Extreme Drought	once per 20 to 50 years	3 to 5	Warning
D4: Exceptional Drought	once per 50 to 100 years	0 to 2	Emergency

Source: U.S. Drought Monitor; MA Drought Management Plan 2013.

Severity

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with immediate impacts on people or property, but they can have significant impacts on agriculture, which can impact the farming community of the region. As noted in the state Hazard Mitigation Plan, agriculture-related drought disasters are quite common, with 1/2 to 2/3 of the counties in the U.S. having been designated as disaster areas in each of the past several years. These designations make it possible for producers suffering losses to receive emergency loans. Such a disaster was declared in December 2010 for Berkshire County (USDA Designation # S3072).

When measuring the severity of droughts, analysts typically look at economic impacts on a planning area. Drought warnings, watches and advisories can be reduced based on: 1) normal levels of precipitation, and 2) groundwater levels within the "normal" range. In order to return to a normal status, groundwater levels must be in the normal range and/or one of two precipitation measures must be met. The precipitation measures are: 1) three months of precipitation that is cumulatively above normal, and 2) long-term cumulative precipitation above normal. The period for long-term cumulative precipitation ranges from 4 to 12 months, depending on the time of year. Precipitation falling during the fall and spring is ideal for groundwater recharge and, therefore, will result in the quickest return to normal conditions. Because the same levels of cumulative precipitation can differ in their abilities to reduce drought conditions, the decision to reduce a drought level will depend on the professional judgment of the Secretary of EEA with input from his agencies and the Drought Management Task Force (EEA, MEMA 2013)

MassDEP has the authority to declare water emergencies for communities facing public health or safety threats as a result of the status of their water supply systems, whether caused by drought conditions or for other reasons. The Department of Public Health (DPH) in conjunction with MassDEP monitors drinking water quality in communities.

According to the data at hand, the most severe droughts in Massachusetts occurred 1930-31 and 1964-67. Many local water managers and officials remember the drought years of the 1960s, where mandatory water bans were issued. Outside of this time period, most water restrictions in the region have been voluntary.

Secondary Hazards

The secondary hazard most associated with drought is wildfire. For drought conditions to occur it is likely that soil moisture is limited or lacking, forest duff is dried out and standing vegetation is dry and possibly dead, providing the fuel needed for a wildfire. Given that the Town of Dalton is 76% forested, the risk of wildfire during drought conditions is a concern. Dry vegetation conditions along the railroad route are also a of greater concern during dry, drought conditions.

Warning Time

Droughts are climatic patterns that occur over long periods of time. Drought levels advisories are issued at gradual levels to alert the public to conditions that, if continued, could result in more serious degrees of drought. Initial drought levels include Advisory and Watch levels. Voluntary water conservation efforts are advised during early stages of drought conditions and increasing conservation requirements are expected when Drought Warning and Emergency conditions develop. These higher levels of drought require months of dry conditions to be reached. (MEMA, 2013) Therefore, according to state agencies, there is a lot of lead time as drought conditions progress.

Despite the long lead time to drought conditions, efforts to conserve water on the municipal, private and individual level should be conducted in an ongoing basis. Efforts by water managers to identify and remedy leaks in the piping system that deliver water supplies should be given ongoing attention, and efforts to encourage customers to conserve water in the home and in commercial and industrial uses should be given additional attention. Water conservation efforts will reduce the demand on reservoir and groundwater supplies in the event that a multi-year Emergency Drought event like that of the 1960s recurs.

Climate Change Impacts

Changes in winter temperatures will lead to less snow pack and more rain-on-snow events, leading to more surface runoff and less groundwater recharge, leading to less stream and river base flows. Higher temperatures in warmer seasons can more severely impact the reduced base flows due to higher rates of evaporation of moisture from soil and lower groundwater and surface water inputs. According to the state's Climate Change Adaptation Report, a continued high greenhouse-gas-emission scenario could result in a 75% increase in the occurrence of drought conditions lasting 1-3 months.[2]

Exposure

For the purposes of this plan, the entire Town of Dalton is at risk of exposure to drought. It is generally believed that residents in Dalton that are on private wells may be more susceptible to drought, particularly those with shallow wells, but there is not definitive data to verify this belief.

3.7.3. Vulnerability

To understand risk, this plan considers the impact to population, critical facilities and the economy.

Population

For the purposes of this plan update, the entire population of Dalton is exposed and vulnerable to drought. Those residents who are served by the Dalton Fire and Water District are believed to be less vulnerable to drought due to the abundance of water in the Cleveland Reservoir system. However, the Berkshire region has not suffered a severe, Emergency level drought since the 1960s and it is unclear how well the system could serve the demands of Dalton and Pittsfield, both of which are served by the Reservoir.

The Dalton Fire & Water District has a water storage tank system for both supply storage and to ensure proper pressure through the distribution system. The District estimates that the tanks hold four days worth of water to supply its customers during an emergency. The tanks could provide water for a longer period if water restrictions were put in place.

Due to the great expanses of state forest and wildlife lands in the region, which attract hikers and campers, and a tourist-based economy that brings additional people to the region in the summer, the risk of wildfire would increase during a severe drought. Drought would reduce the capacity of local firefighting efforts, hampering control of wildfire or urban fires. A more detailed discussion of wildlife and the Town's vulnerability is found in that section of the report.

Critical Facilities

Drought does not threaten the physical stability of critical facilities in the same manner as other hazards such as wind-based or flood-related events. Facilities and structures located outside the town center

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[2] EEA, Adaptation Advisory Committee, 2011. *MA Climate Change Adaptation Report, Boston*, MA.

and that are in areas surrounded by forest or dry vegetation, such as water tanks, water pumps, sewer pumps and other infrastructure, could be more vulnerable to wildfire.

If a severe drought of long duration were to occur, the Town and the Fire and Water District may need to provide some assistance to provide water to residents whose wells have gone dry. An emergency dispensing center may need to be created to serve this population.

Economy

A severe, long-term drought could severely impact the operation of Dalton's major employer, Crane Company, which depends on a large supply of high quality water for its paper-making processes. Crane is the largest user of water in the Town, using approximately 2/3 of the total water provided by the Dalton Fire and Water District. Crane does have groundwater wells that also provide water for its operations, but it is unknown if these wells would be available during a severe drought.

Drought would also impact local farmers, causing crop and livestock losses. Dry standing vegetation in fields could increase risk of wildfires.

3.7.4. Existing Protections

The Dalton Fire and Water District has conducted several activities in the past several years to add storage capacity to the water system. It has installed two storage tanks to increase storage, provide redundancy and ensure good water pressure. The tanks have the capacity to provide water to its customers for up to four days. This estimate is predicated on Crane Company drawing water from Pittsfield and, depending on how timely water restrictions are issued, how well customers adhere to the restrictions. Additionally it has conducted improvements to the Windsor Reservoir dam to reduce water leakage. Cleveland Reservoir, the main water supply for the Town of Dalton, is owned and managed by the City of Pittsfield, and in recent years the City has conducted maintenance on the reservoir dam and pipe conveyance system.

The Massachusetts Department of Environmental Protection has broad jurisdiction to protect water supply and water quality. During a state of water emergency, MassDEP may issue orders to: (1) establish priorities for the distribution of any water or quantity of water use; (2) permit any person engaged in the operation of a water supply system to reduce or increase by a specified amount or to cease the distribution of that water; to distribute a specified amount of water to certain users as specified by the department; or to share any water with other water supply systems; (3) direct any person to reduce, by a specified volume, the withdrawal or use of any water; or to cease the withdrawal or use of any water; (4) require the implementation of specific water conservation measures; and, (5) mandate the denial, for the duration of the state of water emergency, of all applications for withdrawal permits within the areas of the Commonwealth to which the state of water emergency applies (EEA, MEMA, 2013)

Municipalities also have jurisdiction to control water supplies for protection of public health. Municipalities can adopt and implement bylaws to regulate public water supply pipes or to manage their prudential affairs and preserve peace and good order under their police powers, pursuant to G.L. c. 40, § 21, and c. 41, § 69B. Municipalities, which have established water supply or distributing systems, may regulate through such bylaws the use of water from the municipal system. Further, when MassDEP determines that an emergency exists in the case of a drought or disaster, a municipality may, following appropriate notice, regulate or otherwise restrain the use of water on public or private property (regardless of whether the supply source is public or private) pursuant to G.L. c. 40, § 41A. (EEA, MEMA 2013)

3.7.5. Actions

- Continue to take opportunities to improve the condition of infrastructure where feasible, including continuing to work with the Town of Dalton to bundle road and other infrastructure improvement projects where possible for cost effectiveness.
- Introduce conservation efforts to reduce water use on a town wide level.

3.8. Fire Hazards

3.8.1. General Background

There are three basic fire hazard categories that are discussed as part of this risk assessment: Urban Fire, Wildland-urban, and Wildfire. A major urban fire or conflagration is a large destructive, often uncontrollable, fire that spreads and causes substantial destruction. Over the past several years, structure fires in Massachusetts account for the majority of fire deaths, injuries, and property loss within the Commonwealth. In Massachusetts, 83% of building fires and 69% of fire deaths in 2010 took place in residential occupancies, with more fire deaths occurring in one-and two-family homes than in all other residential occupancies combined. People under the age of 5 and over the age of 55 have a much higher death rate than the average population, accounting for more than one-third of all deaths nationally.

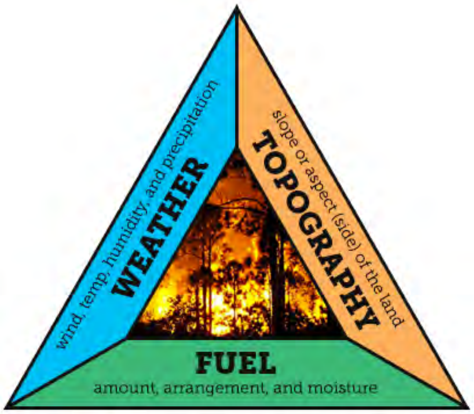
A wildland-urban interface area defines the conditions where flammable vegetation is adjacent to developed areas. The wildland-urban interface is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. In these areas, homes are built among densely wooded areas, so humans are more likely to start a fire that will easily spread to the surrounding forested areas with plentiful vegetative fuels. The wildland-urban interface is at risk for wildfires due to human caused fire ignitions, which are more common than natural causes such as lightning. (MEMA, 2013)

A wildfire can be defined as any non-structure fire that occurs in the vegetative wildland, including grass, shrub, leaf litter, and forested tree fuels. In general, wildfires in Massachusetts can be caused by human activity (prescribed burns or accidents) or natural events. Wildfires often begin unnoticed, but can spread quickly, igniting brush, trees, and homes. Because 95% of wildfires are started by negligent human behavior, such as smoking in forested areas or improperly extinguishing campfires, most are considered preventable. In 2011, approximately 8% of the outside and other fires were considered intentionally set, indicating that the vast majority are started by accident. Wildfires can result in the destruction of forests, brush, field crops, grasslands, and personal property. (MEMA, 2013)

Fire Ecology and Wildfire Behavior

The "wildfire behavior triangle" of weather, topography and fuel are the three primary factors that influence wildfire behavior. Of the three, weather is the most variable and least predictable[1]. Climate change may influence future wildfire behavior due to changing weather and resulting forest fuel changes.

- Fuel:
  - Lighter fuels such as grasses, leaves, and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs, and trunks take longer to warm and ignite.



Fire Behavior Triangle

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[1] *https://learn.weatherstem.com/modules/learn/lessons/121/12.html. Source also of the triangle graphic.*

    - Snags and hazard trees—especially those that are diseased, dying, or become receptive to ignition when influenced by environmental factors, such as drought, low humidity, and warm temperatures.
- 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.
    - Spring and summer drying months, many of which maintain drought-like conditions extending beyond normal season also can increase the normal fire season. Likewise, the passage of a dry, cold front through the region can result in sudden wind speed increases and change in wind direction affecting fire spread.
    - Thunderstorms in Massachusetts are usually accompanied by rainfall; however, during periods of drought, lightning from thunderstorm cells can result in fire ignition. Thunderstorms with little or no rainfall are rare in New England but have occurred.
- Topography
    - Topography of a region or a local area influences the amount and moisture of fuel.
    - Barriers such as highways and lakes can affect spread of fire.
    - Elevation and slope of landforms—fire spreads more easily uphill compared to downhill.
- Climate Change
    - Without an increase in summer precipitation (greater than any predicted by climate models), future areas burned is very likely to increase.
    - Infestation from insects is also a concern as it may affect forest health. Potential insect populations may increase with warmer temperatures and infested trees may increase fuel amount.
    - Tree species composition will change as species respond uniquely to a changing climate.
    - Wildfires cause both short-term and long-term losses. Short-term losses can include destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and the destruction of cultural and economic resources and community infrastructure. (MEMA, 2013)

3.8.2. Hazard Profile

Location

The risk of urban fires exists in all developed areas of Dalton, which is largely a bedroom community. The vast majority of buildings are found in the center of the town. The building stock is comprised of modest sized homes in residential neighborhoods, many of which were built in the 19th and early 20th centuries, with subdivision enclaves from the 1960s and more scattered subdivisions of large homes on larger lots.

The majority of land in the town is vulnerable to wildfire. Seventy-six percent of Dalton is forested, with vast unfragmented forest blocks that lie north and south of the centrally developed areas of the town. Warner Hill, with a large coverage of blueberry bushes, is considered at greater risk due to the density of these and other shrubs which provide fast burning fuel.

Previous Occurrences

Based on the DCR Bureau of Forest Fire Control and Forestry records, in 1911, more than 34 acres were burned on average during each wildfire statewide. Since then, that figure has been reduced to 1.17 acres burned annually statewide (MEMA, 2013). According to the Massachusetts Fire Incident Reporting System, wildfires reported to DCR in the past five years are generally trending downward. According to this system there were 901 fire incidents, combined urban and wildland, in Berkshire County during the years 2007-2016, and of these 411 (46% of total) occurred in the City of Pittsfield, the urban center of the region. This same data reports that a total of 832 acres were burned in the county during those 10 years, 631 (76%) of which are reported as acres of wildland burned. This indicates that over this 10-year span an average of 63 acres of wildland burned annually in Berkshire County. Of the 901 incidents, only 12 burned more than 10 acres and two of these burned more than 100 acres. It should be noted that during this same time period there were two large wildland fires in the county: 168 acres in Lanesborough in 2008 and 272 acres in Clarksburg near the Williamstown border in 2015. If these incidents were considered statistic outliers and removed from the data, the average totaled burned acres during 2007-2016 would be 39 and the average wildland acres burned would be 19. Berkshire County fire officials respond rapidly through mutual aid and through a coordinated effort with the DCR.

Table 3.8.1. Wildfires 2007-2016 in Dalton

Year	Number of Wildfires	Acres
2016	5	0.0
2015	4	1.8
2014	2	0.5
2013	5	2.5
2012	3	0.2
2011	0	0.0
2010	3	0.1
2009	0	0.0
2008	4	8.0
2007	3	2.0
Total	**29**	**15.1**

Source: MA Fire Incident Reporting System 2016

In Dalton, 29 wildfire incidents burned approximately 15 acres during 2007-2016, with an overall average of two acres per year. (Massachusetts Fire Incident Reporting System, 2017)

Probability of Future Occurrences

For the purpose of this plan, the probability of future occurrences is defined by the number of events over a specified period. The historical record 2007-2016 indicates that Dalton has on average two wildfires a year. Major urban fires are a low concern due to the lack of large urbanized areas where buildings are adjacent to one another. Many commercial buildings have their own fire detection and suppression systems. Risks continue to be mostly limited to structures, particularly homes, which as discussed earlier in this section pose the greater risks of injury and death.

Frequency

It is difficult to predict the likelihood of urban fires and wildfires in a probabilistic manner, such as, “there will be a catastrophic wildfire once every X number of years.” This is because a number of variable factors affect the potential for a fire to occur and because some conditions (for example, ongoing land use development patterns, location, fuel sources, construction, etc.) exert increasing pressure on the wildfire and urban interface zone. Based on available data, urban fires and wildfires will continue to present a risk. (MEMA, 2013)

Differences in climate and building stock could play a factor in urban fires. It is likely that home fires related to heating occur more frequently in the northern areas of the U.S. Electrical distribution fires are likely to be more common in the northeast and south, where the building stocks are older, on average, than in the mid-west and west. (MEMA, 2013)

The wildfire season in Massachusetts usually begins in late March and typically culminates in early June, corresponding with the driest live fuel moisture periods of the year. April is historically the month in which wildfire danger is the highest. However, wildfires can occur every month of the year. Drought, amount of snow pack, and local weather conditions can expand the length of the fire season. The early and late shoulders of the fire season usually are associated with human-caused fires. (MEMA, 2013)

Severity

Dalton is not developed to a density that would provide fuel for a major urban fire. Single family detached houses in the most densely developed residential neighborhoods, in the historic town center area and in the more modern 1950s subdivisions, have the greatest risk of urban fire due to their older wooden structure and close proximity to each other (with some less than 20 feet apart from each other. The later subdivisions are on larger lots and tend to have greater distances between the homes. The greater potential for significant damage to property from wildfire in Dalton exists in areas designated as wildland-urban interface areas.

Warning Time

Early warning for urban fires is none or minimal at best. Smoke detectors provide early warning of a fire; however, they do not guarantee an escape. Federal studies have shown in a typical fire, one has only about three minutes to evacuate safely before unsustainable conditions are encountered. (MEMA, 2013)

Dry seasons and droughts are factors that greatly increase fire likelihood, and posting forest fire risk, issuing warnings and burn bans can reduce the risk of urban and urban-forest areas. If a fire breaks out and spreads rapidly, residents may need to evacuate within days or hours. A fire’s peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time. (MEMA, 2013) In Berkshire County, mutual aid response from neighboring towns is common, further reducing risks.

Secondary Hazards

Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. (MEMA, 2013) Heavy smoke can limit visibility and make it difficult to navigate for both civilian traffic and first responders, possibly causing traffic accidents.

Wildfires can generate a range of secondary environmental effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines, and contribute to flooding. They can strip slopes of vegetation, exposing them to greater amounts of runoff, which can in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. (MEMA, 2013) There are no areas in Dalton that have been affected by secondary environmental impacts in recent memory.

Climate Change Impacts

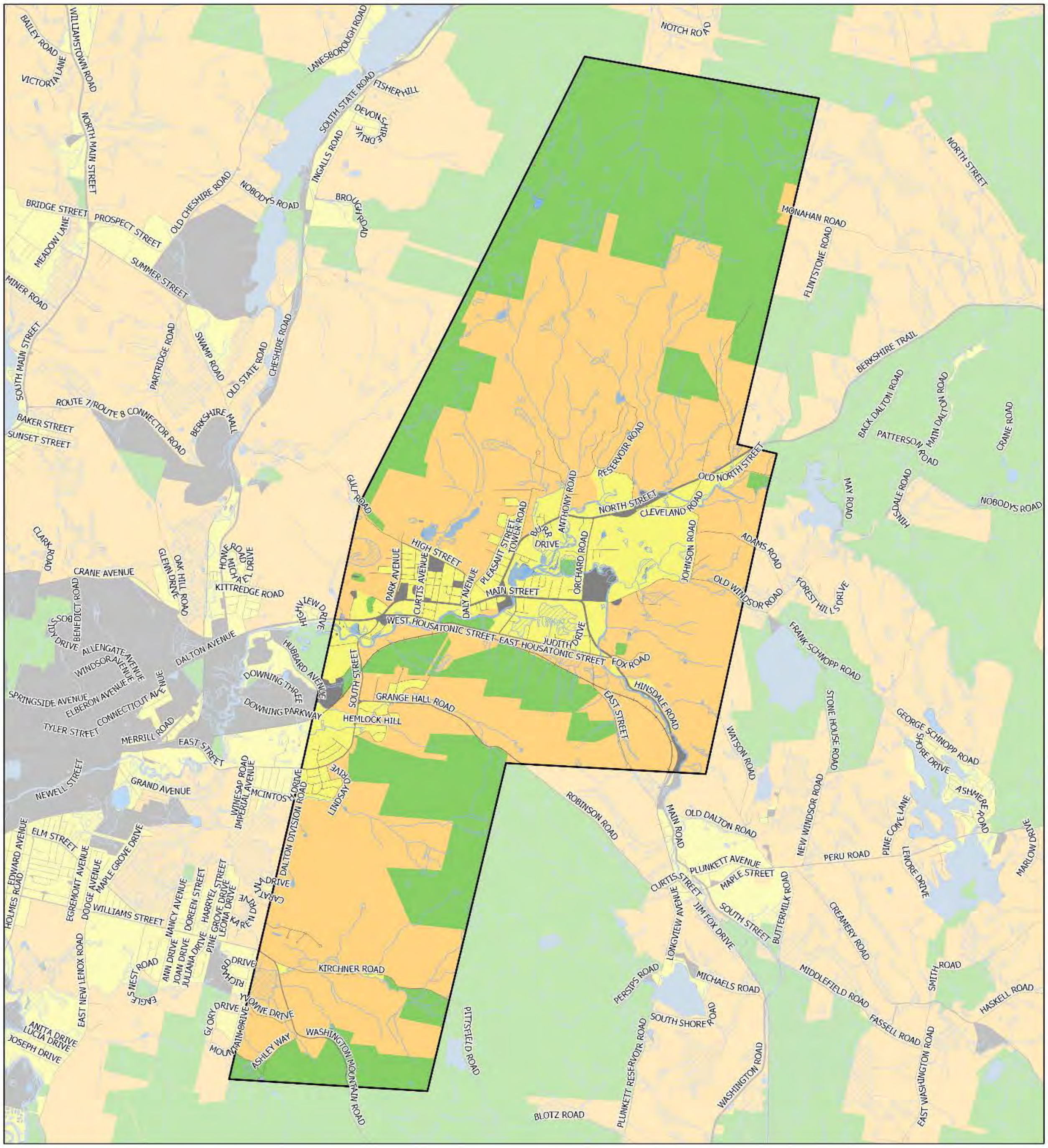
While climate change is unlikely to change topography, it can alter the weather and fuel factors of wildfires. Climate scenarios project summer temperature increases between 3°F and 9°F and precipitation increases of up 5 inches. (Northeast Climate Science Center, 2018) Hot dry spells create the highest fire risk, due to decreased soil moisture and increased evaporation and evapotranspiration. While in general annual precipitation has slightly increased Massachusetts in the past decades, the timing of snow and rainfall is changing. Less snowfall can lead to drier soils earlier in the spring and possible drought conditions in summer. More of our rain is falling in downpours, with higher rates of runoff and less soil infiltration. Such conditions would exacerbate summer drought and further promote high elevation wildfires where soil depths are generally thin. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods. (MEMA, 2013)

Exposure

The ecosystems in Massachusetts that are most susceptible to wildfire hazard are pitch pine, scrub oak, and oak forests. These are the most flammable vegetative fuels. (MEMA, 2013) Dalton does not have any significant land coverage that include these ecosystems. However, Dalton fire officials believe that the area along the Appalachian National Scenic Trail (AT) is at a higher risk of wildfire due to human exposure. The AT travels 11 miles through Dalton, which draws large numbers of people to hike and sometimes camp overnight along the trail. Land use and forest cover are shown on Fig. 2. National Land Cover Database Map.

To understand risk, the assets exposed to the hazard areas are identified. In its statewide hazard mitigation plan the Commonwealth utilized the SILVIS Lab, Department of Forest Ecology and Management at the University of Wisconsin to determine this risk. This method utilized census track data, the national land cover database and the protected areas database to determine risk. This same method was utilized as part of the fire risk assessment analyses for the Town of Dalton for this hazard mitigation plan. However, upon examination of this data, the accuracy at the local level was questionable and raised more questions than it answered. For example, census blocks in some areas of the town include large blocks of undeveloped land and do not necessarily reflect the areas where homes are located within those blocks, most particularly in the Intermix areas. The Intermix areas on the SILVIS map are shown in tan and the Interface areas are shown in yellow. Additionally, yellow Interface areas are moderately- to densely-developed areas of the town and the vast interior of this area does not realistically correlate to urban/wildland interface areas. Finally, protected land status on does not necessarily reduce the risk of fire on those lands, as most of the protected lands across Berkshire County and the town are open to the public and used by hikers and overnight campers. As an example, the Appalachian Trail and the two campsites associated with it are located in protected lands and see much more human traffic than non-protected private forested lands in Dalton.

Fig. 3.8.1. SILVUS Dalton Wildland-Urban Interface

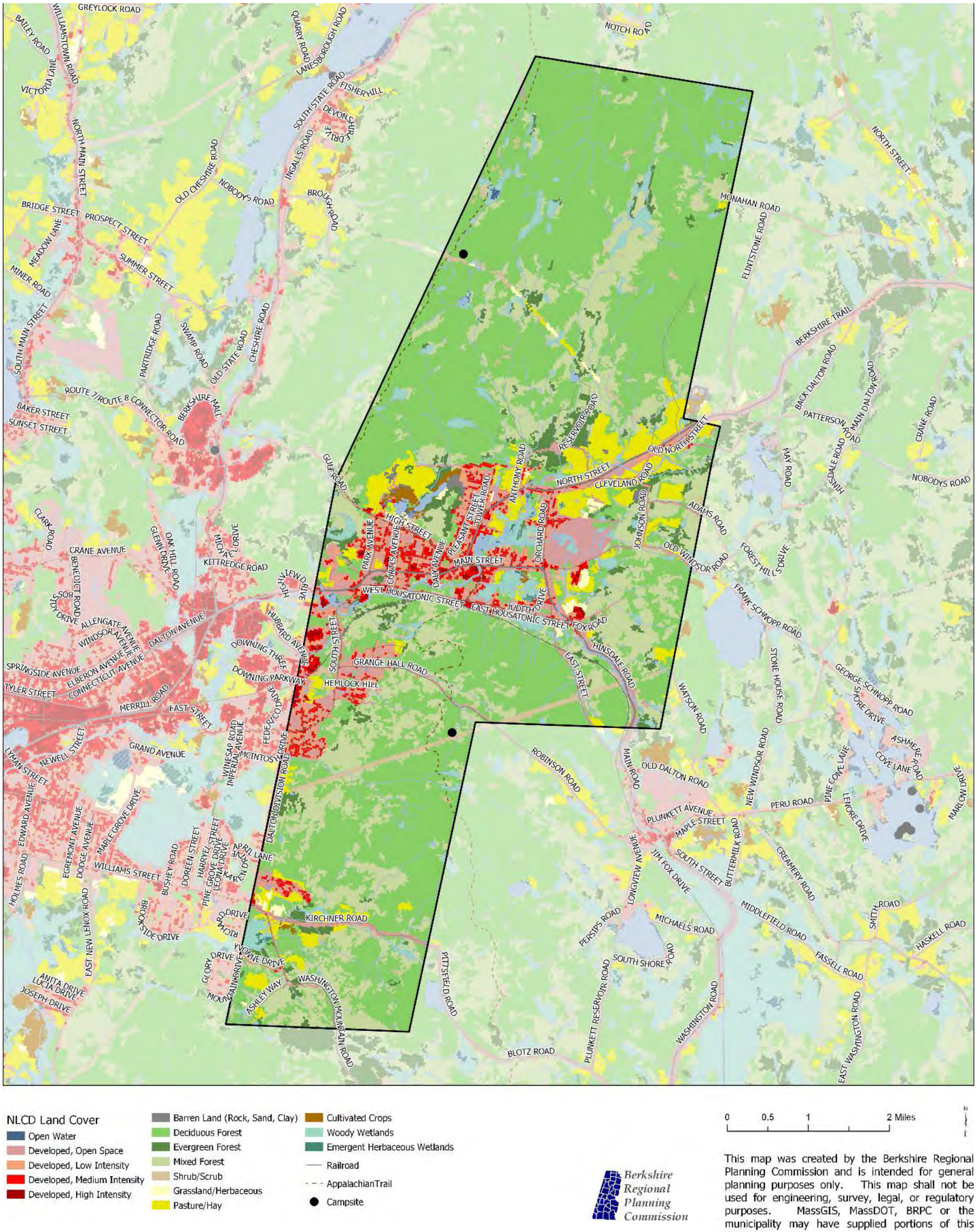


This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

Source: SILVUS, BRPC 2018.

Therefore, Dalton is not using the SILVIS data and is instead using the NLCD data (NLCD map) to more accurately show the locations and interface of development and forest lands. The location of the Appalachian Trail has been added to the NLCD map to show where in town this heavily traveled trail is located. The designated overnight sites in the AT, which are at a higher risk for fires due to this human activity, was also added to the map. Although not added to the map, there are a scattering of trails and unauthorized campsites throughout the northern and southern parts of town which have a higher risk of fires. Finally, the railroad that passes through town along with the utility right-of-way's that pass-through town have a higher risk of fire due to the presence of dry, non-forested shrub/scrub vegetation, the potential of sparks (trains or all-terrain vehicles), and a greater chance of human activity than dense unfragmented forests.

Fig. 3.8.2. National Land Cover Database Map



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Berkshire Regional Planning Commission

3.8.3. Vulnerability

Population

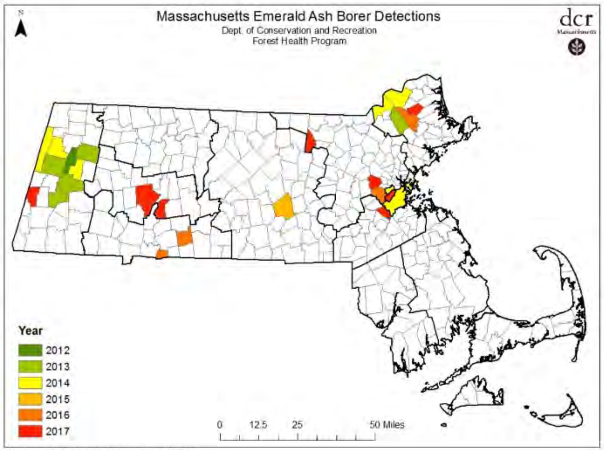
As noted previously in this section, wildfires tend to travel upslope and can be driven by high winds. The majority of the population in Dalton lives in the lowlands along the Housatonic River valley and its tributaries, which would indicate that fire would spread away from populations areas rather than travel towards them. Scattered homes along roads that travel up through hilly forested areas, such as Washington Mountain, Kirchner and Grange Hall Roads would be more susceptible in these cases. The prevailing westerly winds could be a compounding factor for these areas.

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. (MEMA, 2013) Residents in all areas of the town are vulnerable to these secondary hazards due to the amount of forest lands within the town, and first responders throughout the region who respond to fires within their town or through mutual aid are vulnerable to direct and indirect dangers fighting fires.

All Berkshire County communities are considered by the state, based on historic occurrences, to be at low risk of fire due to the number of fires that have occurred. This is most likely due to the low population density along the urban/woodland interface. The county’s exception is the City of Pittsfield, which is considered to be at medium risk. To better understand the urban/wildland interface and the general forest types in the town, land cover was mapped using the Multi-Resolution Land Cover Database. According to this data Dalton is about 76% forested, with northern hardwoods comprising 68% of the forest and mixed forest comprising 27% of the forest. Conifer dominant forest, which poses a greater risk of wildlife, comprises only about 5% of the forest. (Multi-Resolution Land Characteristics Consortium, 2011)

Fires within the town’s forests are highly dependent on soil and vegetation moisture and amount of underbrush. Much of the forest in Berkshire County is lightly being harvested, which can lead to a buildup of dry brush fuel. The ice storm of 2008, which impacted the higher elevations along the Berkshire and Hoosac Ranges, damaged much of the timber stock by knocking down limbs and damaging crowns, which exposed areas of the trees and main trunks to the elements. As a result, this storm created a large amount of fallen debris in the forest, is leaving dead and dying snags, and in the long run is increasing fuel for wildfire. The higher elevations in Dalton were affected by this ice storm.

Fig. 3.8.3. Emerald Ash Borer Dispersal 1. Emerald Ash Borer Dispersal 2017



Map Created by N Keleher DCR Forest Health 12/4/2017

The presence of the Emerald Ash Borer, first found in Massachusetts in Dalton in 2012 (shown in dark green on Fig. 3.), has quickly spread throughout central Berkshire County. This rapidly-spreading invasive insect quickly kills its host trees within a few years of settling in an area, leading to massive die-offs of all ash trees within an area. This will increase the amount of dead limbs, brush and standing dead trees throughout forests in the county. UMass Extension states that, as a component of Massachusetts forests, the highest percentages of ash are located in Berkshire County[2]. Other invasive insects such as the Hemlock Wooly Adelgid threaten healthy hemlock stands and the Asian Longhorn Beetle threatens ash, maples, elms, poplar and willow. The fire risk impacts of the ice storm and invasive insects are not well documented at this time.

Critical Facilities

The vast majority of the critical facilities in Dalton are located in developed areas of the town and would be vulnerable to urban fires. In the event of wildfire, there would likely be little damage to the infrastructure and facilities located in the path of the fire. Most road and railroads would be without damage except in the worst scenarios. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Power lines are the most at risk to wildfire because most poles are made of wood and susceptible to burning. In the event of a wildfire, pipelines could provide a source of fuel and lead to a catastrophic explosion. (MEMA, 2013)

There are a few facilities that house or carry hazardous materials and are considered by Town Officials to be an additional fire risk. The CSX railroad travels five miles through the middle of the town, south of Housatonic Street. It is generally known that the railroad transports large quantities of hazardous materials, although information about the exact content and volumes are not provided to local first responders. As such it is difficult to determine the severity of the risk to the population. Information provided by the Dalton Fire District indicates that there are on average 219,000 freight cars that travel the route annually, of which approximately 42% carries hazardous materials, including more than 2 billion gallons of ethanol.[3] The Cleveland Reservoir water treatment facility, which houses three one-ton cylinders of chlorine and is located in area surrounded by forest, is a potential risk for a dangerous fire incident. Whiting Oil on North Street also hosts large amounts of fuel.

Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire

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[2] *https://ag.umass.edu/landscape/fact-sheets/emerald-ash-borer*

[3] *Dalton Fire Chief Cahalan, personal communication Oct. 2017*

apparatus and thousands of volunteer man-hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from work to fight these fires.

To estimate potential residential losses, a risk exposure analysis was conducted. Quantifying the number of homes at risk involved utilizing 2010 census and breaking it into the intermix and interface areas delineated from SILVUS. The SILVUS model was determined to be a good model for this analysis because it fairly accurately could estimate the number of residential units within those areas. Using this method, it was determined that the interface hazard area (yellow area covering the more densely developed neighborhoods in the Urban-Wildland Interface Map) contains 1,983 housing units, and the intermix hazard area (tan on the map) contains 912 housing units.

To estimate the total potential loss of buildings in the community, the wildfire hazard areas were overlaid upon the assessor's parcel data. It was determined that $188,643,200 is at risk of wildfire in the interface area and $243,592,775 is at risk of wildfire in the intermix area. (Berkshire Regional Planning Commission, 2010) It should be noted that these figures are assessor estimates and does not include market cost or replacement costs, nor do they include estimate of loss of building contents. These figures also do not include the major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business, loss of employment and decrease in tourism.

3.8.4. Existing Protections

The Dalton Fire Department has 34 members, 22 of whom are certified EMTs. The department has three fire engines, a 5-ton ex-military vehicle capable of traveling through four feet of water, and ATVs.

- Dalton has active Mutual Aid Agreements with other fire departments through the Berkshire County Fire Chiefs Association.
- Fire department staff take classes and drills, including training with the railroad personnel.
- The fire department has ex-military vehicle and other forestry equipment for forest fires and flood emergency response.
- The Savoy Fire Tower would cover the Dalton area, but it is not manned except under special request.
- The Town utilizes the Code Red emergency communications system.

3.8.5. Actions

- Monitor dry and drought conditions and request manning of DCR fire towers during period of higher risk of wildfires.

3.9. Landslide Hazards

3.9.1. General Background

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

Landslides in Massachusetts can be divided into four general groups, construction related, over steepened slopes caused by undercutting due to flooding or wave action, adverse geologic conditions, and slope saturation. Construction related failures occur predominantly in road cuts excavated into glacial till where topsoil has been placed on top of the till. This juxtaposition of materials with different permeability often causes a failure plane to develop along the interface between the two materials resulting in sliding following heavy rains. (MEMA 2013)

Undercutting of slopes during flooding events is a major cause of property damage. Streams erode the base of the slopes causing them to over steepen and eventually collapse. This is particularly problematic in unconsolidated glacial deposits, which covers the majority of the community. Adverse geologic conditions exist anywhere there are lacustrine or marine clay soils. Clays have relatively low strength, and when over steepened or exposed in excavations these areas often produce classic rotational landslides. (MEMA 2013)

Another occurrence of landslides in Massachusetts results from slope saturation. This occurs following heavy rains and dominantly in areas with steep slopes underlain by glacial till or bedrock. Bedrock and glacial till soils are relatively impermeable relative to the unconsolidated material that overlies them. Water accumulates on these less permeable layers, increasing the pore pressure at the interface. This interface becomes a plane of weakness, and if conditions are favorable failure can occur. (MEMA 2013) Saturation was a leading cause of the landslide that occurred in Savoy at Route 2 during T.S. Irene in 2011.

3.9.2. Hazard Profile

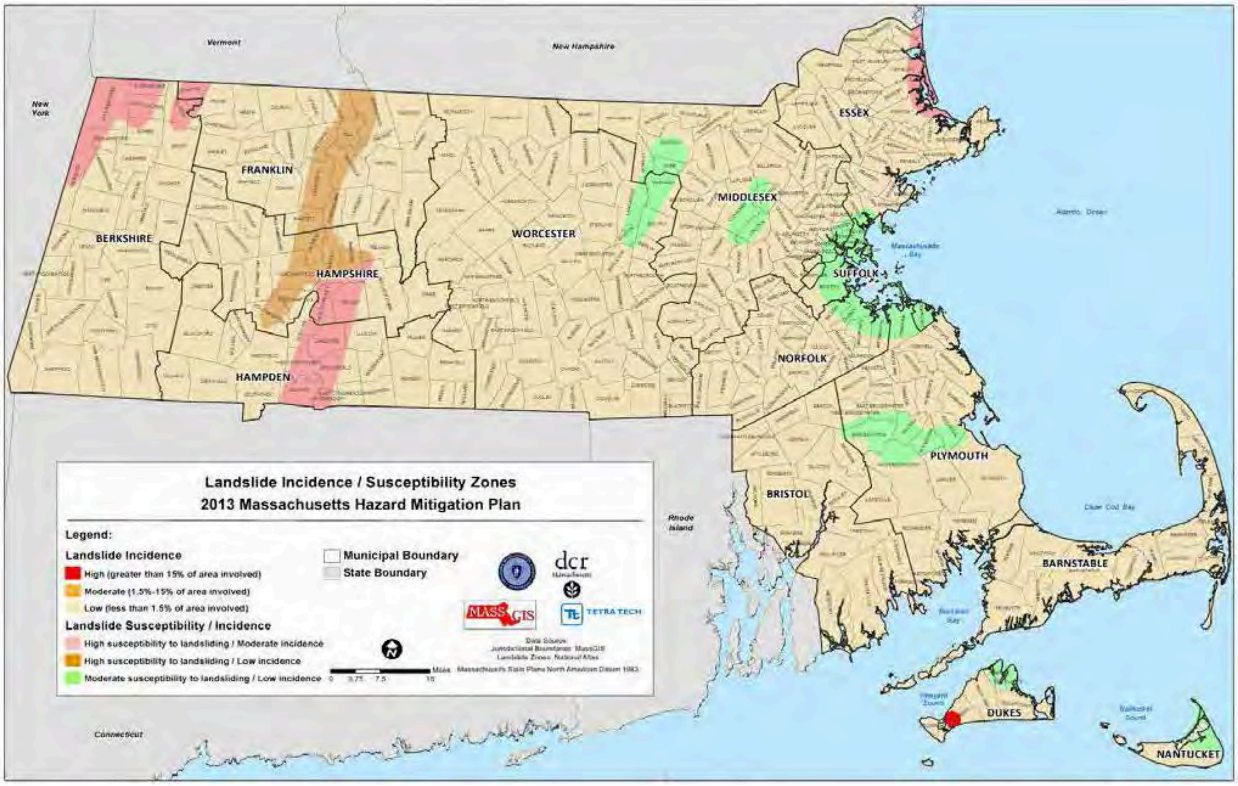
Location

Thirty-six of the 50 U.S. states have moderate to highly severe landslide hazard areas. Within Massachusetts, there are a few areas that have a high susceptibility / moderate incidence occurrence to landslides, including areas within the Taconic and Hoosac Mountain Ranges of northern Berkshire County (see Fig. 3.9.1 for locations). The Town of Dalton is not included in this area.

When referring to Fig. 3.9.1, the definition of incidence and susceptibility are defined as such:

- Landslide incidence is the number of landslides that have occurred in a given geographic area. High incidence means greater than 15% of a given area has been involved in landsliding, medium incidence means that 1.5-15% of an area has been involved, and low incidence means that less than 1.5% of an area has been involved.
- Landslide susceptibility is defined as the probable degree of response of geologic formations to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. It can be assumed that unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced numerous landslides in the past. Landslide susceptibility depends on slope angle and the geologic material underlying the slope. Landslide susceptibility only identifies areas potentially affected and does not imply a time frame when a landslide might occur. High, medium, and low susceptibility are delimited by the same percentages used for classifying the incidence of landsliding. (MEMA, 2013)

Fig. 3.9.1 Landslide Incidence / Susceptibility Zones



Source: MEMA 2013

To investigate landslide risk more closely, data from the Slope Stability Map produced by the Massachusetts Geologic Survey was gathered. According to this source, Dalton has 17 acres of Unstable land and 420 acres of Moderately Unstable land. As seen in the map in Fig. 2, these locations tend to be located on steeply sloped mountain sides and along steeply sloped stream ravines. Many of the Moderately Unstable areas are steeply sloped bases of mountainsides. There are a few small sites in Dalton that are rated as Unstable areas (shown in red in Fig. 2) and all of these appear to be in forested, undeveloped areas. There is one area that appears to be in the Petricca gravel pit, although that landscape is altered by mining. These areas Moderately unstable slopes, shown in pink, is largely found in undeveloped terrain. The majority of these areas are along stream banks or are in remote forested areas.

However, there are a few key areas within the town center that have been rated as Moderately Unstable, most notably sections of Main Street, the main commercial and commuter route through Dalton and serving the central Berkshire region. If this route were to close for road failure, traffic would be detoured through residential neighborhoods. There is also the steeply sloped ravine that the Housatonic River flows through between Main Street and South Street.

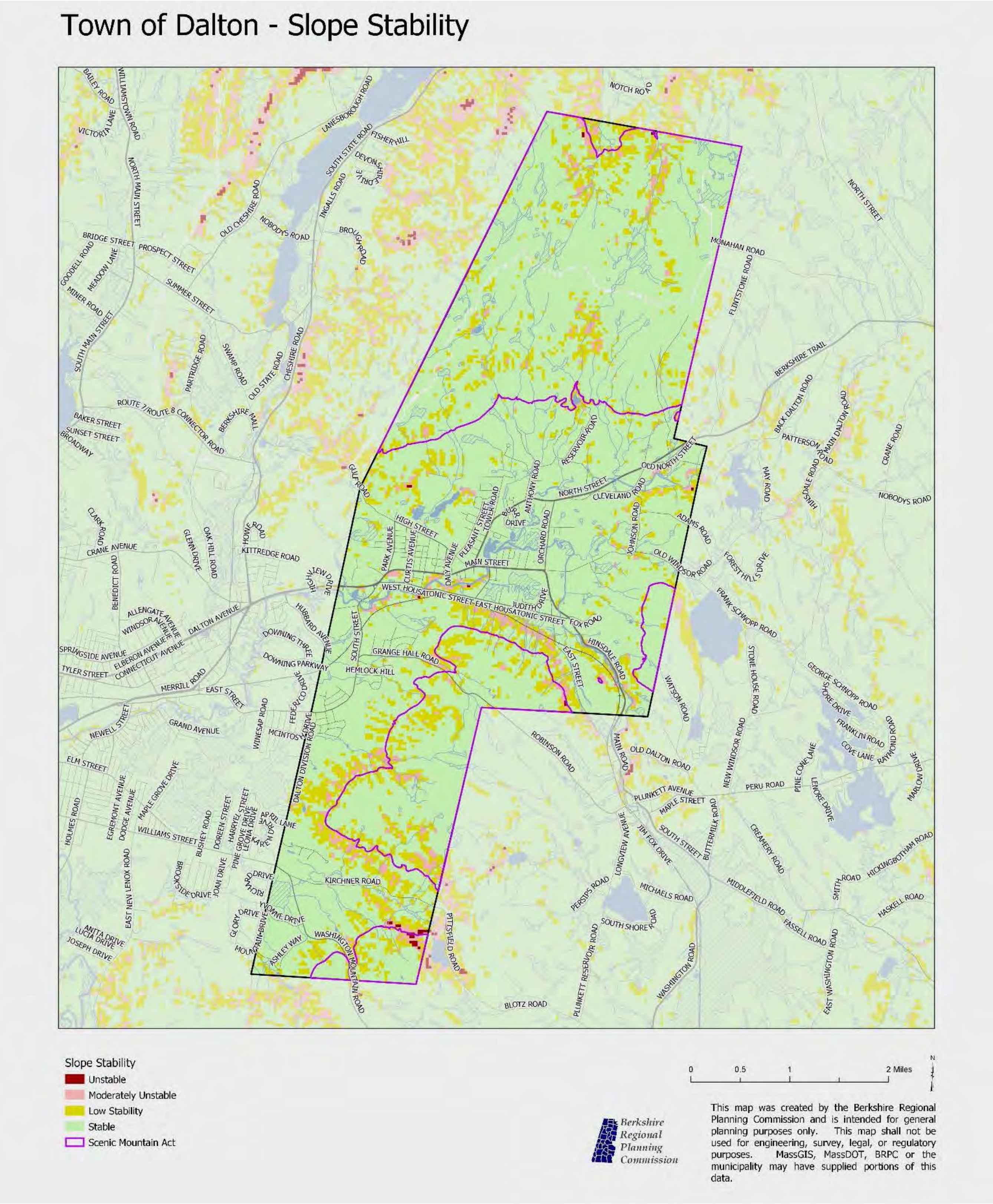
Approximately a one-mile stretch of the CSX railroad runs parallel to Housatonic Street and much of that stretch is rated as Moderately Unstable, with one key area rated as Unstable where the Housatonic River flows directly beneath the railroad bed. Given the amount of hazardous materials that the railroad carries, this may be cause for concern, particularly during times of deep soil saturation that could undermine soil and bedrock and weaken the hold of root systems of trees and other vegetation. High precipitation events that also include high winds will add additional stress to tree root systems and further weaken their ability to hold fast to soil and bedrock.

The Town of Dalton has enabled the Berkshire Scenic Mountain Act (M.G.L. Chapter 131 Section 39A), which allows Berkshire County communities to “adopt reasonable rules and regulations relative to the mountain regions … to protect watershed resources and preserve the natural scenic qualities of the environment.” As noted in the preamble to the town’s Scenic Mountain Act bylaw regulations, “Destruction of the natural ground cover can result in severe erosion. Alteration of mountainsides increases the likelihood of uncontrolled runoff.” The bylaw governs development projects or alterations on land with elevations higher than 1,500 feet. For the purposes of the bylaw, alteration includes, but is not limited to, one or more of the following actions taken within the mapped mountain regions:

> 1) removal, filling, excavation, or dredging of soil, sand, gravel, rock, or aggregate material of any kind in excess of 20 cubic yards;
>
> 2) changing of pre-existing drainage characteristics, sedimentation patterns and flow patterns;
>
> 3) disturbance of existing drainage, watercourses or water table;
>
> 4) substantial change in topographic or scenic features;
>
> 5) erection of any building or structure with a footprint in excess of 500 square feet or a height in excess of 22 feet above maximum existing ground elevation;
>
> 6) dumping or discharging of any material except where it is necessary to stockpile materials to conduct the project;
>
> 7) removal or destruction of plant life, including clearing of trees in a ground area of more than 5,000 square feet; or
>
> 8) construction and/or paving of any new road or parking lot greater than 800 square feet.

The intended purpose of the Act is to protect the scenic values of mountains and to control the host of potentially negative environmental impacts of development on steep slopes. Dalton’s regulations require applicants to provide hydrologic calculations and meet engineered drainage standards. This review process allows the town to review projects and place conditions on them for most development projects, including single family homes. While this regulation can guide development in a more careful way, it should be noted that not all the Unstable and Moderately Unstable slopes in the town are located within the Scenic Mountain Act boundaries. In fact, many of the more steeply sloped Moderately Unstable areas in town lie below the 1,500-foot contour and are therefore outside the jurisdiction of the bylaw. M.G.L. does allow communities the right to adopt a lower elevation if there is justification.

Fig. 3.9.2 Slope Stability (using the Massachusetts Geologic Survey), with Scenic Mountain Act Boundaries



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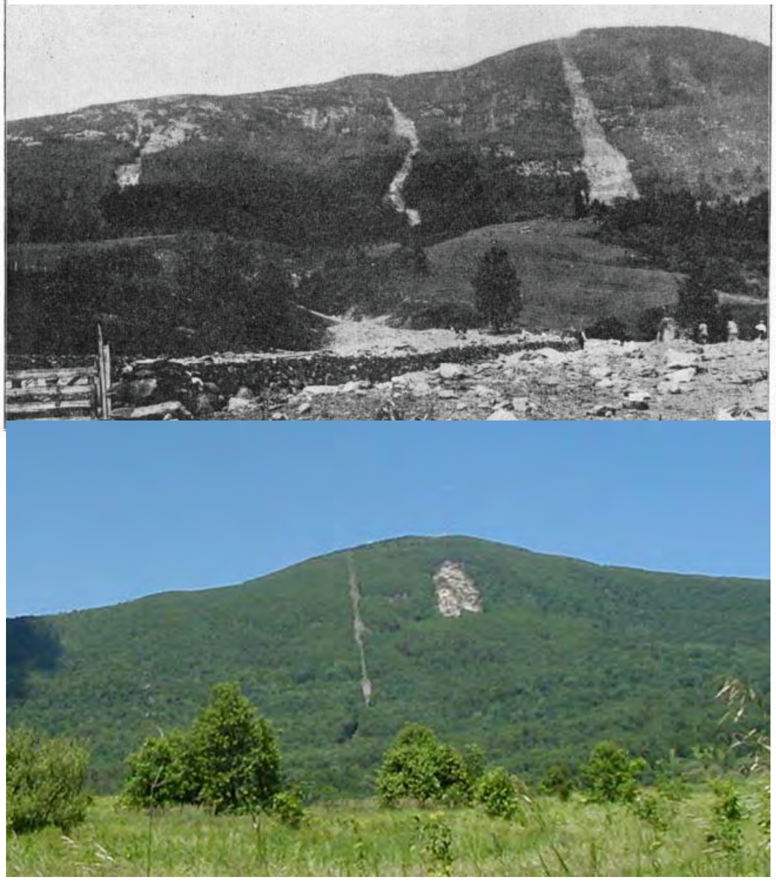
Previous Occurrences

Landslides commonly occur with other major natural disasters such as earthquakes and floods that exacerbate relief and reconstruction efforts. Rock slides occur along roadsides throughout the county where bedrock was blasted to make way for the road and there is little room between the road bed and the rock. Common examples are found on Route 2 near the Hairpin Turn and Route 7 in New Ashford

Many landslide events may have occurred in remote areas causing their existence or impact to go unnoticed. Therefore, this hazard profile likely does not identify all ground failure events that have impacted the Berkshires. While the region has had a few landslides of note, the data on them is very limited and there is nothing specific to Dalton that can be presented in this report. Data taken from the state's hazard mitigation plan of 2013 notes these events that occurred in the Berkshire region.

Fig. 3.9.3. Landslide scars on Mt. Greylock 1901 and 1990



Sources: Top - Mabee, Stephen B., Duncan, Christopher C. 2013. Slope Stability Map of Mass., MA Geological Survey. Bottom – BRPC 1999.

- 1901: 11 landslides occurred along the east face of Mount Greylock after heavy rains (Fig. 3.9.3 top photo). The mountain was designated in 1898 as the first Massachusetts State Reservation for conservation purposes, due largely to deforestation that occurred during private land ownership. The deforestation may have contributed to these landslide events.
- 1936: North Adams - one home was destroyed and six others evacuated during a slide in North Adams.
- 1990 – following two days of heavy rain, a landslide estimated to be at least 1,000 feet long and 300 feet wide occurred in August on the eastern slope of Mt. Greylock, the state's highest peak. The landslide scar is still widely visible today (see Fig. 3.9.3. bottom).
- Early 2000s: Notable rock fall on Route 7 in New Ashford which closed a portion of the road for over a year. This is an example of the type of event that occurs throughout the region.
- August 2011: Hurricane Irene caused damage throughout portions of the Commonwealth, including a 5.8-mile section of Route 2 that was closed from South County Road in Florida to West Charlemont due to erosion and undercutting of the roadway, damage to retaining walls, debris flows, landslides, and bridge damage.

Probability of Future Occurrences

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods, or wildfires, so landslide frequency is often related to the frequency of these other hazards. In general, landslides are most likely during periods of higher than average rainfall. The ground must be saturated prior to the onset of a major storm for significant landsliding to occur. (MEMA, 2013)

For the purposes of this plan, the probability of future occurrences is defined by the number of events over a specified period of time. There have been zero federally declared landslide disasters from 1954 to 2017 in Massachusett. This time period includes the landslide in Savoy, which was included in a disaster declaration for a flooding/tropical storm. It is noted that the historical record may underestimate the true number of events that have taken place in the community because steep slopes are generally undeveloped and unmonitored for this type of event. Massachusetts state officials estimate that approximately one to three landslide events occur each year throughout the state. (MEMA, 2013)

Severity

To determine the extent of a landslide hazard, the affected areas need to be identified and the probability of the landslide occurring within some time period needs to be assessed. Natural variables that contribute to the overall extent of potential landslide activity in any particular area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. (MEMA, 2013)

The most severe landslide to occur in the Berkshire region was the one that occurred along Route 2 in Savoy during T.S. Irene in 2011. The slide was 900 feet long and involved approximately 1.5 acres, with an average slope angle is 28 to 33°. The elevation difference from the top of the slide to the bottom was 460 feet, with an estimated volume of material moved being 5,000 cubic yards. Only the top 2 to 4 feet of soil material was displaced.

It is unknown what the severity of a landslide in the Unstable or Moderately Unstable areas of Dalton would be due to the number of factors that lead to landsliding and to the low number of serious incidences that have occurred in the region.

Fig. 3.9.4. Landslide in Savoy August 2011

Source: Top: Mabee, Stephen B., Duncan, Christopher C. 2013. Slope Stability Map of Mass., MA Geological Survey. Bottom: courtesy Stan Brown of Florida, MA

Warning Time

Mass land movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Some methods used to monitor mass land movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred. Generally accepted warning signs for landslide activity include the following:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together. (Massachusetts Emergency Management Agency, 2013)

Secondary Hazards

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for property owners. (Massachusetts Emergency Management Agency, 2013)

Landslides can severely alter the course of rivers and streams, erode banks and contribute large amounts of sediment and debris into waterways. Stream and river banks that are already prone to erosion or which are already undercut could become more unstable due to a large event. Landslide debris can block the flow of water under bridges and through culverts, threatening the structures themselves and transportation routes for miles downstream of the actual landslide event. If the landslide occurs during a flood event, debris could be widely distributed throughout the floodplain area.

Climate Change Impacts

With the latest regional models showing warmer and wetter winters for New England, climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences. (Massachusetts Emergency Management Agency, 2013)

In the Berkshires, the areas rated as being more prone to landslide incidence and susceptibility are undeveloped, forested steep slopes. Trees and other vegetation help to hold soil in place. Climate change is expected to impact forest species composition in a variety of ways, with cooler species such as sugar maples and hemlocks retreating northward and higher in elevation and invasive forest pests such as the emerald ash borer, wooly adelgid and Asian long-horned beetle increasing tree mortality of key species. Hemlocks are a species that tend to be found in cool, steeply sloped ravines, and the dieback of this species could result in an increase in unstable slopes.

Exposure

In general, as shown in Figures 1 and 2, most of the developed areas within Dalton are considered to be a low risk for landslides. However, it should be recognized that landslides can occur throughout the town during severe events, particularly earthquakes, and more commonly during high precipitation events during times of soil saturation.

3.9.3. Vulnerability

Population

In general, the population exposed to higher risk landslide areas is considered to be vulnerable, including populations located downslope. Overlaying slope stability from the Massachusetts Geological Survey, it appears that 15 buildings in Dalton are on Unstable or Moderately Unstable land, of which 14 are houses and one is a church. To estimate the population vulnerable to the landslide hazard, the approximate hazard areas were overlaid with the assessor parcel data to determine the impact. Based on the 14 houses in the Unstable or Moderately Unstable land, and the 2.33 people/household average within Dalton, it can be calculated that approximately 33 people may need to be sheltered in the event of a landslide.

Expansion of urban and recreational developments up onto hillside areas leads to more people being threatened by landslides each year.

Critical Facilities

Several types of infrastructure are exposed to landslides, including buildings, transportation routes, bridges, water, sewer, and power lines. At this time all critical facilities, infrastructure, and transportation corridors located within the high incidence and high susceptibility hazard areas are considered vulnerable until more information becomes available. (Massachusetts Emergency Management Agency, 2013) The 2013 state hazard mitigation plan notes that the estimated cost to address landslide problems to state highways alone was $1 million during the years 1986-90, and the expense to keep highways safe from landslides was $2 million. The cost associated with remediation work and cleanup of debris from only four landslide-related events during the October 2005 rain event was $2,300,000. The repair to a 6-mile stretch of Route 2 caused by T.S. Irene (2011) which included debris flows, four landslides, and fluvial erosion and undercutting of infrastructure cost $23 million just for the temporary repairs. Accordingly, landslides have a significant cost to taxpayers, yet this hazard is not well known because most earth movements occur during extreme rainstorms and it is the rain and associated flooding that receives the majority of the publicity. (Massachusetts Emergency Management Agency, 2013)

Based on the Slope Stability map, there are no critical municipal facility buildings within the Unstable or Moderately Unstable land areas in Dalton. There are, however, several road sections that travel through Moderately Unstable land. This includes a portion of Main Street hear the Park Avenue intersection, which if damages or closed would be the temporary loss of a major, high volume transportation route and would force detours through residential neighborhoods. The loss of any section of Hinsdale Road cause long detours and delays, including school bus traffic. As might be expected sections of local commuter routes of Washington Mount Road, Kirchner Road (in neighboring Hinsdale) and Grange Hall Road are rated Moderately Unstable, and would force detours of several miles.

Land along Egypt Reservoir is rated as Moderately Unstable.

As noted previously, a stretch of the CSX railroad runs through Moderately Unstable land, with one particular site near a bend in the Housatonic River being rate as Unstable.

Economy

In general, the built environment located in the high susceptibility zones (Unstable and Moderately Unstable) and the population, structures, and infrastructure located downslope are vulnerable to this hazard. In an attempt to estimate the general building stock vulnerable to this hazard, the associated building replacement values (buildings and contents) were determined by using the assessor's data. These values estimate the costs to repair or replace the damage caused to the building. These dollar value losses to the community's total building inventory replacement value would impact the local tax base and economy. These buildings have a value of $4,849,800. It should be noted that the value to damages to the CSX railroad tracks is not calculated as part of this equation.

3.9.4. Existing Protections

- Scenic Mount Act limits and overseen development on elevations higher than 1,500 feet in the Town of Dalton. However, the much of the land identified as Moderately Unstable slopes in the Town are at the tow of the slopes, below 1,500 feet in elevation.

3.9.5. Actions

- Consider evaluating elevations of Moderately Unstable slopes for consideration of expanding the Scenic Mount Act boundaries.

3.10. Earthquake Hazards

3.10.1. General Background

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. A fault is a fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other. The cause of earthquakes in eastern North America is the forces moving the tectonic plates over the surface of the Earth. New England is located in the middle of the North American Plate. One edge of the North American plate is along the west coast where the plate is pushing against the Pacific Ocean plate. The eastern edge of the North American plate is at the middle of the Atlantic Ocean, where the plate is spreading away from the European and African plates. New England's earthquakes appear to be the result of the cracking of the crustal rocks due to compression as the North American plate is being very slowly squeezed by the global plate movements. (MEMA, 2013)

Seismic waves are the vibrations from earthquakes that travel through the Earth. The magnitude or extent of an earthquake is a seismograph-measured value of the amplitude of the seismic waves. Table 1 summarizes Richter scale magnitudes and corresponding earthquake effects. Effects listed are more applicable at lower levels to California than to Massachusetts. For example, earthquakes in the 2 to 2.5 range are typically felt in Massachusetts and throughout the eastern United States. Generally, earthquakes in the eastern U.S. are felt over a larger area than those in the western U.S. (MEMA, 2013)

Table 3.10.1. Richter scale

Richter Magnitude	Earthquake Effects
2.5 or less	Not felt or felt mildly near the epicenter, but can be recorded by seismographs
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and varies with location. Intensity is expressed by the Modified Mercalli Scale; a subjective measure that describes how strongly an earthquake was felt at a particular location. Table 2 summarizes earthquake intensity as expressed by the Modified Mercalli Scale. (MEMA 2013)

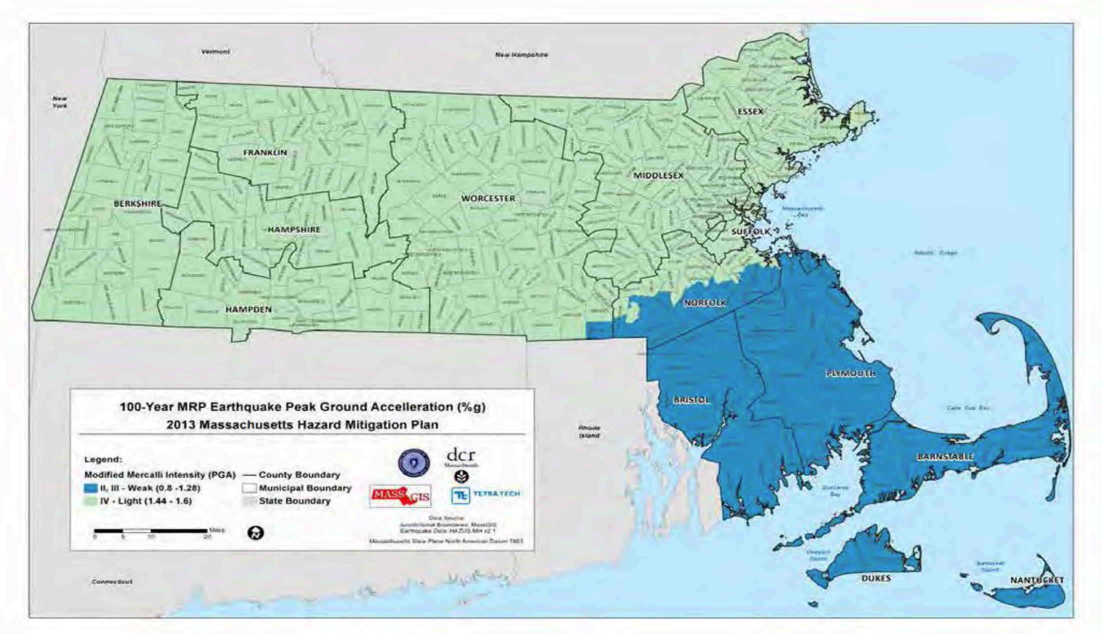
Table 3.10.2. Modified Mercalli Scale

Mercalli Intensity	Description
I	Felt by very few people; barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.
V	Felt by almost everyone, some people awakened. Small objects move, trees and poles may shake.

VI	Felt by everyone; people have trouble standing. Heavy furniture can move; plaster can fall off walls. Chimneys may be slightly damaged.
VII	People have difficulty standing. Drivers feel cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built ones.
VIII	Buildings suffer slight damage if well-built, severe damage if poorly built. Some walls collapse.
IX	Considerable damage to structures; buildings shift off their foundations. The ground cracks. Landslides may occur.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Seismic hazards are often expressed in terms of Peak Ground Acceleration (PGA) and Spectral Acceleration (SA). USGS defines PGA and SA as the following: 'PGA is what is experienced by a particle on the ground. Spectral Acceleration (SA) is approximately what is experienced by a building, as modeled by a particle mass on a massless vertical rod having the same natural period of vibration as the building'. Both PGA and SA can be measured in *g* (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). PGA and SA hazard maps provide insight into location specific vulnerabilities. More specifically, a PGA earthquake measurement shows three things: the geographic area affected, the probability of an earthquake of each given level of severity, and the strength of ground movement (severity) expressed in terms of percent of acceleration force of gravity (%g). (MEMA, 2013)

Fig. 3.10.1. Peak Ground Acceleration Modified Mercalli Scale for a 100-year Mean Return Period



Source: MEMA 2013

According to MEMA’s State Hazard Mitigation Plan, New England has not experienced a damaging earthquake since 1755, but numerous, less powerful earthquakes have been centered in Massachusetts and neighboring states. Seismologists state that a serious earthquake occurrence is possible. There are five normal faults in Massachusetts, three of these traverse portions of Berkshire County, but there is no discernable pattern of previous earthquakes along these fault lines. Earthquakes can occur without warning, can occur anywhere within the county, and may be followed by aftershocks. Most buildings and infrastructures in Massachusetts were constructed without specific earthquake resistant design features. Filled, sandy or clay soils are more vulnerable to earthquake pressures than other soils.

3.10.2. Hazard Profile

Location

New England’s earthquakes to date have not aligned along mapped faults. Because earthquakes have been detected all over New England, seismologists suspect that a strong earthquake could be centered anywhere in the region. Furthermore, the mapped geologic faults of New England currently do not provide any indications detailing specific locations where strong earthquakes are most likely to be centered. (MEMA, 2013)

Previous Occurrences

According to Alan Kafka, Director of Boston College’s Weston Observatory, the most catastrophic earthquake to impact the state was the magnitude 6.0 event off Cape Ann in 1755. It was devastating and felt all over the Northeast. This article was written after earthquakes were felt in the Boston area in 2011 and 2012.[1]

The largest earthquake since 1900 to strike Massachusetts was a magnitude 3.9 on the Richter Scale located east of the Quabbin Reservoir in 1994. According to the USGS, there have been two recent earthquakes with epicenters close to the Berkshires. A magnitude 3.3 on the Richter scale struck the area around Westfield, MA in 2000 and a magnitude 1.9 struck the area around Northampton in 2012. To our west, a magnitude 3.1 struck in the Catskills region of New York in 2009. (USGS Earthquake Hazards Program 2017)

There are conflicting records reporting the occurrences of earthquakes in the Berkshires. According to the 2004 MA State Hazard Mitigation Plan, between 1668 and 1997 only three earthquakes have occurred in the Berkshire region -- 1932, 1963 and 1982. The 1932 event occurred at Lake Garfield in Monterey, but the magnitude is unknown. The 1963 earthquake, which registered as 2.4 on the Richter Scle, is reported to have occurred in North Adams but with coordinates that indicate that it occurred in Savoy. The 1982 earthquake also occurred in North Adams and is registered at 2.0. (The Dewberry Company, 2004) However, the 2013 State Hazard Mitigation Plan indicates that only two earthquakes have occurred in the Berkshires, in Savoy and in the vicinity of the Hinsdale/Peru town border, both of which were in the magnitude of2.0. The sites are shown in Fig. 3.10.2.

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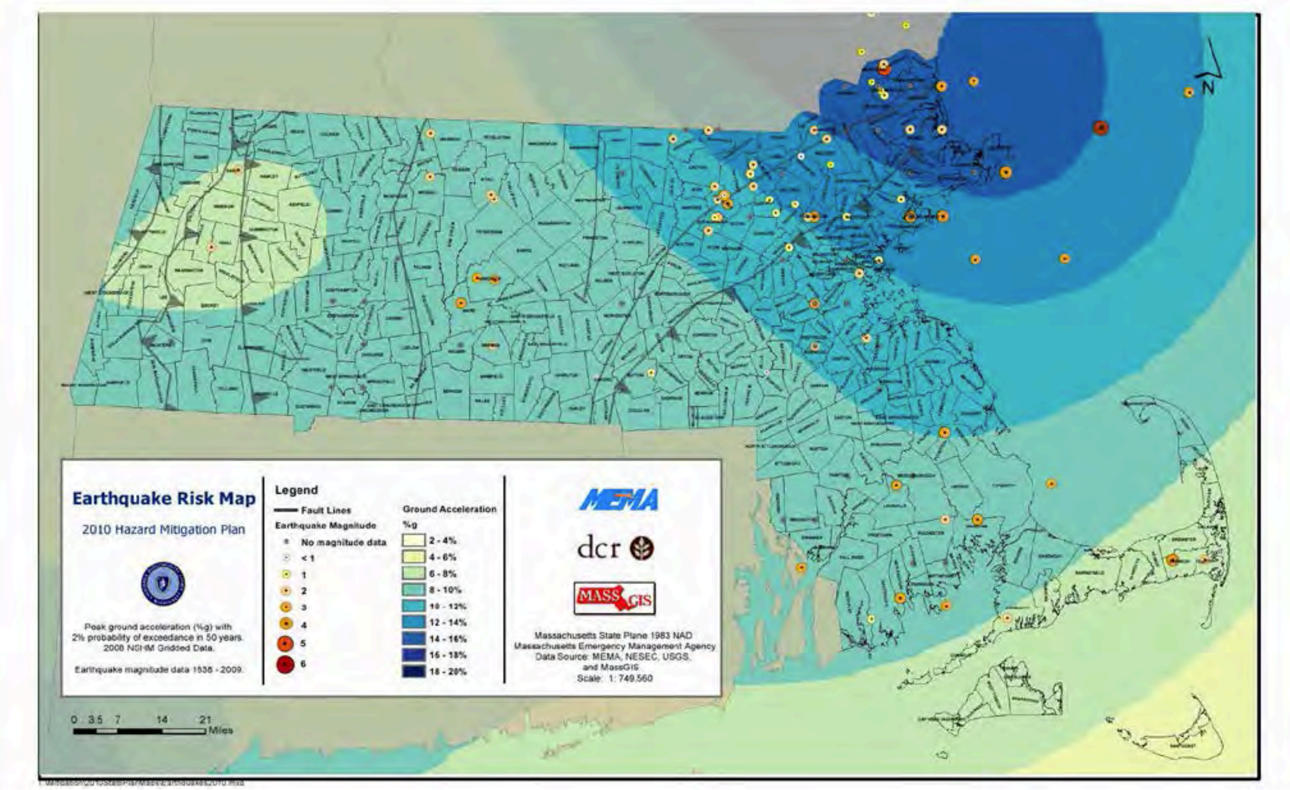
[1] Quintana, Olivia. 12-6-2016. *New England earthquakes happen more often than you think,* Boston Globe, Boston, MA.

Fig. 3.10.2. Earthquake Historic Occurrences and Risk



Source: MEMA 2013

Probability of Future Occurrences

According to the state hazard mitigation plan, earthquakes cannot be predicted and may occur any time of the day and any time of the year. Because the region's geologic faults zones do not correlate well to earthquake locations or aid in predication of occurrence, it is difficult to identify reasonably affordable mitigation measures. Based on the historic occurrences, which have been few and of limited severity, the community could be considered to be at a low risk for major earthquake damage in the future.

Severity

The most commonly used method to quantify potential ground motion is in terms of peak ground acceleration (PGA), which measures the strength of a potential earthquake in terms of the greatest acceleration value of ground movement. The potential damage due to earthquake ground shaking increases as the acceleration of ground movement increases. For example, 100-year mean return period (MRP) event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year. As shown in Fig. 1, the 100-year earthquake event for Berkshire County is a Modified Mercalli Scale of IV (light impacts), felt by many indoors and a few outdoors, and may feel like passing truck. According to the MA State Hazard Mitigation Plan of 2013, the county could experience heavier impacts during the 500 and 1,000 MRP, with Modified Mercalli Scale ratings of V (moderate), felt by almost everyone, some people awakened, small objects move, and trees and poles may shake.

Because of this low frequency of occurrence and the relatively low levels of ground shaking that would be experienced, the community can be expected to have a low risk to earthquake damage as compared to other areas of the country. However, the impacts at the local level can vary based on types of construction, building density, soil type among other factors. (MEMA, 2013)

Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with early-warning systems that use the low energy waves that precede major earthquake to issue an alert that earthquake shaking is about to be felt. These potential early warning systems can give up to approximately 40-60 seconds notice that earthquake shaking is about to be experienced, with shorter warning times for places closer to the earthquake epicenter. Although the warning time is very short, it could allow for immediate safety measures such as getting under a desk, stepping away from a hazardous material, or shutting down a computer system to prevent damage. (MEMA, 2013)

Secondary Hazards

Secondary hazard can occur to all forms of critical infrastructure and key resources as a result of earthquake. Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes. (MEMA, 2013) Damages roadways could impede rescue efforts.

Climate Change Impacts

The impacts of global climate change on earthquake probability are unknown. Some scientists feel that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth’s crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could be at higher risk of liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts. (MEMA, 2013)

Exposure

The entire town of Dalton is at risk from earthquakes. However, some locations, building types, and infrastructure types are at greater risk than others are, due to the surrounding soils or their manner of construction. (MEMA, 2013)

3.10.3. Vulnerability

To assess the community's vulnerability to the earthquake hazard, probabilistic analyses were run in HAZUS for the 100-year mean return period (MRP) events. The HAZUS -MH model was used to estimate potential losses to these events. For the 2018 plan, a probabilistic assessment was conducted for the 100-year MRP using default settings in HAZUS-MH 4.0 to analyze the earthquake hazard for the community. The 100-year MRP event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year.

Population

The entire population of Dalton is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil type their homes are constructed on, their proximity to fault location, etc. The region's high percentage of older building stock could increase the risk of damage to some buildings. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself. (MEMA, 2013)

According to the HAZUS-MH analysis, no injuries or casualties are estimated for the 100-year event and no sheltering is needed.

Critical Facilities

All critical facilities in the planning area are exposed to the earthquake hazard. Earthquakes losses can include structural and non-structural damage to buildings, loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Roads that cross earthquake-prone soils have the potential to be significantly damaged during an earthquake event, potentially impacting commodity flows. Access to major roads is crucial to life and safety after a disaster event, as well as to response and recovery operations. In addition, there is increased risk associated with hazardous materials releases, which have the potential to occur during an earthquake from fixed facilities, transportation-related incidents (vehicle transportation), and pipeline distribution. Facilities holding hazardous materials are of particular concern because of potential rupture and leaking into the surrounding area or an adjacent waterway. (MEMA, 2013)

Based on the HAZUS analysis for the community, it is expected that there will be minimal damage to the infrastructure or critical facilities in town.

Economy

HAZUS-MH estimates the total economic loss associated with each earthquake scenario, which includes building and lifeline-related losses (transportation and utility losses) based on the available inventory. Direct building losses are the estimated costs to repair or replace the damage caused to the building. It is estimated that the community will experience $50,000 in total building related losses across the town.

Earthquakes also have impacts on the economy, including: loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. It is estimated that the community will experience $0 in infrastructure losses and business losses.

3.10.4. Existing Protections

- The Town of Dalton adheres to the Massachusetts Building Code.

3.10.5. Dalton Actions for Earthquakes

- Continue strict enforcement of the Massachusetts Building Code.

Section 4. Mitigation Strategies and Actions

4.1. Major Findings

During the planning process several major findings of risk surfaced. A summary of the Major Findings for the Town of Dalton are as follows:

Walker Brook Flooding

Walker Brook flooding remains a major concern for town officials and residents. There are a few engineering options to address the issue. Some are straightforward and feasible, but the high cost of implementation remains a key barrier. Some engineering solutions require extensive construction, which is a consideration in this residential neighborhood. Pursuit of mitigation options should remain a high priority for the Town, as mitigating flooding in this area will help to protect High Street and the Senior Center, a community asset.

Center Pond Flooding

Center Pond is at the confluence of the Housatonic River and its tributaries, and flooding occurs during spring melt and severe precipitation events. Flooding and evacuations at Pomeroy Manor are expected to continue to occur unless flooding of the pond can be reduced or structural protections put in place. The bridge and infrastructure on Main Street are expected to continue to be threatened during flood events. The hydrology of Center Pond needs to be studied to determine why, if anything, can be done to reduce the impacts of flooding to homes, property and infrastructure in this area. There is a desire to dredge built up sediments from the pond in an effort to restore flood storage capacity, and designing, permitting and dredging would undoubtedly be an expensive and drawn out endeavor. The first step would be to conduct a study to gather the hydrologic data necessary to determine if dredging would be beneficial and, if so, to what degree. In the short term it may be prudent to investigate options to lessen flood impacts to Pomeroy Manor, such as structural protections around the facility or to the buildings themselves.

Dam Failure

Inundation flooding from a dam failure has the potential to claim the greatest loss of life, injury and property damage in the Town of Dalton (see Section 3.5 for more details). Due to existing monitoring and dam maintenance procedures the chance of a full failure and breach is low, but it would be prudent to conduct an exercise with a key dam owner and local response teams in neighboring Hinsdale and Pittsfield.

Risks from CSX Railroad

Natural hazards and disasters increase the risk of train accidents due to a variety of factors. Local officials believe that almost 220,000 freight cars travel through Dalton annually, with more than 40% of those carrying hazardous materials, include more than two billion gallons of ethanol.[1] The neighboring town of Hinsdale, also undertaking an update of its hazard mitigation plan, has also expressed its concern about a hazardous materials accident. Due to the pressing requests of first responders in the Central Berkshire REPC, the railroad has in recent years sponsored emergency response exercises. An increase in emergency response drills under various hazardous materials or fire scenarios for the

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[1] *Personal communication from Dalton Police Chief Coe, 2017.*

Dalton/Hinsdale corridor should be considered, especially given the close proximity of the railroad tracks to schools, critical facilities and vulnerable populations.

Energy and Water Conservation

The Dalton Water Department, within the Fire and Water District, has not experienced a drought in several decades, and has not in recent memory declared a water emergency with mandatory restrictions on use. The Town of Dalton has regulations in place to enforce a water use restriction but has not had to utilize its enforcement powers. The District could proactively encourage residents to install water conservation measures, such as low-flow shower heads and water-saving washing machines, with links to financial incentives to help residents and businesses afford the measures. Many of the water conservation measures will also conserve energy use and costs. The Town and the Green Dalton Committee could partner with the Water Department to promote the MassSave Energy program, which is a central portal to energy efficiency measures (i.e. building insulation and air sealing) for both residential and business customers. Bundling both energy and water conservation measures will thus help property owners become more resilient against extreme temperature events, power outages and drought. As a state-designated Green Community the Town could consider using the Green Communities Grant program to fund some of this work.

4.2. Goals and Objectives

The Draft Goal, Objectives and Actions within this plan were developed as local vulnerabilities were being identified and concerns were being raised by the Dalton Emergency Management Advisory Council and input was received by local residents. The Advisory Council adopted the following goal, based on the regional goal from the *Berkshire Regional Natural Hazard Mitigation Plan* of 2013.

Overall Goal:

Reduce the loss of life, property, and infrastructure, and environmental and cultural resources from disasters through a comprehensive mitigation program that includes planning, prevention, adaption and preparedness strategies.

Major Objectives to meet the Goal and address the Major Findings

- *Investigate, design and implement structural projects that will reduce and minimize the risk of flooding.*
- *Investigate and implement projects that will reduce and minimize the risk of non-flooding hazards.*
- *Increase the capacity of local Emergency Managers, DPWs, and Fire, Police and Health Departments to plan for and mitigate natural hazards*
- *Increase public awareness of natural hazard risks and mitigation activities available to them*
- *Improve the quality of the data for the region as it pertains to natural hazards*
- *Improve existing local policies, plans, regulations, and practices to reduce or eliminate the impacts of natural hazards*

4.3. Local Capability Assessment

In addition to gathering data and information from the Dalton Emergency Management Council, interviews were held with key stakeholders to discuss current capabilities of the Town to address natural hazards in Dalton. Interviews were held with the Central Berkshire Regional School District (regional middle and high schools located in town), the Dalton Fire and Water District (public drinking water), Emergency Management Director, Stormwater Committee, Council on Aging, Dalton Housing Authority, and Crane Company. Risk assessment, strength and weakness were discussed frankly and incorporated into this hazard mitigation plan to identify and prioritize existing protections and future actions. The existing protections have been described throughout the Risk Assessment sections of this plan. Additional findings on local capabilities are described herein.

Capability Self-Evaluation

As part of this Plan update, the Town of Dalton conducted a self-evaluation of its hazard mitigation capabilities, reviewing its existing policies, programs, permitting and resources to monitor or reduce natural hazard impacts. As part of this effort key Town staff filled out the Capability Assessment Worksheet developed by FEMA and found in the *Local Mitigation Planning Handbook.* (FEMA, 2013) A summary of the self-evaluation includes:

> Planning and Regulatory: In general the Town is well served by its planning and regulatory capabilities, having full time staff to conduct building and fire inspection/enforcement and having recently hired a Town Planner to aid land use permitting boards in reviewing and conditioning permits. The Massachusetts Wetlands Protection Act and the Dalton Floodplain District bylaw limits and conditions building in floodplain and wetland resources areas. Although findings and recommendations from existing plans do not conflict with this Natural Hazard Mitigation Plan, they do not specifically consider hazard mitigation or response. The Town will be investigating climate change impacts and mitigation in the next year, with the support of a Municipal Vulnerability Preparedness Planning Grant. The Town does not have a Continuity of Operations Plan.
>
> Administrative and Technical: The Town is well served by its staff. The Town does not have a certified Floodplain Administrator, but development within floodplain areas are overseen through strict state law and local bylaws, combined with staff to inspect and enforce those regulations. The Town does not have the demand or resources to maintain an engineer on staff. The Dalton EMD is becoming increasingly familiar with MEMA's online GIS tool and is updating critical facilities and other data. Training for the EMD and other key staff would be beneficial to ensure timely updates and edits, and to create redundancy in familiarity with the online tool. Technical hazard mitigation data assessment, such as GIS modeling and HAZUS analysis, will likely continue to be conducted when needed by the Berkshire Regional Planning Commission.
>
> Financial: The Town develops and updates as needed its Capital Improvement Plan, and had just recently decided to undertake an inventory of key infrastructure condition and needs. Town staff apply for grant funds where available to mitigate flooding and other hazards.
>
> Education and Outreach: The Dalton Emergency Management Council meets regularly to maintain communications and coordination among town departments. The regional school

district and state police conduct regular emergency preparedness exercises in all its schools, including those in Dalton. Code Red is heavily promoted and has been utilized during emergency situations such as severe weather predictions, power outages and road closures. However, cell phone coverage is only to those who voluntarily sign up for it.

Safe Growth Audit: State and Town regulations prohibit or limit and condition development in floodplain and wetland resource areas, and Town regulations limit and condition development in higher elevation areas. The Town does have an Open Space Residential District that allows for greater intensity and preservation of undisturbed land. The Town has not considered discouraging development in other areas of Dalton because those areas more prone to hazards, such landslides or wildfire, were not identified until the update of this Hazard Mitigation Plan. Development trends in Dalton largely include 1) single family homes along rural roadways outside the town center, often carving a housing site out of forest, or 2) small subdivisions, again often carving housing sites out of forested areas. Recent housing developments are reaching outwards into more steeply areas, although to date they have not typically advanced into areas that are modeled to be moderately unstable or unstable (see Section 3.9 for more details).

Mutual Aid Agreements and Coordination

In general, the first responder communities in the Berkshires coordinate and work well together during emergency situations. The Berkshire region is somewhat isolated due to the Berkshire and Taconic mountain ranges, and the population of the area is relatively small compared to the rest of the state. As a result, local first responders tend to know each other. Formal mutual aid agreements are held by both fire and police, and most communities in the county belong to one of three Regional Emergency Planning Committees (REPCs). Dalton is an active member of the Central Berkshire REPC. Fire departments routinely exercise mutual aid, including responding to wildlife events. Additionally, emergency equipment and shelter supplies are stored on a regional basis and can be used by a community in the event they are needed; the Town of Dalton maintains an updated list of equipment and supplies available.

Sheltering

The local shelter at Nessacus School will serve well as a mass care shelter as long as the site and the main routes to the site are not flooded. The school’s location just outside the floodplain boundary is a cause of concern, and it will be important to reassess this site once new floodplain mapping is updated for the region. If new FIRM boundaries indicate continued concern, the Town should undertake a feasibility review to determine a more appropriate shelter site, such as Craneville Elementary School, which is clearly not in a flood zone and is approximately 500 farther away from the CSX railroad (providing additional protection during a hazardous materials incident). Formal MOUs and protocols for opening the shelters should also be drafted so that both the town and the regional school district agree on when and how to open and operate the shelters.

The Senior Center and its staff are assets to the Town of Dalton, as the building seldom closes during severe storm events. The building currently serves as an informal cooling/warming center, but the building itself is at risk of flooding. The Town is actively pursuing a solution to the chronic flooding issues from Walker Brook that threaten this area of the town. Also, there is no backup power if a widespread power outage occurs during an extreme heat event, reducing the building effectiveness to serve as a cooling/warming center. It would be prudent to retrofit the building with backup power so that the building could continue to serve as an emergency asset.

Decreasing Volunteerism

Local fire companies are still largely populated by volunteers. Many of the larger and mid-sized communities such as Dalton have a small core of paid staff, but the smaller surrounding towns are still manned purely by volunteers. While some communities, including Dalton, still have active ambulance/EMT staff, the trend seems to be moving away from local volunteers and towards full-time ambulance companies. Part of this trend is due to greater demands for EMT training and certification, which volunteers struggle to maintain, and part of it is the lack of volunteers to maintain full fire/EMT membership. The lack of volunteers is not unique to Berkshire County, and is due to a variety of social and population trends, among them:

- Increasing demands for trainings and certifications in both fire-fighting and ambulance services.
- The region's population is aging, increasing demands for emergency response. On top of an increase in demand, many volunteers are aging and retiring from their volunteer fire and ambulance positions.
- Family trends where two-income families are the norm, leaving less free time for volunteerism.
- Decreasing numbers of able-bodied adults in the town to fill in retirees. In the Berkshires this is more severe than other areas of the northeast, where the county's workforce is projected to decrease by another 25% by 2030.
- Trends where the able-bodied population is less interested in volunteer service. The volunteer rate dropped to 25% in 2014, the lowest since the government started issuing a report on volunteerism in 2002 (according to the U.S. Bureau of Labor Statistics). The greatest drops were in people with higher education degrees. (BRPC, 2016)

The Dalton Fire Department, within the umbrella of the Dalton Fire and Water District, has within it an ambulance service. In an effort to fully cover all shifts with ambulance service, the Fire Department started paying EMTs on a per diem basis, and yet the department still misses some calls. State regulations require dispatched ambulances to have two certified EMTs aboard, and if Dalton or another town cannot get two EMTs to respond to a call, then another town or City of Pittsfield has to respond to the call, and the extra distance traveled from that other town or city can delay response. The issue was highlighted on September 14, 2017 when ambulances in Pittsfield were already dispatched on calls and could not respond to an automobile accident in Pittsfield. Mutual aid was summoned from Dalton and Lenox. Delays in response in Pittsfield are sometimes caused by a high volume of calls, while in other times it is because ambulances serving the city are assisting other towns in the county. [2] As Dalton Chief Cahalan recently stated, "we all stealing from each other" to respond.[3] Efforts to reduce the state ambulance requirement to having one certified EMT on board with a driver that is a trained first responder have been discussed as a possible solution.

4.4. Prioritizing Actions

Although tornadoes have caused the most serious loss of life in Berkshire County in the last 50 years, their frequency, location and severity are unpredictable. Severe winter storms are serious, annual, relatively predictable events that are viewed as part of life in the Berkshires, although ice storms and rain-on-snow events are becoming more frequent and dangerous. Flooding remains the natural hazard of most concern, being the end result of several natural hazards, including heavy snowfall/spring melt,

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[2] Drane, Amanda, 9-14-18. *Berkshire Eagle* article, "Crash highlights gaps in Pittsfield emergency services," Pittsfield MA.

[3] Drane, Amanda, 12-19-17. *Berkshire Eagle* article, "First responders, emergency personnel try to address growing gaps in ambulance services," Pittsfield MA.

ice jams, heavy rains from severe thunderstorms and hurricanes, and beaver activity. Flooding can also occur due to dam failure or poor stormwater management. Flooding is a natural hazard that can reasonably be mitigated to some degree through proper land use and structural improvements. Therefore, it is appropriate that flooding remain a major focus in future mitigation planning and implementation.

The Dalton Emergency Management Advisory Council has developed and prioritized a list of actions based on the findings if this plan update. Priority Levels were determined using three general criteria: 1) the level of potential severity of the hazard/disaster event 2) the level of concern for the hazard/disaster, as voiced by local officials, and 3) practicality of implementing each particular action. Although cost was considered as part of criteria #3, it was not a determining factor. Priority Levels were assigned as follows:

- High Priority: Actions that address hazards of greatest severity and concern in the Town, as voiced by the Hazard Mitigation Committee and residents, and which should begin to be implemented immediately or in the near future to avert or mitigate the impacts of future disasters.
- Medium Priority: Actions that address hazards of a lesser severity and concern, as voiced by the Hazard Mitigation Committee and residents, and which should be implemented as local capacity and funding becomes available.
- Lower Priority: Actions that address hazards of a lesser severity and concern, and should be monitored for opportunities for future implementation.

4.5 Dalton Multi-Hazard Mitigation Action Table

The Action Table listed herein is the culmination of the planning process undertaking by the Dalton Emergency Management Advisory Council. The original actions from the 2012 Multi-Hazard Mitigation Plan are shown in black text, with red text describing how the action has progressed in the past six years. Actions that are in red text across all rows are new actions developing as part of this plan update in 2018.

The Critical Facilities Map that follows the Action Table illustrates the areas in Dalton that are of most concern regarding natural hazard impacts. For example, floodplains are shown in green and chronic flooding areas are shown in red hatching; areas determined to be more prone to wildfire, due to high recreational use along the Appalachian Trail, are shown in green hatching. A second Critical Facilities Map is an insert, showing the town center in a more readable scale.

Table 4.5.1. Town of Dalton Action Table

Actions listed in black are from the Town's expired Hazard Mitigation Plan.

Actions listed in red are new actions arising out of this Hazard Mitigation Plan Update.

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status 2018
Structural Project - Flooding	Perform engineering study of Walker Brook as it flows underground through town and implement findings.	Improving the draining of this area will reduce the risk of flooding	Town of Dalton	1-3 years/ High	Town, FEMA	Engineering in progress with FEMA funding
Structural Project – Flooding	Perform engineering study of Kirchner Road bridge to determine solutions to alleviate flooding	Improving the bridges capacity for water flow will help reduce flooding	Town of Dalton, Mass Department of Transportation (MassDOT)	4-6 years/ Medium	Town, MassDOT, Federal Highway Admin. (FHWA)	Bridge culvert replaced; complete
Structural Project - Flooding	Perform engineering study of Orchard Road bridge to determine solutions to alleviate flooding	Improving the bridges capacity for water flow will help reduce flooding	Town of Dalton, MassDOT	4-6 years/ Medium	Town, MassDOT, FHWA	MassDOT investigating with Rt. 9 Walker Brook; keep in mind sidewalk recommendation from Complete Streets study
Prevention – Flooding	Implement beaver control solutions	Using beaver control solutions to control the beaver population will reduce or eliminate the risk of flooding	Town of Dalton	7-10 years/ Low	Town, MSPCA	This is an ongoing technique used by the Town

Prevention - Flooding	Continue to utilize Stormwater Management Committee to reduce stormwater runoff	Reducing new stormwater will reduce the load on the existing system reducing the need to perform upgrades and expansions to the system	Town of Dalton	1-3 years / High	Town	Ongoing
Prevention – Flooding, Dams	Work with the City of Pittsfield to ensure Cleveland Reservoir Dam is in good condition	reduce the risk of failure and subsequent flooding which could be catastrophic if full dam breach	Town of Dalton, City of Pittsfield	1-3 years / High	Town, City	Ongoing
Prevention – Flooding, Dams	Work with Dalton Fire District to ensure Windsor Dam is in good condition	Ensuring the dam is in good shape will reduce the risk of failure and subsequent flooding	Town of Dalton, Dalton Fire District	1-3 years / High	Fire District	Ongoing; major repairs 2008-10; additional minor repairs 2017
Prevention, Natural Resource Protection - Wildfire	Reduce excess dry timber in the surrounding forest lands	Clearing the debris from the forests will help in reducing the chance of wildfire	Town of Dalton, Dalton Fire & Water District, DCR, F&W	4-6 years/ Medium	Town, DCR, F&W, FEMA	No Action
Property Protection – All Hazards	Identify historic structures, businesses and critical facilities located in hazard-prone areas, including floodplains and dam failure inundation areas.	Identifying historic structures in floodplain and inundation areas will enable those facilities to be better prepared for the hazards and to prevent their loss	Town of Dalton, MEMA, Massachusetts Historical Commission	4-6 years/ Medium	Town	No Action

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status 2018
Assessment	Evaluate sedimentation and loss of storage capacity at Center Pond and potential for dredging or other action	Reduce flooding in vicinity and upstream; increase flood storage capacity; reduce risks to dam structure	Town, DEP, MEMA	Long-term / High	MEMA	New
Assessment	Consider structural options to protect Pomeroy Manor housing complex from flooding	Reduce risk to elderly residents and property damage	Town, Dalton Housing Authority	3-5 years / Medium	MA Dept. of Housing & Comm. Dev., MEMA	New
Shelter preparedness	Evaluate Craneville Elem, School for possible primary shelter; possible feasibility/cost study; possible wiring of building for portable generator	Less risk than Nessacus from 100-year or dam-related flooding, or chemical spill on RR	Town, CBRSD	2-4 years / High	None at this time – MEMA, Homeland Sec. for implementa-tion	New
Emergency Preparedness	Draft formal MOU with school district	MOU protocols and responsibilities clear if sheltering needed	EMD, CBRSD	1-3 / High	No funds needed	New
Communications – stormwater hotline	Remind residents that there is a stormwater hotline call in number for potential pollution discharges; could be used to also report culverts or stormdrains clogged or not properly functioning	Proactively reduce flood risk	Stormwater Commission, DPW	Ongoing	No funds needed	New

Emergency Preparedness	Retrofit Senior Center with backup power	Option for cooling/warming center; possible shelter during electricity outage	EMD, COA	2-4 / Medium	MEMA, Homeland Security	New
Capital Improvement Planning	Coordinate capital improvement plans between town and water district	Coordinate and bundle infrastructure projects for maximum efficiency and cost effectiveness; Dalton Division Rd. could be an opportunity	Town, Water District	Ongoing	No funds needed	New
Emergency Preparedness	Conduct evacuation exercise with Pomeroy Manor residents	Improved evacuation process and reduce risk to residents and first responders	Fire District, Dalton Housing Auth.	Ongoing	No funds needed	New
Emergency Preparedness	Conduct water conservation program to raise awareness of importance of water supply and reduce water demand; promote MassSave for free water conservation measures	Reduce demand and prep residents for possible emergency measures in event of drought	Water District, Dalton Green Committee	2-4 years / Medium	No funds needed	New
Emergency Preparedness	Incorporate floodproofing as part of the redesigning of Wahconah High School; consider flood retention on school grounds.	Reduced risk of flooding and use of building; reduced risk of losing school days	Town, CBRSD	1-5 years as design progresses / Medium	MEMA, state school program	New
Assessment	Assess bridges for condition of both bridge structure and infrastructure attached	Reduce possible failure of structures due to flood damages; aid in	Town	1-3 years / High	Town, MEMA, Ch. 90, MVP	New

		prioritizing projects				
Documentation and assessment	Document all town costs associated with response to flood events, including staff time, materials, equipment value and fuel	Identify flooding trends for improved pre-disaster prep; record costs for potential reimbursement from grants or disaster disbursements	Town departments, Dalton Fire & Water District	Ongoing	No funds needed	New
Regulatory Tools	Review town stormwater bylaw for potential to strengthen requirements for on-site retention of stormwater runoff	Reduce increased risk of flooding from new development	Planning Bd, Stormwater Committee	3-5 years / Low	No funds needed	New
Emergency Preparedness	Increase enrollment in Code Red	Keep residents informed before and during severe storm events	EMD	Ongoing	No funds needed	New
Emergency Preparedness	Update online ArcGIS to include all critical facilities and hazard areas of concern; train key staff	Improved coordination and redundancy between town depts.	EMD, Town depts, Water & Fire District, CBRSD, MEMA	Long-term / High	MEMA, BRPC tech. assistance	New
Emergency Preparedness	Coordinate with City of Pittsfield for emergency response plans	Improved response to water / sewer line breaks	EMD, Dalton & Pittsfield public works	2-4 years / Medium	No funds needed	New
Emergency Preparedness	Promote MassSave and other home improvement programs to tighten building envelopes	Helps maintain interior conditioned space during severe temperature events; reduce energy demands	Dalton Green Committee	3-5 years / Low	No funds needed	New

Section 5. References

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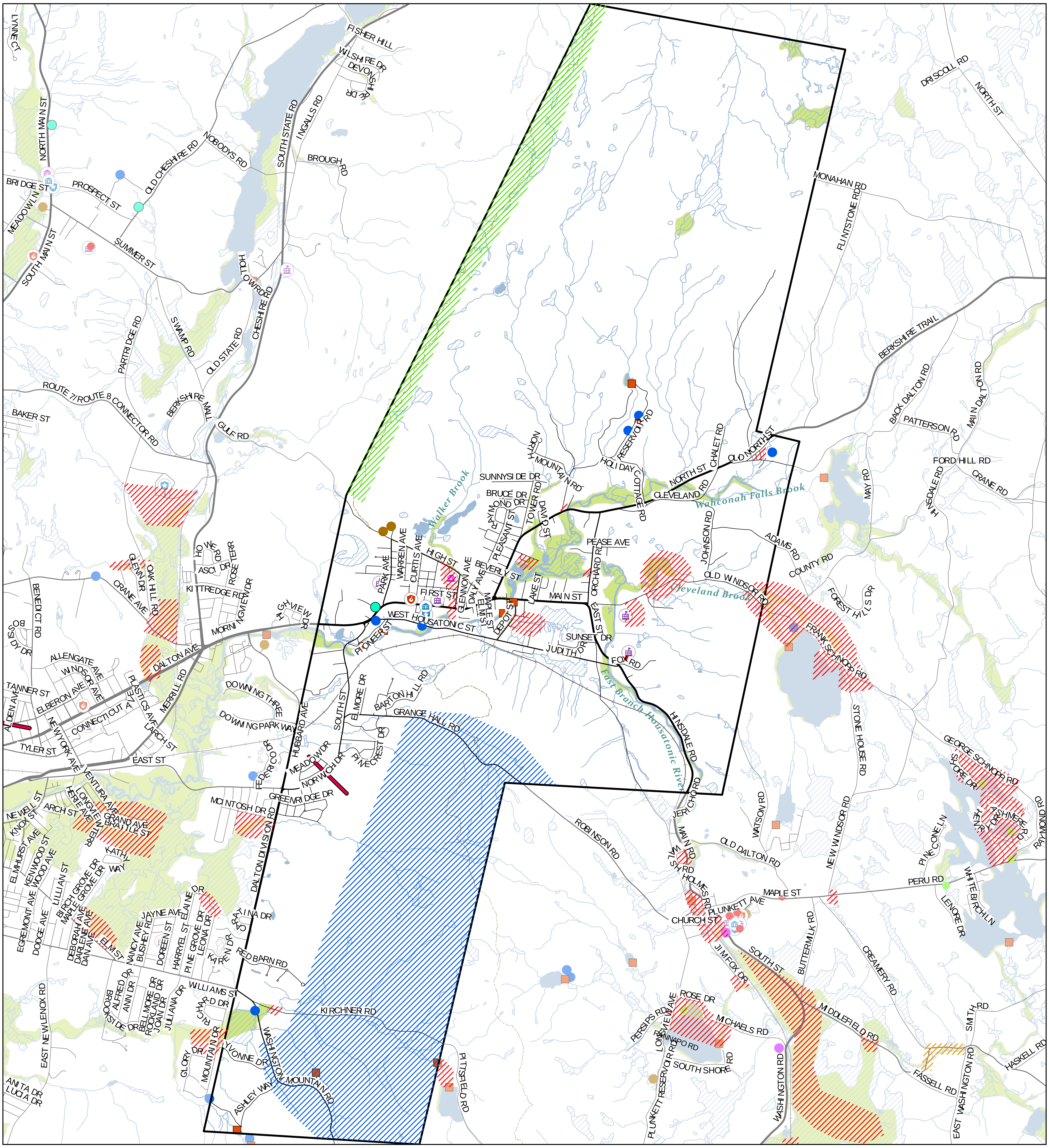
APPENDIX A

Critical Facilities and Areas of Concern Maps

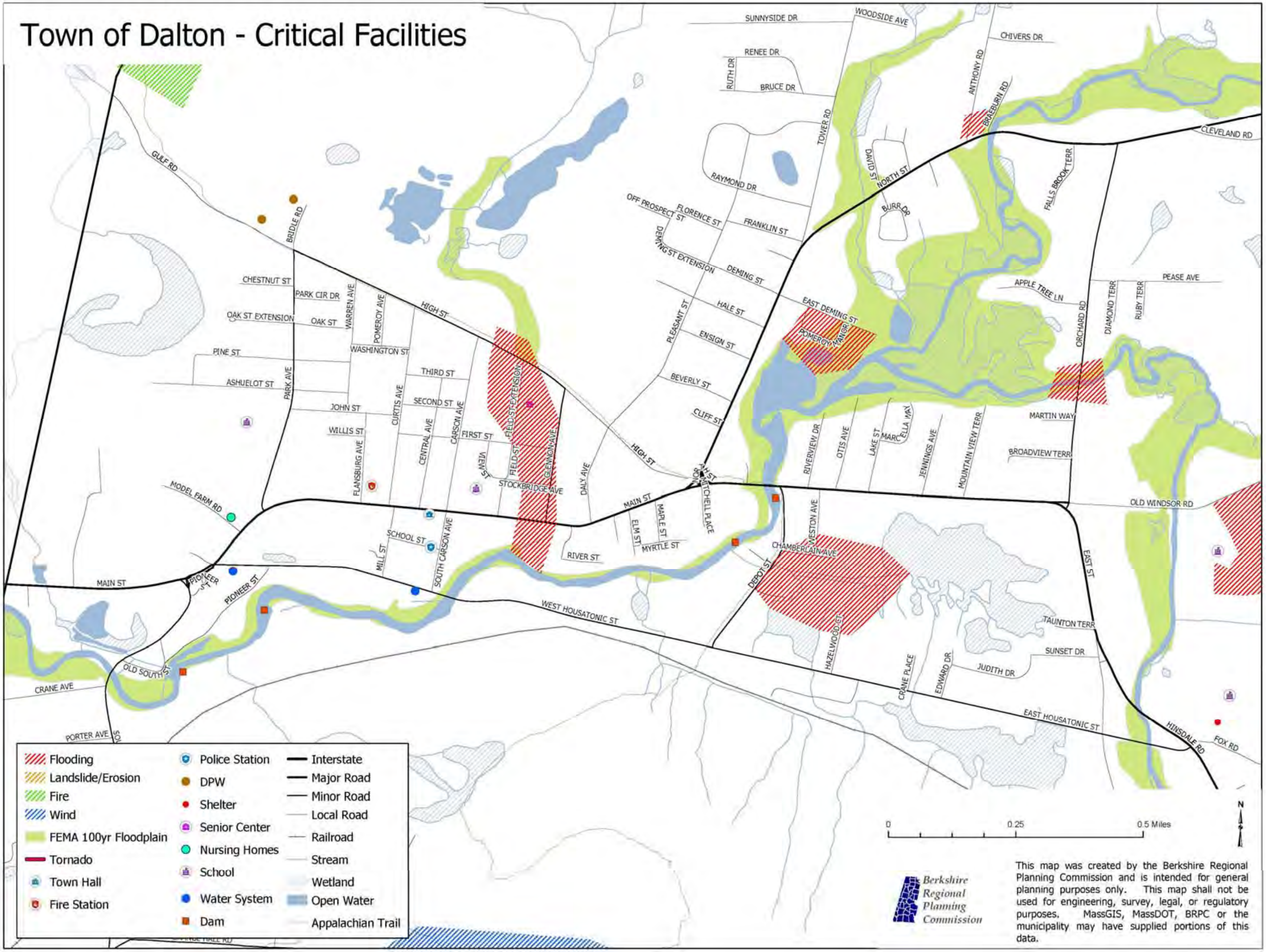
Town of Dalton - Critical Facilities



Berkshire Regional Planning Commission

This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

Town of Dalton - Critical Facilities



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APPENDIX B

HAZUS-MH Reports

HAZUS MH
EARTHQUAKE • WIND • FLOOD

Hazus-MH: Flood Global Risk Report

Region Name: Dalton

Flood Scenario: Flood100

Print Date: Monday, November 6, 2017

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 Flood. These results can be improved by using enhanced inventory data and flood hazard information.

FEMA

RiskMAP
Increasing Resilience Together

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). 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 flood loss estimates provided in this report were based on a region that included 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 22 square miles and contains 231 census blocks. The region contains over 3 thousand households and has a total population of 6,756 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 2,764 buildings in the region with a total building replacement value (excluding contents) of 833 million dollars (2010 dollars). Approximately 91.64% of the buildings (and 72.90% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,764 buildings in the region which have an aggregate total replacement value of 833 million (2014 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	607,252	72.9%
Commercial	67,383	8.1%
Industrial	129,908	15.6%
Agricultural	1,170	0.1%
Religion	12,116	1.5%
Government	2,709	0.3%
Education	12,415	1.5%
Total	**832,953**	**100.0%**

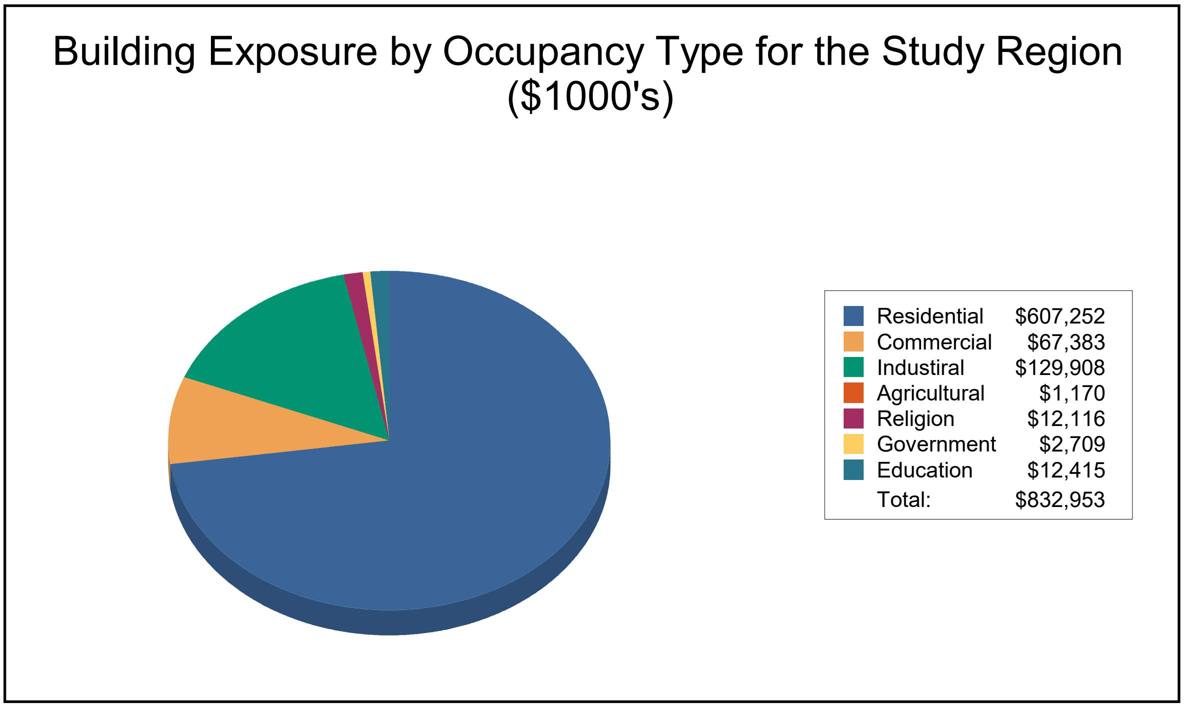
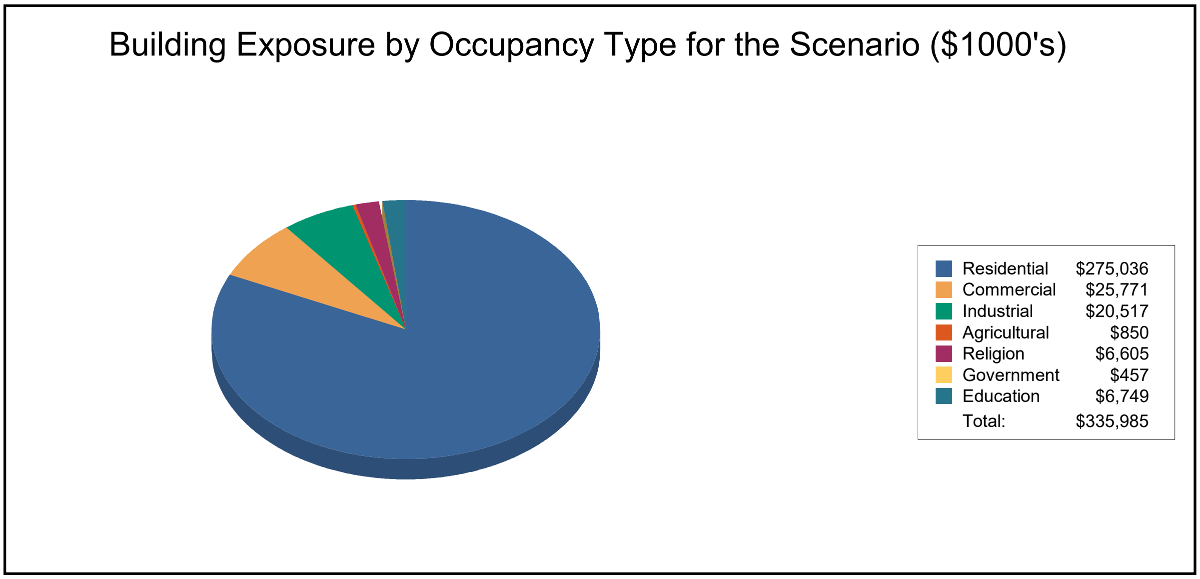


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	275,036	81.9%
Commercial	25,771	7.7%
Industrial	20,517	6.1%
Agricultural	850	0.3%
Religion	6,605	2.0%
Government	457	0.1%
Education	6,749	2.0%
Total	**335,985**	**100.0%**



Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 47 beds. There are 4 schools, 1 fire station, 1 police station and 1 emergency operation center.

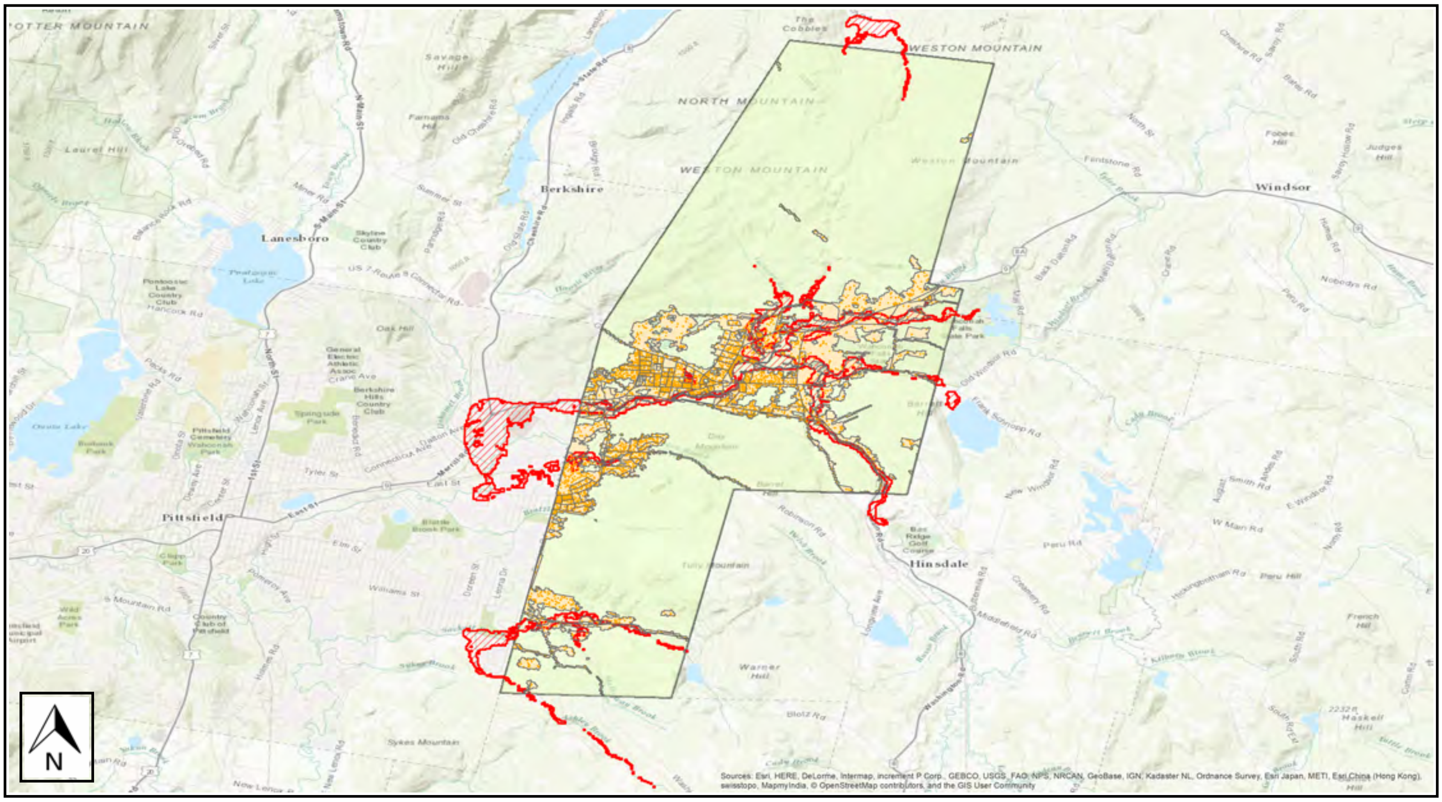
Flood Scenario Parameters

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

Study Region Name:	Dalton
Scenario Name:	Flood100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Building Damage

General Building Stock Damage

Hazus estimates that about 16 buildings will be at least moderately damaged. This is over 92% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

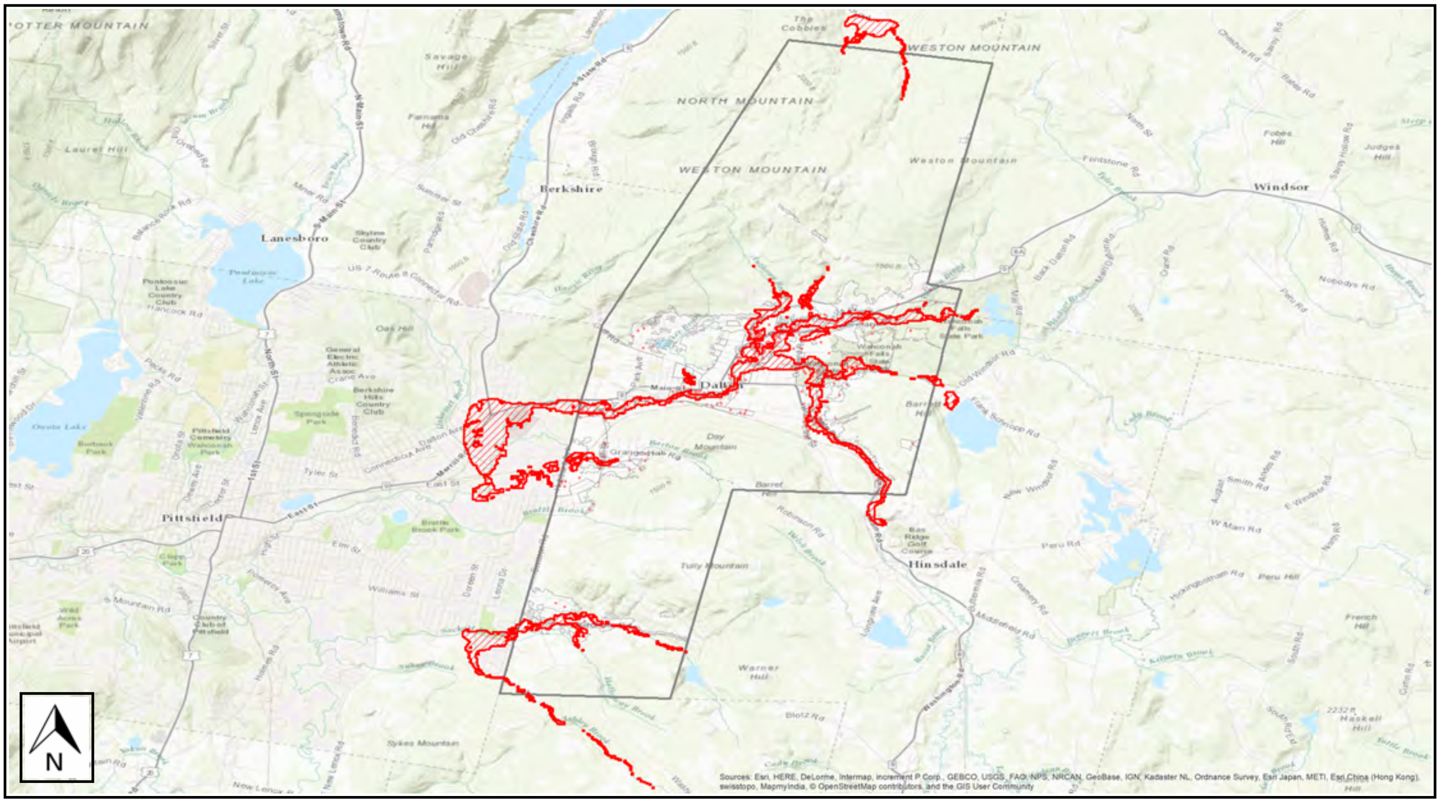


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	18	52.94	11	32.35	4	11.76	1	2.94	0	0.00	0	0.00
Total	**18**		**11**		**4**		**1**		**0**		**0**	

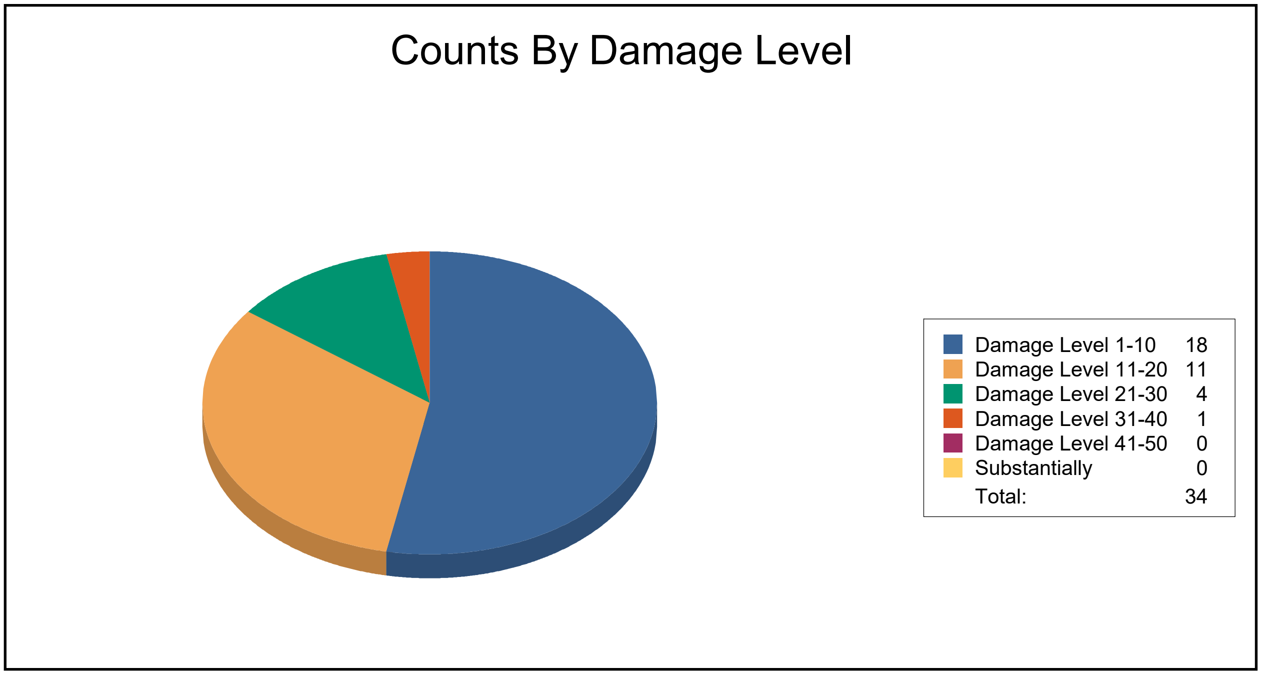


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	0	0	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	18	53	11	32	4	12	1	3	0	0	0	0

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 47 hospital beds available for use. On the day of the scenario flood event, the model estimates that 47 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	1	0	0	0
Police Stations	1	0	0	0
Schools	4	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

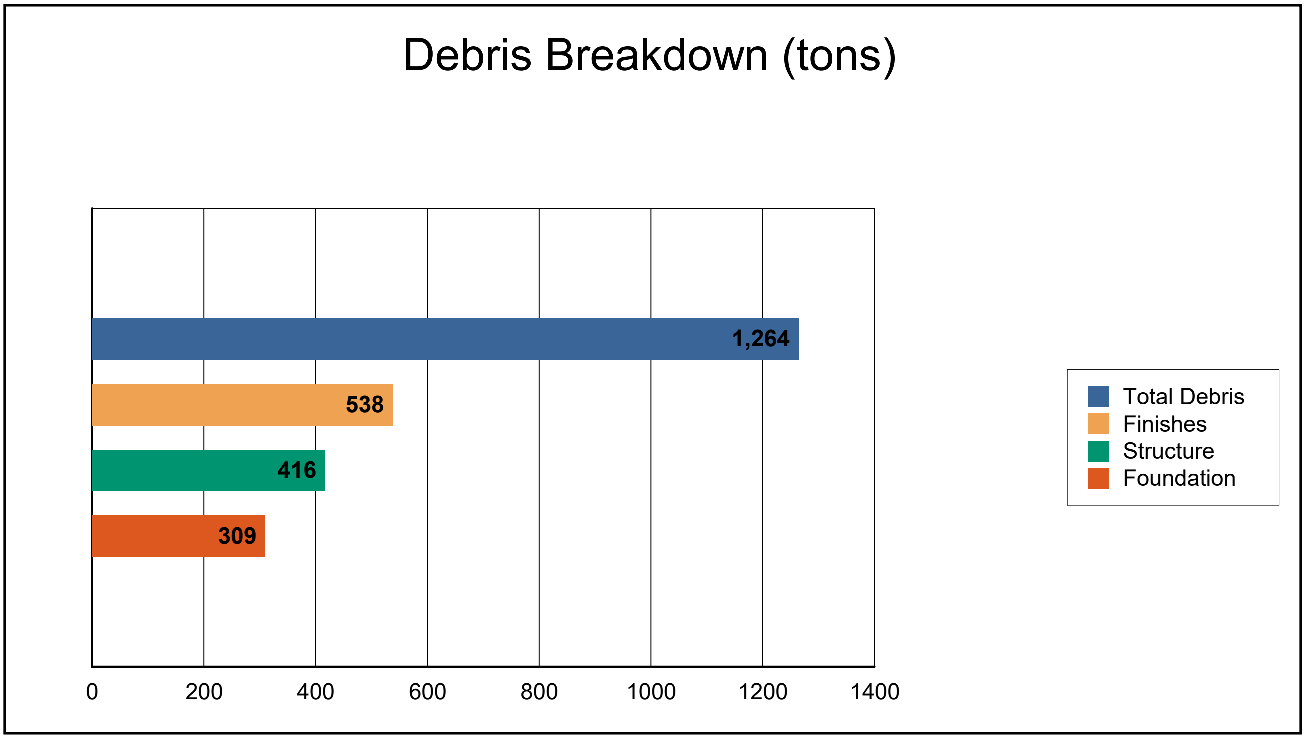
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

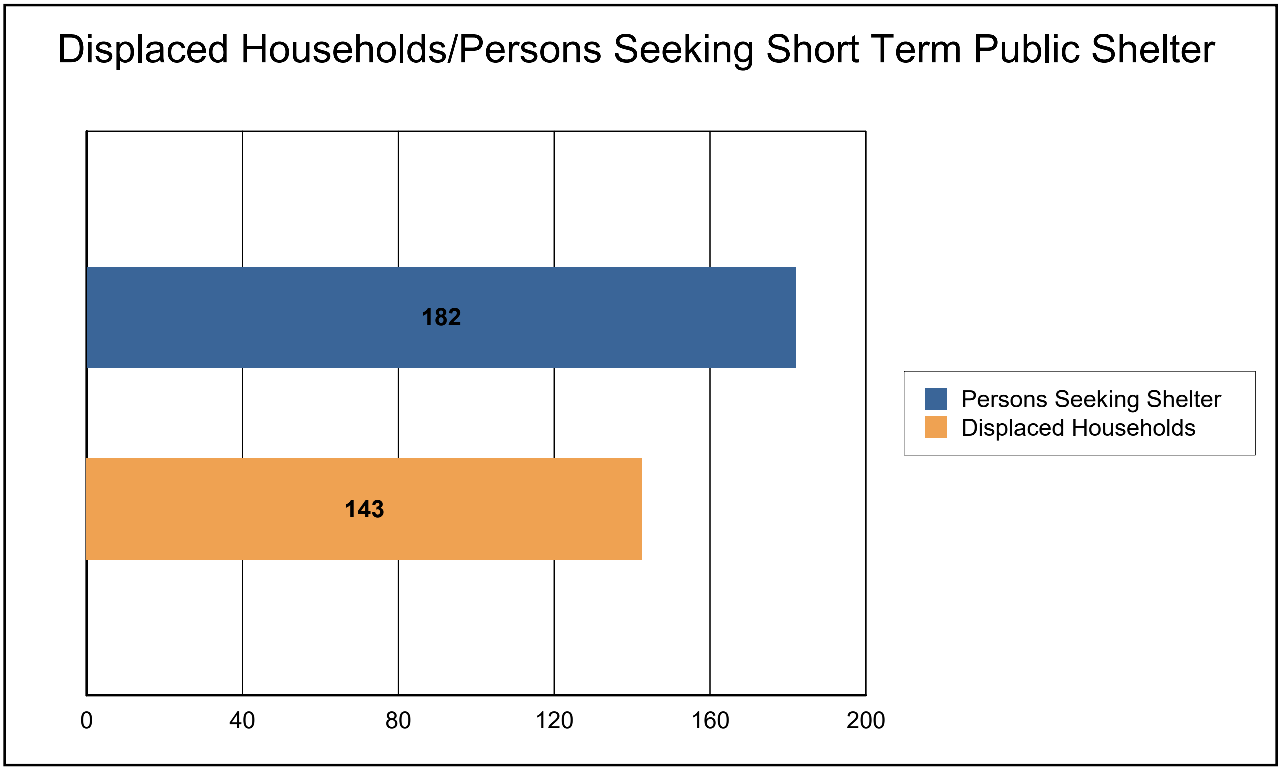


The model estimates that a total of 1,264 tons of debris will be generated. Of the total amount, Finishes comprises 43% of the total, Structure comprises 33% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 51 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 143 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 182 people (out of a total population of 6,756) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 15.06 million dollars, which represents 4.48 % of the total replacement value of the scenario buildings.

Building-Related Losses

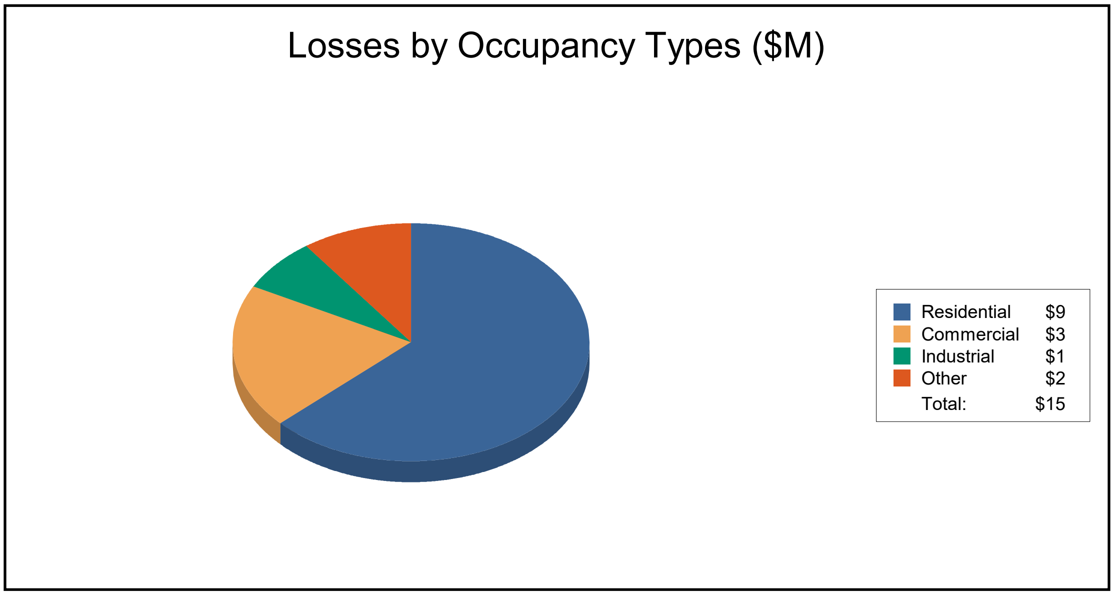
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability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

The total building-related losses were 15.04 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 62.97% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	6.61	0.74	0.40	0.19	7.94
	Content	2.87	2.19	0.61	1.31	6.98
	Inventory	0.00	0.03	0.09	0.00	0.12
	Subtotal	**9.48**	**2.96**	**1.10**	**1.50**	**15.04**
Business Interruption						
	Income	0.00	0.01	0.00	0.00	0.01
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.01	0.00	0.01	0.01
	Subtotal	**0.00**	**0.01**	**0.00**	**0.01**	**0.03**
ALL	**Total**	**9.48**	**2.97**	**1.10**	**1.51**	**15.06**



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	6,756	607,252	225,701	832,953
Total	**6,756**	**607,252**	**225,701**	**832,953**
Total Study Region	**6,756**	**607,252**	**225,701**	**832,953**

HAZUS MH
EARTHQUAKE • WIND • FLOOD

FEMA

Quick Assessment Report

RiskMAP
Increasing Resilience Together

November 6, 2017

Study Region : Dalton
Scenario : Flood100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	22
Number of Census Blocks	231
Number of Buildings	
Residential	2,533
Total	2,764
Number of People in the Region (x 1000)	7
Building Exposure ($ Millions)	
Residential	607
Total	833

Scenario Results

Shelter Requirements

Displaced Population (# Households)	143
Short Term Shelter (# People)	182

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	9
Total Property (Capital Stock) Losses ($ Millions)	15
Business Interruption (Income) Losses ($ Millions)	0

Disclaimer:

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 flood. These results can be improved by using enhanced inventory data and flood hazard information.

Hazus-MH: Hurricane Global Risk Report

Region Name: Dalton

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Thursday, November 2, 2017

Disclaimer:

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

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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.

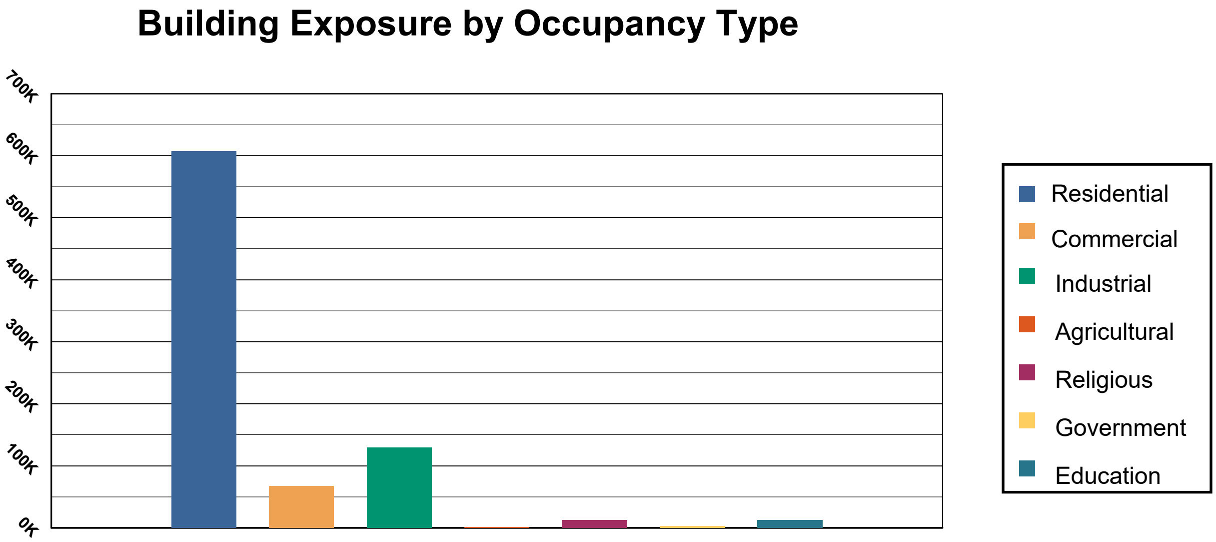
The geographical size of the region is 21.88 square miles and contains 1 census tracts. There are over 2 thousand households in the region and has a total population of 6,756 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 833 million dollars (2014 dollars). Approximately 92% of the buildings (and 73% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 2,764 buildings in the region which have an aggregate total replacement value of 833 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.



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Religious	12,116	1.45%
Government	2,709	0.33%
Education	12,415	1.49%
Total	**832,953**	**100.00%**

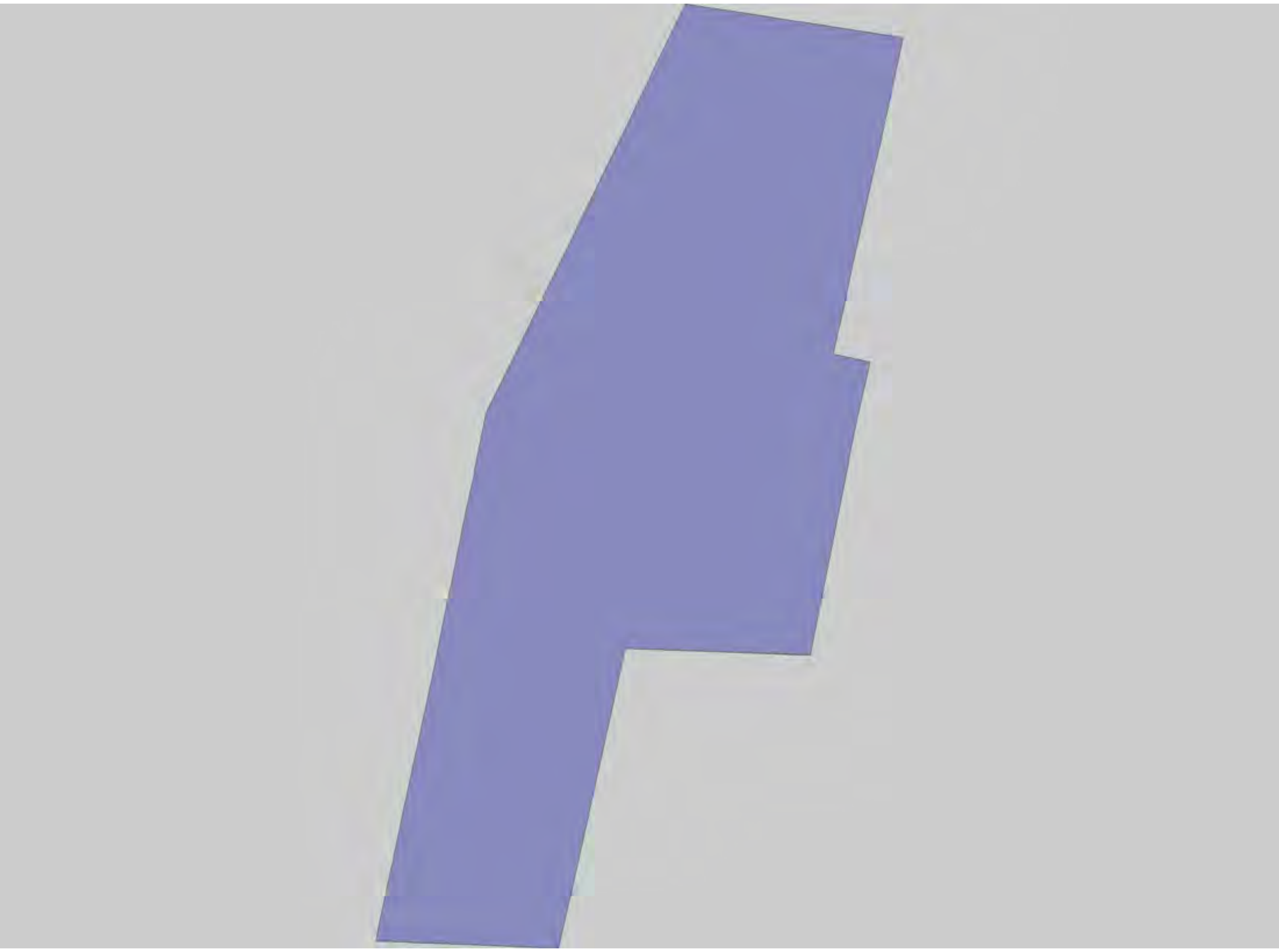
Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 47 beds. There are 4 schools, 1 fire stations, 1 police stations and 1 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.

Thematic Map with peak gust windfield and HU track



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 Volume 1: Chapter 6 of 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.

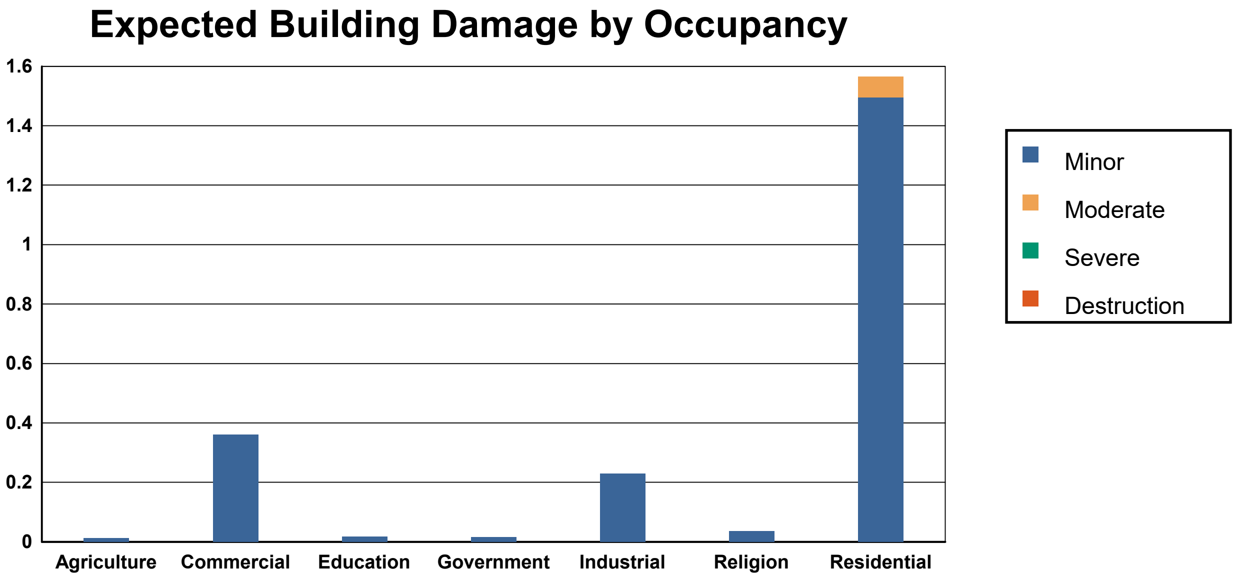


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	6	99.79	0	0.21	0	0.00	0	0.00	0	0.00
Commercial	129	99.72	0	0.28	0	0.00	0	0.00	0	0.00
Education	6	99.70	0	0.30	0	0.00	0	0.00	0	0.00
Government	5	99.68	0	0.32	0	0.00	0	0.00	0	0.00
Industrial	69	99.67	0	0.33	0	0.00	0	0.00	0	0.00
Religion	16	99.78	0	0.22	0	0.00	0	0.00	0	0.00
Residential	2,531	99.94	1	0.06	0	0.00	0	0.00	0	0.00
Total	**2,762**		**2**		**0**		**0**		**0**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	15	99.62	0	0.38	0	0.00	0	0.00	0	0.00
Masonry	134	99.59	1	0.39	0	0.02	0	0.00	0	0.00
MH	16	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	100	99.66	0	0.34	0	0.00	0	0.00	0	0.00
Wood	2,358	99.98	0	0.02	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 47 hospital beds available for use. On the day of the hurricane, the model estimates that 47 hospital beds (only 100.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

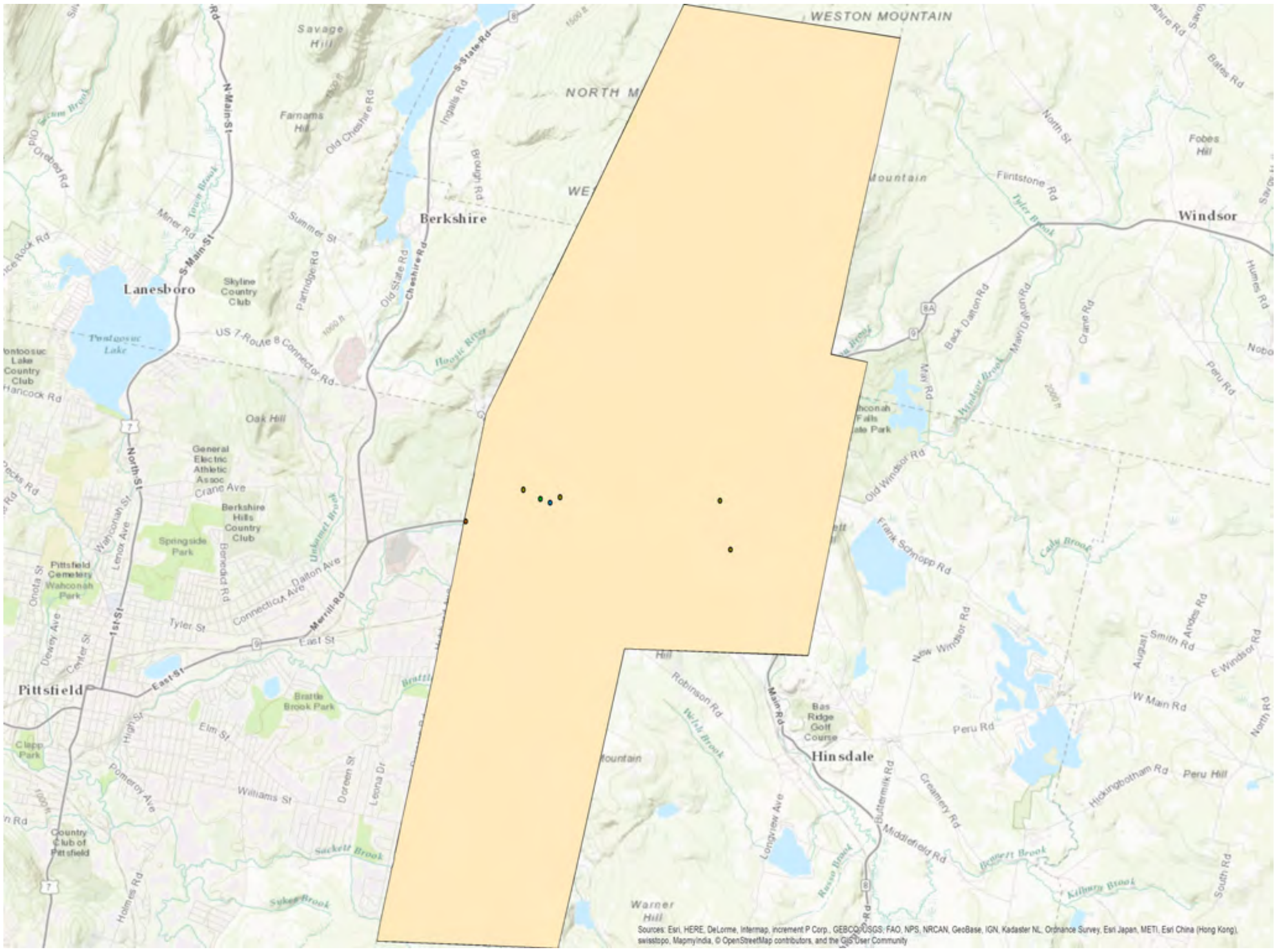
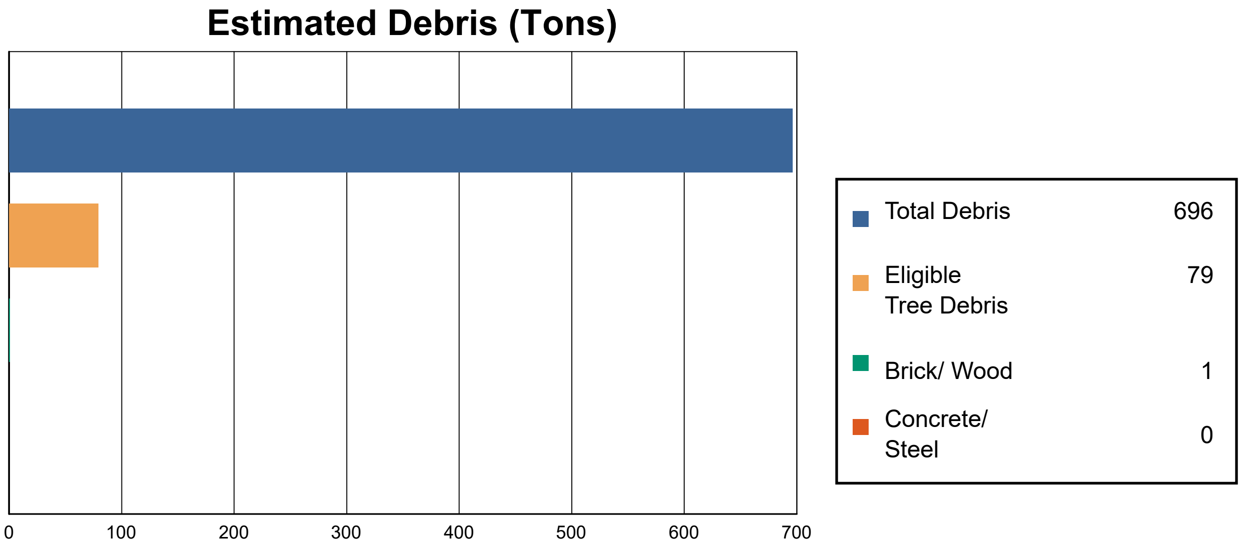

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, Mapmyindia, © OpenStreetMap contributors, and the GIS User Community

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
EOCs	1	0	0	1
Fire Stations	1	0	0	1
Hospitals	1	0	0	1
Police Stations	1	0	0	1
Schools	4	0	0	4

Induced Hurricane Damage

Debris Generation

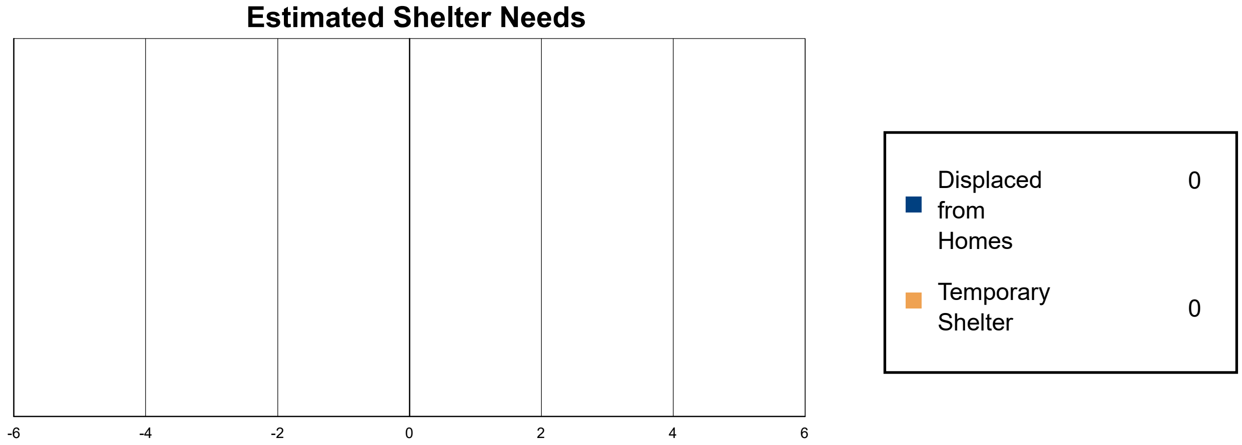


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 696 tons of debris will be generated. Of the total amount, 616 tons (89%) is Other Tree Debris. Of the remaining 80 tons, Brick/Wood comprises 1% 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 79 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 6,756) will seek temporary shelter in public shelters.

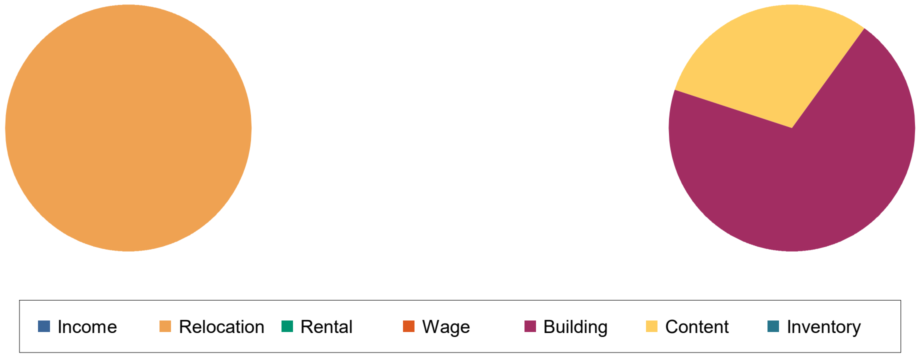
Economic Loss

The total economic loss estimated for the hurricane is 0.5 million dollars, which represents 0.06 % of the total replacement value of the region’s buildings.

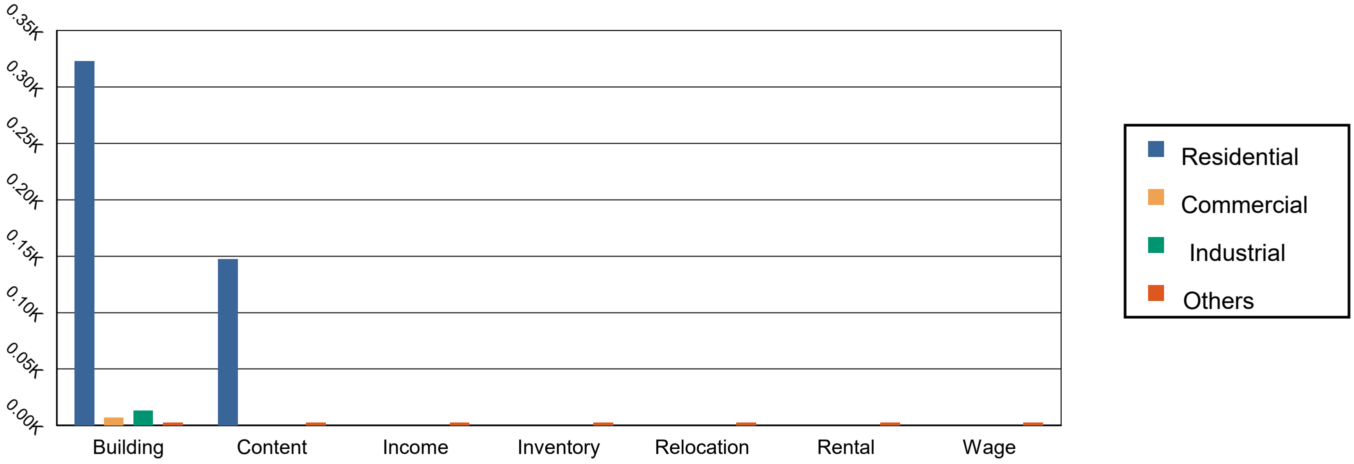
Building-Related Losses

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. 1% 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 95% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.



Total Loss by General Occupancy



Total Loss by Occupancy Type

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	323.28	6.74	12.99	2.72	345.74
	Content	147.36	0.00	0.00	0.00	147.36
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**470.65**	**6.74**	**12.99**	**2.72**	**493.10**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.11	0.00	0.00	0.00	0.11
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.11**	**0.00**	**0.00**	**0.00**	**0.11**
Total						
	Total	**470.76**	**6.74**	**12.99**	**2.72**	**493.21**

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	6,756	607,252	225,701	832,953
Total	**6,756**	**607,252**	**225,701**	**832,953**
Study Region Total	**6,756**	**607,252**	**225,701**	**832,953**

Quick Assessment Report

November 2, 2017

Study Region : Dalton

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	22
Number of Census Tracts	1
Number of People in the Region	6,756

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	2,533	607,252
Commercial	129	67,383
Other	102	158,318
Total	2,764	832,953

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	1	0	0	0	1
100	1	0	0	0	2
200	7	0	0	0	7
500	43	2	0	0	45
1000	108	6	0	0	115

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	1	0	0	0	1
100	2	0	0	0	2
200	8	0	0	0	9
500	46	2	0	0	48
1000	114	7	0	0	122

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption (Income) Losses*
ReturnPeriod	***Residential***	***Total***	
10	0	0	0
20	0	0	0
50	84	84	0
100	471	493	0
200	1,234	1,257	1
500	3,238	3,341	33
1000	5,287	5,569	156
Annualized	28	30	1

Disclaimer:

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.

Hazus-MH: Earthquake Global Risk Report

Region Name: Dalton

Earthquake Scenario: quake100

Print Date: November 06, 2017

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 is a regional earthquake 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 earthquake 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 earthquakes 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 21.88 square miles and contains 1 census tracts. There are over 2 thousand households in the region which has a total population of 6,756 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 2 thousand buildings in the region with a total building replacement value (excluding contents) of 832 (millions of dollars). Approximately 92.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 439 and 9 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 2 thousand buildings in the region which have an aggregate total replacement value of 832 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 86% 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 1 hospitals in the region with a total bed capacity of 47 beds. There are 4 schools, 1 fire stations, 1 police stations and 1 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as ‘high hazard’. The inventory also includes 0 hazardous material sites, 0 military installations and 0 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 448.00 (millions of dollars). This inventory includes over 69 kilometers of highways, 12 bridges, 458 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

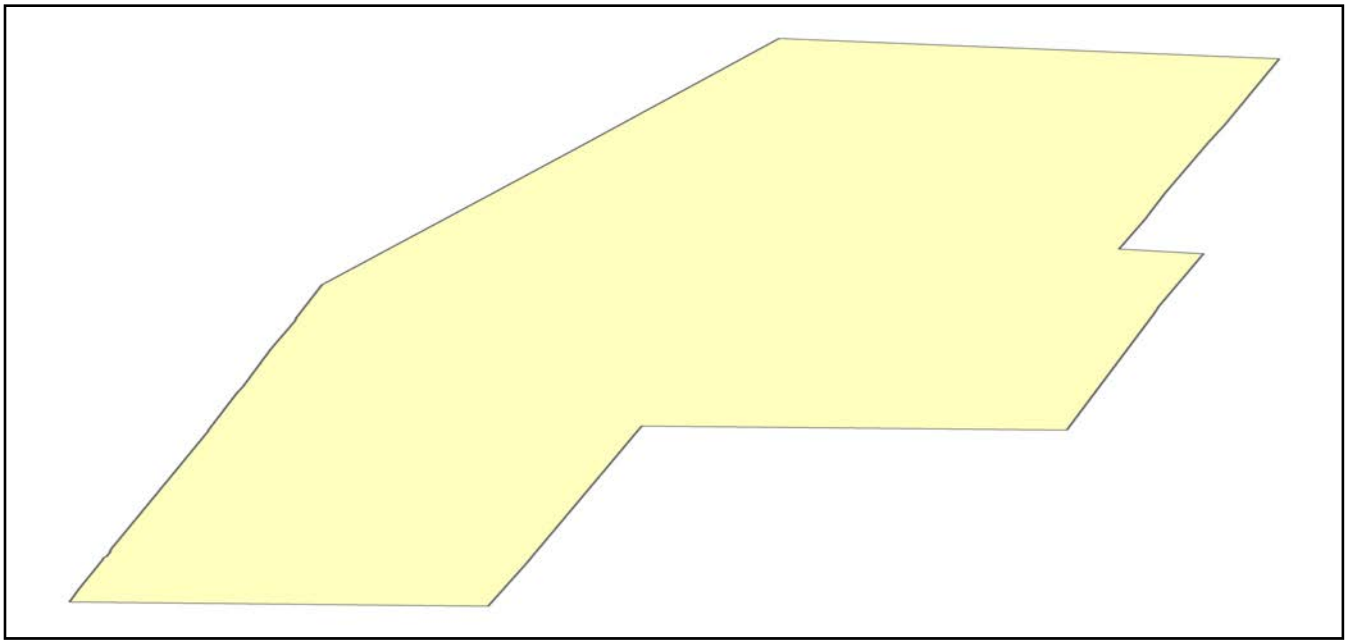
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	12	60.60
	Segments	16	354.80
	Tunnels	0	0.00
		Subtotal	**415.50**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	3	23.20
	Tunnels	0	0.00
		Subtotal	**23.20**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**439.90**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.60**
Waste Water	Distribution Lines	NA	2.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.80**
Natural Gas	Distribution Lines	NA	1.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.80**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**9.20**

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	quake100
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	100.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 1 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 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

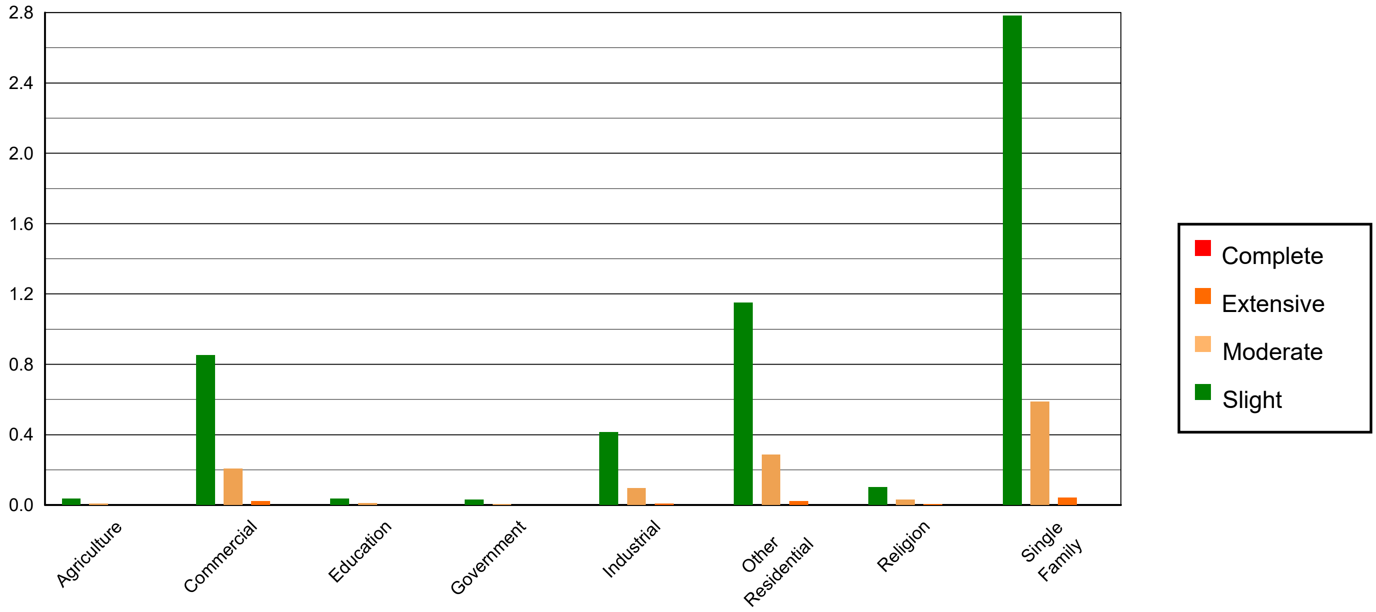


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	6	0.22	0	0.66	0	0.61	0	0.74	0	0.00
Commercial	128	4.64	1	15.78	0	16.72	0	20.68	0	0.00
Education	6	0.22	0	0.67	0	0.69	0	0.83	0	0.00
Government	5	0.18	0	0.54	0	0.53	0	0.58	0	0.00
Industrial	68	2.48	0	7.67	0	7.89	0	8.79	0	0.00
Other Residential	205	7.42	1	21.31	0	23.38	0	20.78	0	0.00
Religion	16	0.58	0	1.89	0	2.36	0	3.27	0	0.00
Single Family	2,324	84.27	3	51.48	1	47.82	0	44.33	0	0.00
Total	**2,757**		**5**		**1**		**0**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2,380	86.33	2	32.40	0	19.36	0	0.00	0	0.00
Steel	113	4.09	1	10.13	0	8.38	0	5.95	0	0.00
Concrete	22	0.82	0	1.79	0	1.24	0	0.03	0	0.00
Precast	8	0.29	0	1.48	0	2.69	0	3.86	0	0.00
RM	34	1.22	0	3.16	0	4.33	0	5.53	0	0.00
URM	173	6.29	2	43.00	1	56.49	0	84.63	0	0.00
MH	26	0.96	0	8.04	0	7.52	0	0.00	0	0.00
Total	**2,757**		**5**		**1**		**0**		**0**	

*Note:

RM	Reinforced Masonry
URM	Unreinforced Masonry
MH	Manufactured Housing

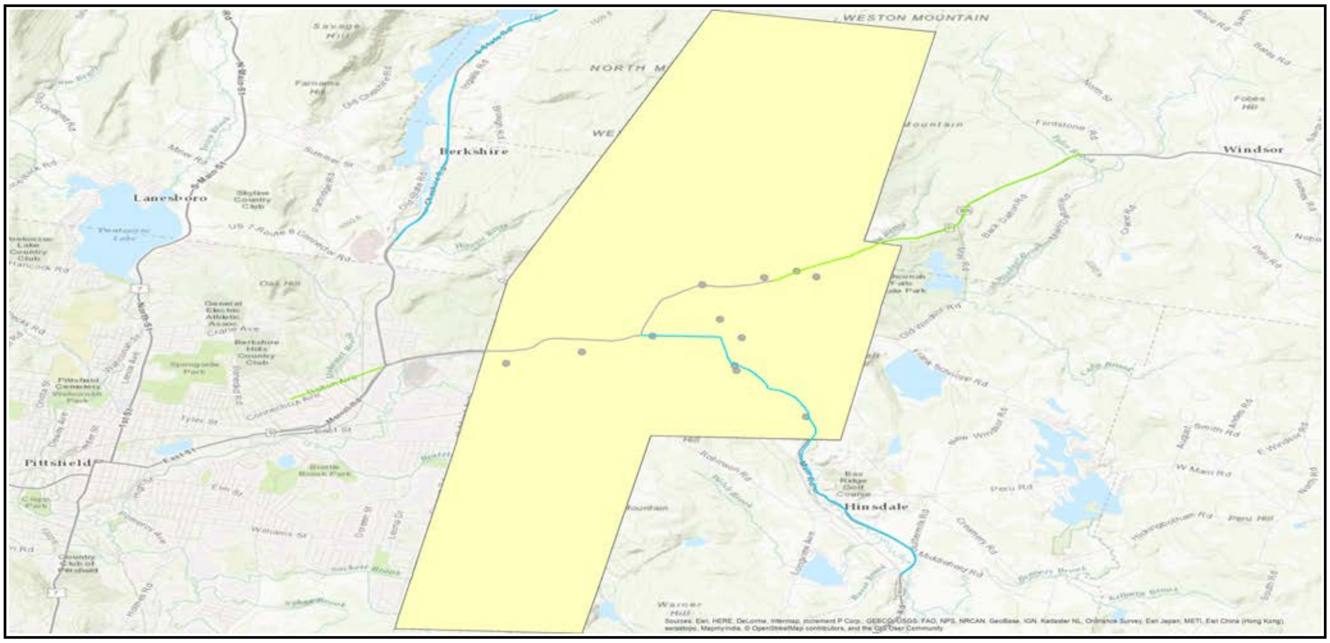
Essential Facility Damage

Before the earthquake, the region had 47 hospital beds available for use. On the day of the earthquake, the model estimates that only 45 hospital beds (98.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 99.00% of the beds will be back in service. By 30 days, 100.00% 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	1	0	0	1
Schools	4	0	0	4
EOCs	1	0	0	1
PoliceStations	1	0	0	1
FireStations	1	0	0	1

Transportation Lifeline Damage



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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	16	0	0	12	12
	Bridges	12	0	0	12	12
	Tunnels	0	0	0	0	0
Railways	Segments	3	0	0	2	2
	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	1	0	0	1	1
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 (kms)	Number of Leaks	Number of Breaks
Potable Water	229	0	0
Waste Water	138	0	0
Natural Gas	92	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of	Number of Households without Service				
	Households	At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	2,737	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 77.00% 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 0 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	0 (@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 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 6,756) 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
0	0

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	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

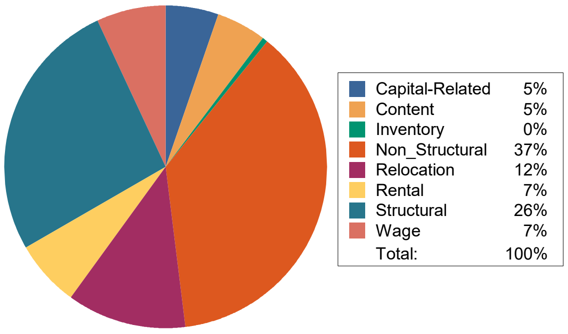
The total economic loss estimated for the earthquake is 0.10 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 0.09 (millions of dollars); 31 % 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 48 % 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)

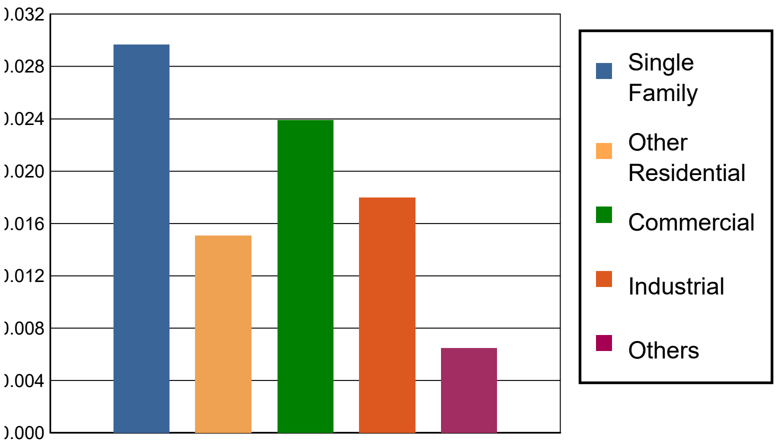


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.00	0.00	0.00	0.01
	Capital-Related	0.00	0.00	0.00	0.00	0.00	0.01
	Rental	0.00	0.00	0.00	0.00	0.00	0.01
	Relocation	0.00	0.00	0.00	0.00	0.00	0.01
	Subtotal	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.03**
Capital Stock Losses							
	Structural	0.01	0.00	0.00	0.01	0.00	0.02
	Non_Structural	0.02	0.01	0.00	0.00	0.00	0.03
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.03**	**0.01**	**0.01**	**0.01**	**0.00**	**0.06**
	Total	**0.03**	**0.02**	**0.02**	**0.02**	**0.01**	**0.09**

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	354.83	$0.00	0.00
	Bridges	60.62	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**415**	**0.00**	
Railways	Segments	23.19	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**23**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Bus	Facilities	1.26	$0.00	0.13
	Subtotal	**1**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
	Total	**439.90**	**0.00**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.60	$0.00	0.00
	Subtotal	**4.58**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	2.80	$0.00	0.00
	Subtotal	**2.75**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.80	$0.00	0.00
	Subtotal	**1.83**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**9.17**	**$0.00**	

Appendix A: County Listing for the Region

Berkshire,MA

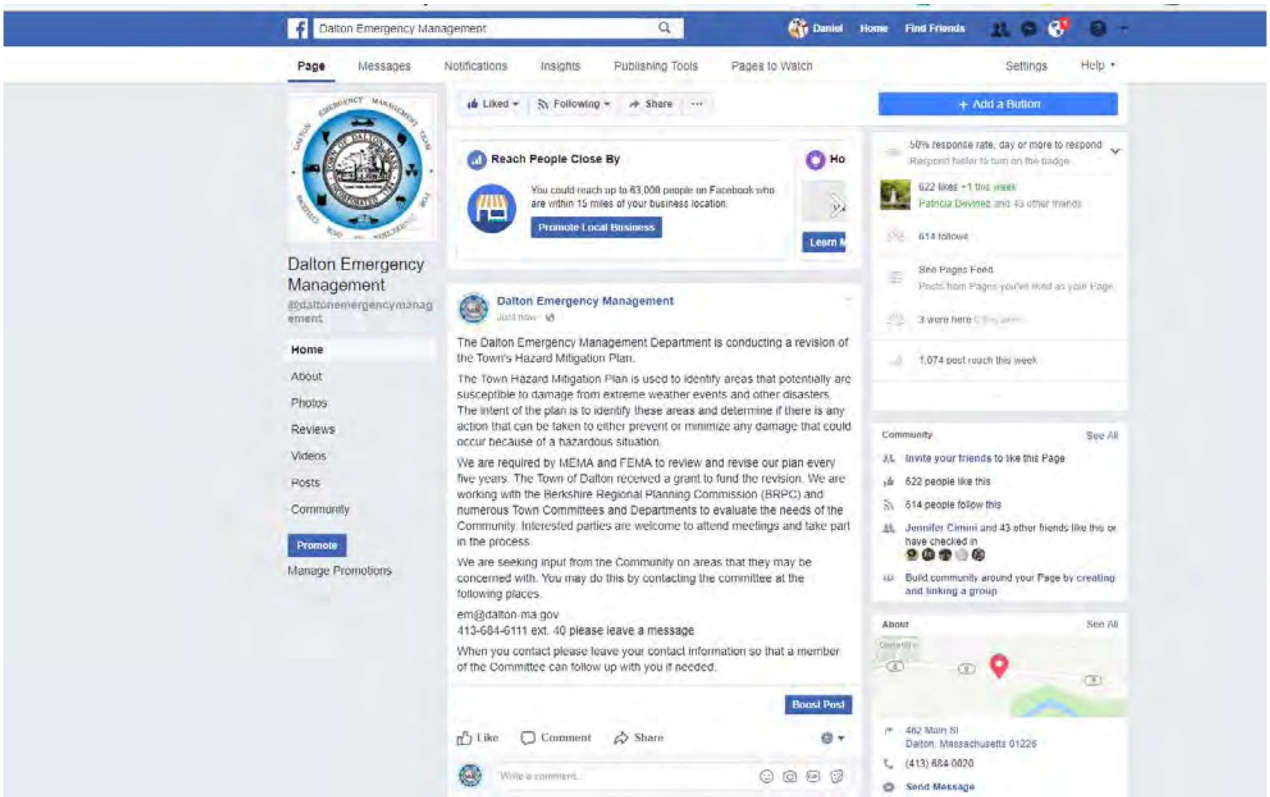
Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Berkshire	6,756	607	225	832
Total State		**6,756**	**607**	**225**	**832**
Total Region		**6,756**	**607**	**225**	**832**

APPENDIX C

Public Outreach

The Dalton EMD Facebook Page kept town residents updated on the progress of plan development, promoted the public forum held on June 12, 2018, and solicited review and input in September 2018.



Dalton Emergency Management

Just now

The Dalton Emergency Management Department is conducting a revision of the Town's Hazard Mitigation Plan.

The Town Hazard Mitigation Plan is used to identify areas that potentially are susceptible to damage from extreme weather events and other disasters. The intent of the plan is to identify these areas and determine if there is any action that can be taken to either prevent or minimize any damage that could occur because of a hazardous situation.

We are required by MEMA and FEMA to review and revise our plan every five years. The Town of Dalton received a grant to fund the revision. We are working with the Berkshire Regional Planning Commission (BRPC) and numerous Town Committees and Departments to evaluate the needs of the Community. Interested parties are welcome to attend meetings and take part in the process.

We are seeking input from the Community on areas that they may be concerned with. You may do this by contacting the committee at the following places.

em@dalton-ma.gov
413-684-6111 ext. 40 please leave a message

When you contact please leave your contact information so that a member of the Committee can follow up with you if needed.

This announcement was sent through the EMD Facebook promoting the Public Forum of June 12, 2018:

Dalton Emergency Management

33 mins ·

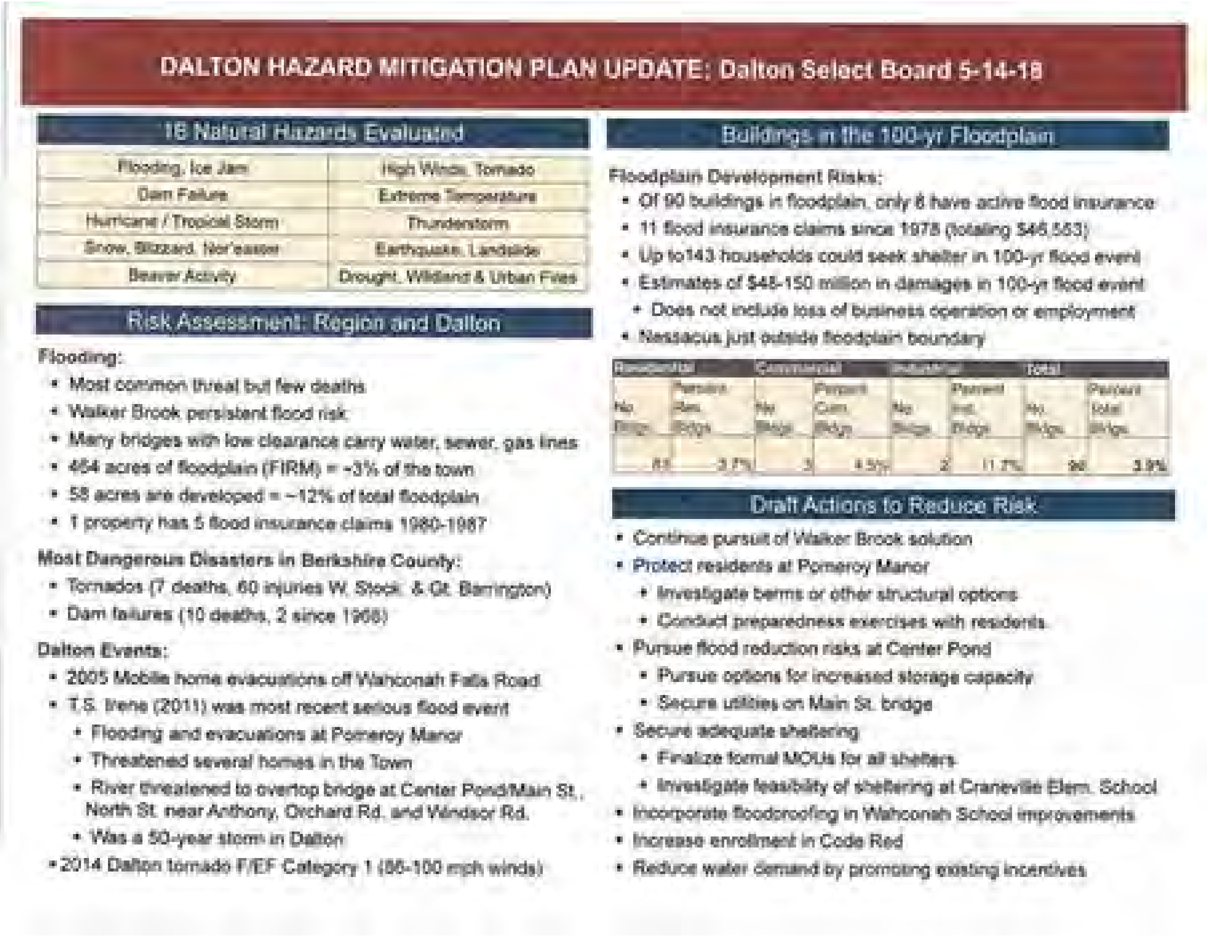
On June 12th at 7:00 p.m. there will be a PUBLIC FORUM on The Dalton Hazard Mitigation Plan in the Callahan Room of the Town Hall. This PUBLIC FORUM is open to all citizens of Dalton.

There will be a short presentation of the updated Hazard Mitigation Plan followed by a question and answer period. Everyone is invited to attend and provide input to the committee.

The Hazard Mitigation Plan is a document that the Town of Dalton is required to have in order to be provided funding through MEMA and FEMA. This document details areas of within the community that are susceptible to damage from Natural Hazards such as flooding and Tornadoes. The Plan must be updated every four years and requires public input.

Questions on the plan and the Forum can be directed to Daniel Filiault at em@dalton-ma.gov or through this website.

The attached document details some of the information that the committee has developed for your review.



DALTON HAZARD MITIGATION PLAN UPDATE: Dalton Select Board 5-14-18

16 Natural Hazards Evaluated

Flooding, Ice Jam	High Winds, Tornado
Dam Failure	Extreme Temperature
Hurricane / Tropical Storm	Thunderstorm
Snow, Blizzard, Nor'easter	Earthquake, Landslide
Beaver Activity	Drought, Wildland & Urban Fires

Risk Assessment: Region and Dalton

Flooding:

- Most common threat but few deaths
- Walker Brook persistent flood risk
- Many bridges with low clearance carry water, sewer, gas lines
- 464 acres of floodplain (FIRM) = ~3% of the town
- 58 acres are developed = ~12% of total floodplain
- 1 property has 5 flood insurance claims 1980-1987

Most Dangerous Disasters in Berkshire County:

- Tornados (7 deaths, 60 injuries W. Stock. & Gt. Barrington)
- Dam failures (10 deaths, 2 since 1968)

Dalton Events:

- 2005 Mobile home evacuations off Wahconah Falls Road
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  - Flooding and evacuations at Pomeroy Manor
  - Threatened several homes in the Town
  - River threatened to overtop bridge at Center Pond/Main St., North St. near Anthony, Orchard Rd. and Windsor Rd.
  - Was a 50-year storm in Dalton
- 2014 Dalton tornado F/EF Category 1 (86-100 mph winds)

Buildings in the 100-yr Floodplain

Floodplain Development Risks:

- Of 90 buildings in floodplain, only 6 have active flood insurance
- 11 flood insurance claims since 1978 (totaling $46,563)
- Up to143 households could seek shelter in 100-yr flood event
- Estimates of $48-150 million in damages in 100-yr flood event
  - Does not include loss of business operation or employment
- Nessacus just outside floodplain boundary

Residential		Commercial		Industrial		Total	
No. Bldgs	Percent Res. Bldgs	No. Bldgs	Percent Com. Bldgs	No. Bldgs	Percent Ind. Bldgs	No. Bldgs	Percent Total Bldgs
83	3.7%	5	4.5%	2	11.7%	90	3.9%

Draft Actions to Reduce Risk

- Continue pursuit of Walker Brook solution
- Protect residents at Pomeroy Manor
  - Investigate berms or other structural options
  - Conduct preparedness exercises with residents
- Pursue flood reduction risks at Center Pond
  - Pursue options for increased storage capacity
  - Secure utilities on Main St. bridge
- Secure adequate sheltering
  - Finalize formal MOUs for all shelters
  - Investigate feasibility of sheltering at Craneville Elem. School
- Incorporate floodproofing in Wahconah School improvements
- Increase enrollment in Code Red
- Reduce water demand by promoting existing incentives

The homepage of the Town of Dalton's website promoted the Public Forum held on June 12, 2018 and solicited review and comment on the draft Hazard Mitigation Plan in September 2018.

Welcome to the Town of Dalton's official Web site

This site has two purposes: to provide Dalton residents with a convenient information resource, and to describe our Town's many attractions for those who may be considering visiting or moving here. Check back often, as new information is continually being added.

DALTON SPECIAL TOWN MEETING
25 June 2018, 7:00 P.M.
Nessacus Regional Middle School
WARRANT IS POSTED FOR DOWNLOAD

DALTON HAZARD MITIGATION PLAN

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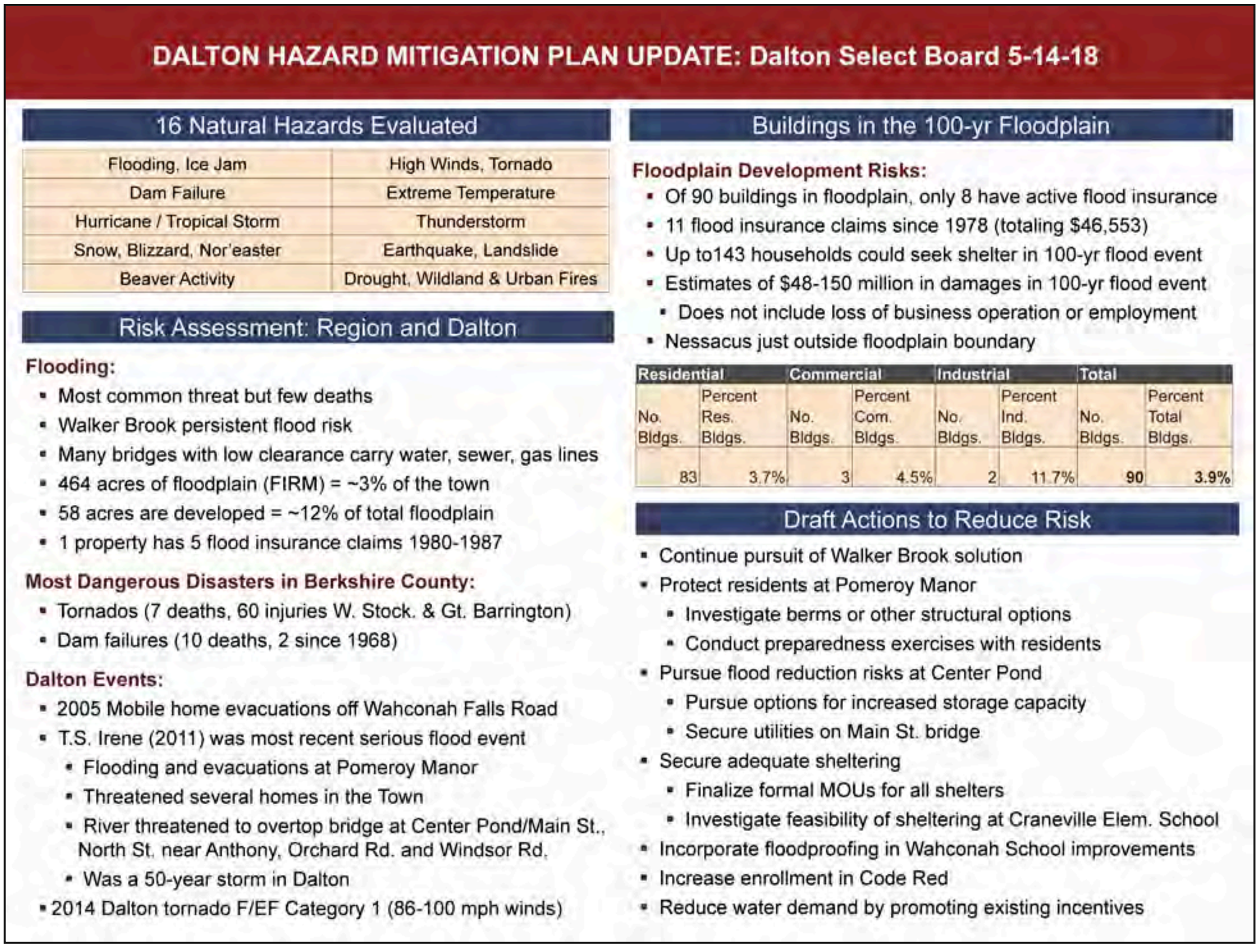
1-day Alcohol License permit

Document available for download below or available for download on the Town Manager link
New Application Form Changes

The Poster used in a Major Findings presentation to Dalton Select Board May 14, 2018. This meeting was televised and the June 12 Public Forum was advertised during this meeting.



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  - Investigate feasibility of sheltering at Craneville Elem. School
- Incorporate floodproofing in Wahconah School improvements
- Increase enrollment in Code Red
- Reduce water demand by promoting existing incentives

Public Forum, June 12, 2018.

This forum included a presentation on the Major Findings that emerged from the Dalton Multi-Hazard Mitigation Plan Update, the Major Findings poster presented to the Dalton Select Board on May 14 (previous page), the Hazard Mitigation Map (see Appendix A), and a handout of the Draft Action Plan. The presentation and handout are displayed on the following pages.

Natural Hazard Mitigation Plan Update

Town of Dalton

June 12, 2018

Hazard Mitigation – What and Who?

Hazard Mitigation Plan Update:

- Gather historical data on past events in the region and in Dalton
- Assesses the vulnerability of a community to the natural hazards / disasters
- Describes activities that can be done to mitigate the hazards before they occur
- Mitigation Plan 5-Year Update is a requirement to maintain eligibility for some FEMA funds
- Consider weather pattern observations and climate change projections

Dalton Emergency Management Advisory Council

- Town officials, Water Dept., first responders, business sector

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Natural Hazards Evaluated for Dalton

Most Dangerous Disasters in Berkshire County:

- Tornados (7 deaths, 60 injuries W. Stock. & Gt. Barrington)
- Dam failures (10 deaths, 2 since 1968)
- Floods (2 deaths, many injuries)

Hazards Evaluated	
Flood	Tornado
Dam Failure	Extreme Temperature
Hurricane / Tropical Storm	Drought
Nor'easter	Wildland Fire
Snow & Blizzard	Major Urban Fire
Ice Storm	Earthquake
Thunderstorm	Landslide
High Winds	Ice Jam
Beaver Activity	

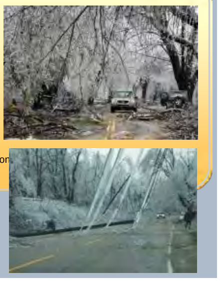
Ice Storm December 2008

- **Loss of electricity for 1+ million customers**
- **>500,000 lost power during peak of storm, some for > 2 weeks**
- **FEMA obligates >$32 million in Mass.**
  - \+ State costs >$7 million
  - \+ Municipal costs >$5 million
  - \+ National Grid claims damages of >$30 million
  - \+ Small businesses without electricity "lose tens of millions of dollars"*

Impacts of the Ice Storm of December 2008

om December 11 through December 13, 2008, central, western, and northern ssachusetts experienced a severe ice storm, which caused devastation over almost 7,000 iare miles. The storm damage affected the energy and transportation infrastructure, nes and schools, and even the Appalachian Trail. Over one million customers were pacted by power outages with over 550,000 customers losing their electricity at the peak he storm, and some for up to two weeks. This also caused additional damage, such as zen water pipes in commercial and residential properties, as well as lost revenue. untless trees were damaged, with downed trees and tree limbs blocking roads, damaging perty and bringing down power lines.

e storm was very costly—the Federal Emergency Management Agency (FEMA) obligated r $32 million for reimbursement to seven Massachusetts counties for eligible costs; te costs exceeded $7 million and municipalities expended over $5 million. National Grid, on a, claimed over $30 million in storm-related costs.



** MA Climate Change Action Plan*

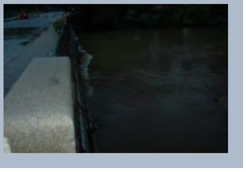
T.S. Irene 2011

- 500,000+ MA residents without electricity
- >100-year flood in Hoosic River
- **50-year storm on the Housatonic River**
- Dubbed the "costliest Category 1 storm" ($15.8 billion in damages)
- Fed. Disaster in MA: FEMA $5.6 million to households, $30 million for public assistance
- Fed. Highways: $46 million for roads and bridges, much of it for Rt 2

Irene @ Rt. 2 and Shelburne Falls

Dalton Emergency Events

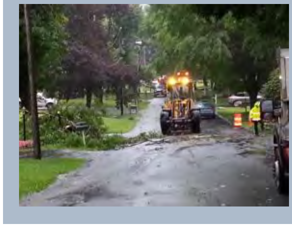
- **2005 Mobile home evacuations off Wahconah Falls Road**
- **2011 T.S. Irene was most recent serious flood event**
  - Flooding and evacuations at Pomeroy Manor
  - Threatened several homes in the Town
  - River threatened to overtop bridges
  - Was a 50-year storm in Dalton

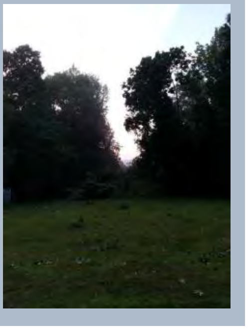


T.S. Irene 2011

Tornado 2014

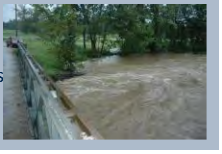
F/EF Category 1 (86-100 mph winds)





Flood Concerns around Dalton

- Flooding is the most common and widespread natural hazard
- Approx. 4 miles of roadway travel through floodplain
- Some bridges with low clearance carry water, sewer, gas lines
- Center Pond = flood threat to Pomeroy Manor, Main St. Bridge
- Walker Brook persistent flood risk
- Some Crane Co. buildings in floodplain
- Flooding on Wahconah High School fields



Floodplain Vulnerability in Dalton

- 58 acres of floodplain are developed = ~12% of total floodplain
- 90 Buildings in Dalton are in the 100-yr floodplain (BRPC 2017)
- 83 are residential homes, many found around Center Pond and its associated tributaries and wetlands
- There are 2 repetitive flood insurance claims in town since 1978
- Only 8 properties have active flood insurance policies
- Estimated $48 - $150 million in damages in 100-yr flood event*

**Does not include loss of business operation, layoffs, unemployment*

Flood-plain Mapping

Same Building 2010 – 50-yr storm

Other Concerns around Dalton

Power outages:
- Vulnerable populations scattered

Sheltering:
- Nessacus is main shelter but just outside floodplain boundary
- Regional shelter at BCC – accessible in 100-yr storm?

Dam Failures:
- Low risk of occurrence, but high potential loss of life, injury and property

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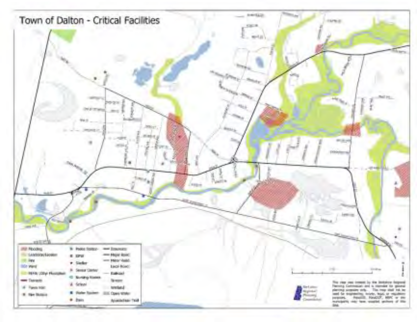
Where are Greatest Risks?



Key Observed Climate Changes in MA

Strong Storms: 71% Since 1958

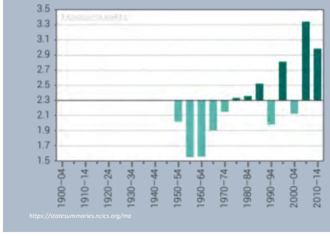
Growing Season: 10 Days Since 1950

Temperature: 2.8°F since 1895 (7-10°F by 2100) Berk. temp. up 1.7°F since 1960

Observed No. Extreme Precip. Events

- Number of Events w/ Precipitation > 2” in 1 day

  “Stepped Increase” in 1970-80s, and continues



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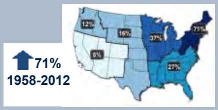
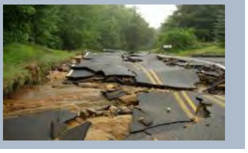
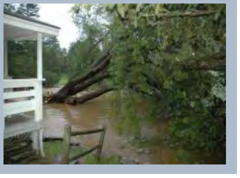




Where can we reasonably focus our Mitigation Efforts?

- **Flooding is our prime target**
  - Several hazards result in flooding (hurricanes, thunderstorms, snow, ice jams, dam failure)
  - Severe rain events cause localized flooding
  - Predictable boundaries (but needs adjustment)
  - Relative ease of implementing mitigation measures
  - Focus of grant programs
  - Local bylaws and zoning offer local control



Draft Actions to Reduce Risk

- Continue pursuit of Walker Brook solution – *in progress*
- Protect residents at Pomeroy Manor
  - Investigate berms or other structural options
  - Conduct preparedness exercises with residents
- Pursue flood reduction risks at Center Pond
  - Pursue options for increased storage capacity
- Assess condition of bridges and their infrastructure for risk; prioritize improvement projects – *in progress*

Draft Actions to Reduce Risk

- Secure adequate sheltering – *in progress*
  - Finalize formal MOUs for all shelters
  - Investigate feasibility of sheltering at Craneville Elem. School
  - Retrofit Senior Center for back up power
- Increase enrollment in Code Red
- Reduce water demand by promoting conservation incentives

Now it's Your Turn!

Provide comments to town officials and first responders:

- Did we get it right?
- Are we missing anything?
- Which actions should be prioritized?

Now it's Your Turn!

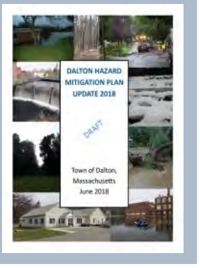
Review the Plan Here:

http://berkshireplanning.org/projects/dalton-hazard-mitigation

Provide comments to:

Lauren Gaherty, Berkshire Regional Planning: lgaherty@berkshireplanning.org

Dan Filiault, Dalton Emergency Management Dir: EM@dalton-ma.gov

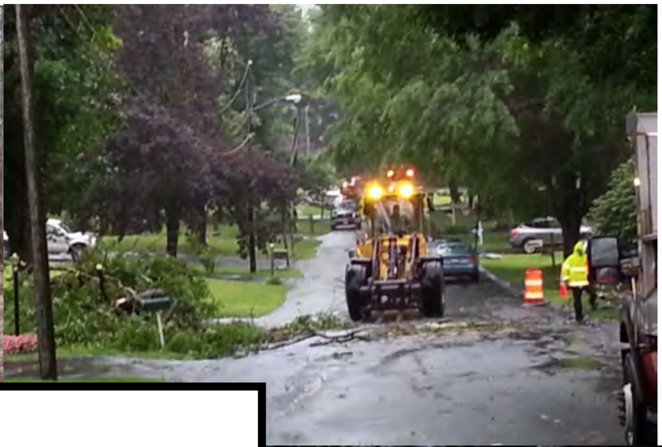


DALTON HAZARD MITIGATION PLAN UPDATE 2018

DRAFT

Town of Dalton, Massachusetts
June 2018



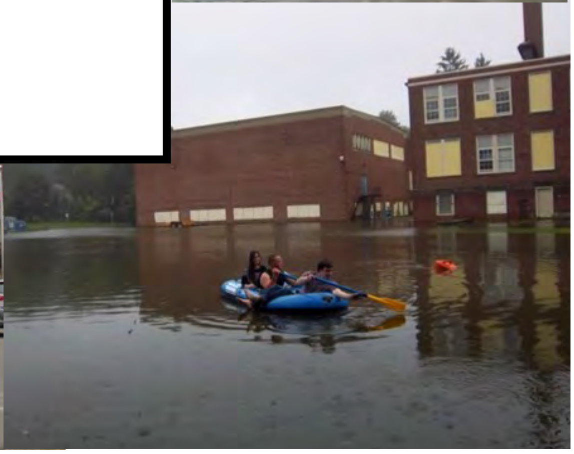



DALTON HAZARD MITIGATION PLAN UPDATE 2018

Town of Dalton,
Massachusetts
June 2018







Dear Dalton Resident –

Thank you for attending the Public Forum on June 12th, in which we discussed the major findings of our work in updating Dalton's Hazard Mitigation Plan. Starting on June 13th you can view the draft plan here: http://berkshireplanning.org/projects/dalton-hazard-mitigation . We welcome your thoughts and input as we put the finishing touches on it. We are accepting public input through June 29, 2018.

Comments on the draft plan can be submitted to Dan Filiault, Dalton Emergency Management Director, at EM@dalton-ma.gov, or to Lauren Gaherty, Berkshire Regional Planning Commission, at lgaherty@berkshireplanning.org.

Attached is an updated Draft Action Plan, which summarizes and prioritizes the most pressing needs identified by the Dalton Emergency Management Action Council. If your time to review the full draft plan is limited, feel free to review and comment solely on the Action Plan. It is the result of all our planning work and is arguably the most important section of the Plan.

There are two action tables offered for review: the first actions (black text) are from the Dalton Hazard Mitigation Plan of 2012, and the second actions (red text) have been added as part of the update of 2018.

Thank you for your interest.

Dan Filiault
Dalton Emergency Management Director

Existing Mitigation Action Plan Update from 2012 in black text
Draft Updates / Revisions in Red Text

Description of Action	Benefit	Status 2018
Perform engineering study of Walker Brook as it flows underground through town and implement findings.	Reduce risk of flooding of High St., Field St. Extension, Senior Center	Engineering in progress – at 25% design review with FEMA (June 2018)
Perform engineering study of Kirchner Road bridge to determine solutions to alleviate flooding	Reduce risk of flooding	Bridge culvert replaced; complete
Perform engineering study of Orchard Road bridge to determine solutions to alleviate flooding; keep in mind sidewalk recommendation from Complete Streets study	Reduce flooding of the road and properties in the vicinity	MassDOT investigating
Implement beaver control solutions	Reduce or eliminate the risk of flooding	Ongoing; control as necessary
Continue to implement Stormwater Bylaw	Reduce the load on the existing system reducing the need to perform upgrades and expansions to the system	Ongoing; project review occurs as needed
Work with the City of Pittsfield to ensure Cleveland Reservoir Dam is in good condition	Reduce the risk of failure and subsequent flooding which could be catastrophic if full dam breach	Ongoing; received updated report 2017
Work with Dalton Fire District to ensure Windsor Dam is in good condition	Reduce the risk of failure and subsequent flooding	Ongoing; major repairs 2008-10; additional minor repairs 2017
Reduce excess dry timber in the surrounding forest lands	Reduce the chance of wildfire	No action taken; DCR Forest staff limited and much of land in private ownership
Identify historic structures, businesses and critical facilities located in hazard-prone areas, including floodplains and dam failure inundation areas.	Enable those facilities to be better prepared for the hazards and to prevent their loss	Ongoing; addressing Walker Brook flooding near old school & senior center (critical facility)

DRAFT Dalton Mitigation Action Plan – Potential New Actions

Description of Action	**Benefit**	**Status 2018**
Evaluate sedimentation, loss of storage capacity and flooding of adjacent properties at Center Pond and potential for dredging or other action	Reduce flooding in vicinity and upstream; reduce risks to dam structure	New
Consider structural or other options to protect housing complex	Reduce risk to residents and property damage	New
Evaluate Craneville Elem. School for possible primary shelter; possible feasibility/cost study; possible wiring of building for portable generator	Less risk than Nessacus from 100-year or dam-related flooding, or chemical spill on railroad	New
Draft formal MOU with school district and Stationary Factory	MOU protocols and responsibilities clear if sheltering needed	New
Retrofit Senior Center with backup power	Option for cooling/warming center; possible shelter during electricity outage	
Increase enrollment in Code Red	Keep residents informed before and during severe storm events	New
Remind residents that of the stormwater hotline call in number for potential pollution discharges; could be used to also report culverts or stormdrains clogged or not properly functioning	Proactively reduce flood risk	New
Continue to coordinate capital improvement plans between town and water district	Coordinate and bundle infrastructure projects for maximum efficiency and cost effectiveness; Dalton Division Rd. could be an opportunity	New
Assess bridges for condition of both bridge structure and infrastructure attached	Reduce possible failure of structures due to flood damages	New
Conduct evacuation exercise with Pomeroy Manor residents	Improved evacuation process and reduce risk to residents and first responders	New

Conduct water conservation program to raise awareness of importance of water supply and reduce water demand; promote MassSave for free water conservation measures	Reduce demand and prep residents for possible emergency measures in event of drought	New
Document all town costs associated with response to flood events, including staff time, materials, equipment value and fuel	Identify flooding trends for improved pre-disaster prep; record costs for potential reimbursement from grants or disaster disbursements	New
Review town stormwater bylaw for potential to strengthen requirements for on-site retention of stormwater runoff	Reduce increased risk of flooding from new development	New
Coordinate with City of Pittsfield for emergency response plans	Improved response to water / sewer line breaks	New
Promote MassSave and other home improvement programs to tighten building envelopes	Helps maintain interior conditioned space during severe temperature events; reduce energy demands	New

APPENDIX D

Adoption

TOWN OF DALTON

Town Hall
462 Main Street
Dalton, MA 01226-1601

Telephone (413) 684-6111 **Fax (413) 684-6107**

CERTIFICATE OF ADOPTION
TOWN OF DALTON, MASSACHUSETTS
A RESOLUTION ADOPTING THE
TOWN OF DALTON MULTI- HAZARD MITIGATION PLAN

WHEREAS, the Town of Dalton authorized the Dalton Emergency Management Advisory Council to prepare the *Town of Dalton Multi-Hazard Mitigation Plan*; and

WHEREAS, the *Town of Dalton Multi-Hazard Mitigation Plan* contains several potential future projects to mitigate potential impacts from natural hazards in Dalton, and

WHEREAS, a duly-noticed public meeting was held by the Dalton Select Board on January 14, 2018, and

WHEREAS, the Dalton Select Board authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Dalton Select Board hereby adopts the *Town of Dalton Multi-Hazard Mitigation Plan*, in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED this FOURTEENTH DAY OF JANUARY 2019.

John W. Bartels, Jr., Chairman
Dalton Select Board

ATTEST:

Deborah J. Merry

Deborah J. Merry
Town Clerk