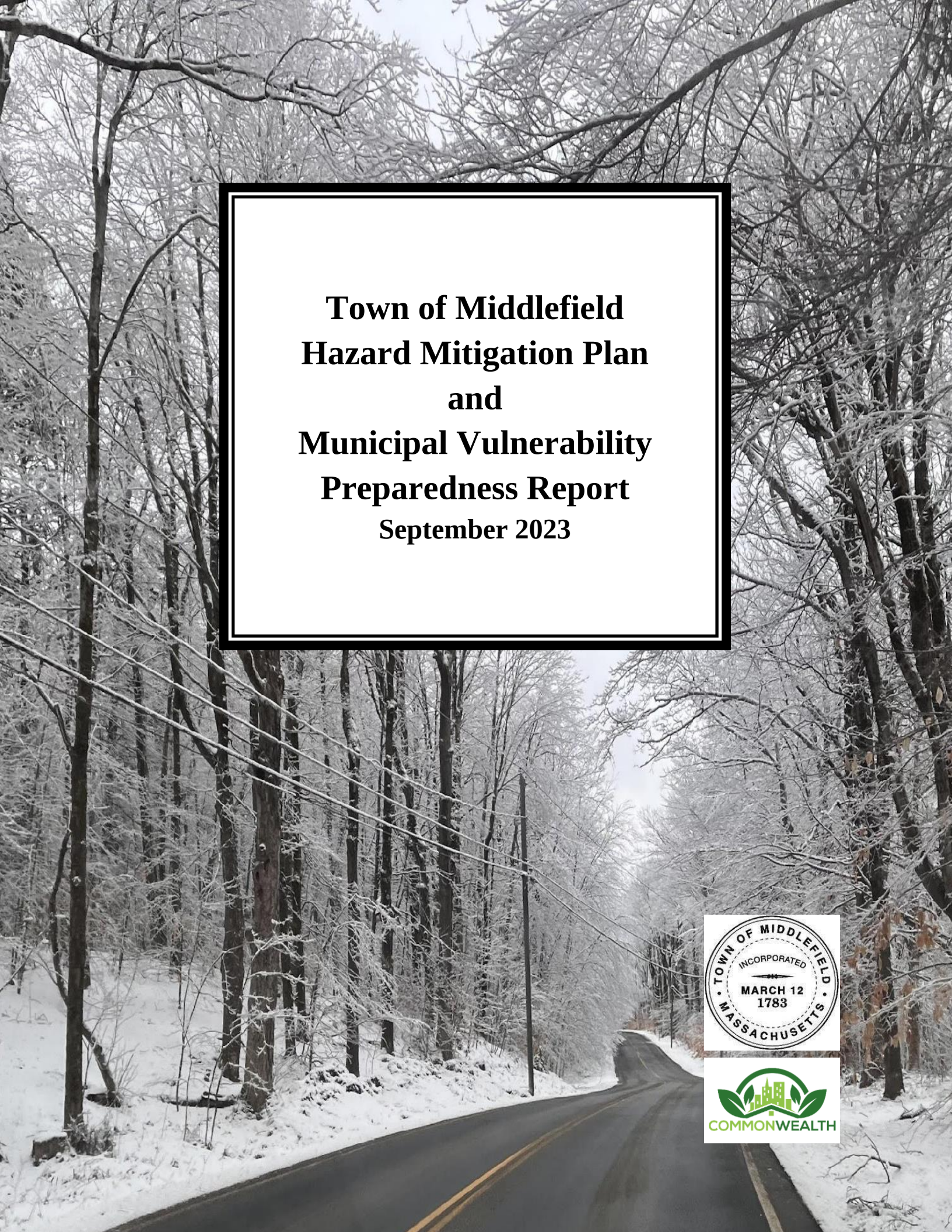

Town of Middlefield
Hazard Mitigation Plan
and
Municipal Vulnerability Preparedness Report
September 2023

TOWN OF MIDDLEFIELD
INCORPORATED
MARCH 12
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MASSACHUSETTS

COMMONWEALTH

ACKNOWLEDGEMENTS & CITATION

The Middlefield Selectboard extends special thanks to the **Middlefield Hazard Mitigation/ MVP Core Team Members** as follows:

Ann Marie Visconti, Selectboard, Chair
Tonya Santaniello, Selectboard Member
Curt Robie, Selectboard Member
Ron Radwich, Fire Chief
Crystal Kruzyna, Emergency Medical Director
Carol Waag, Conservation Commission, Chair
Skip Savery, Highway Superintendent
Jenny Dion, Police Chief
Adair Cafarella, Finance Committee, Business Owner
Joseph Kearns, Finance Committee Chair
Adair Cafarella, Business Owner

Commonwealth Municipal Consulting, LLC
Doreen DeFazio, Executive Director
Robert Polsinelli, Director of Policy
Sophie Protano, Sustainability Specialist

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PLANNING PROCESS

INTRODUCTION

PURPOSE

The Town of Middlefield's Hazard Mitigation Plan and Municipal Vulnerability Preparedness Plan (hereafter, "plan") was established to meet the goals laid out by the community and meet all requirements set forth by the Federal Emergency Management Agency (FEMA), the Massachusetts Emergency Management Agency (MEMA), and the Massachusetts Executive Office of Energy and Environmental Affairs (EEA). The purposes of a community developing and following a combined plan are to reduce the risk posed by natural hazards and increase resilience to the effects of climate change. To achieve these purposes, the community assessed the risk posed by each hazard, factoring in the effects of climate change, and decided on proactive actions that can be taken to decrease their risk. Taking this approach can reduce or eliminate the long-term risks by completing those actions.

To have an approved Hazard Mitigation Plan (HMP), it must meet all FEMA requirements and represent Middlefield's commitment to reducing risk and taking proactive action to reduce the impact of natural hazards on the planning community. FEMA coordinates with MEMA to review and approve plans. Having an approved HMP allows a community to access FEMA's hazard mitigation project grants.

To receive designation as a Municipal Vulnerability Preparedness (MVP) Community and access to MVP Action Grants, the Town of Middlefield has integrated the local effects of climate change into this plan. The completion of the Community Resilience Workshop (CRB) and EEA approval of this report will make Middlefield eligible for MVP Action Grants and assist in the efforts to increase resilience to climate change within the community.

Guiding Principles for Plan Development[1]:

- *Focus on the mitigation strategy*. The mitigation strategy is the plan's primary purpose. All other sections contribute to and inform the mitigation strategy and specific hazard mitigation actions.
- *Process is as important as the plan itself*. In mitigation planning, as with most other planning efforts, the plan is only as good as the process and people involved in its development. The plan should also serve as the written record, or documentation, of the planning process.
- *This is your community's plan*. To have value, the plan must represent the current needs and values of the community and be useful for local officials and stakeholders. Develop the plan in a way that best serves your community's purpose and people.

[1] Federal Emergency Management Agency. (2013). *Local mitigation planning handbook*, I-2.

This plan is the result of a collaborative effort between the Town of Middlefield's Core Team, stakeholders, and neighboring communities.

BACKGROUND

Middlefield completed its last HMP in 2019 in partnership with The Pioneer Valley Planning Commission (PVPC). The Town had not previously planned for climate resilience despite feeling the impact of climate change through increased temperatures, drought, and extreme precipitation events. The Town explored options to plan climate resilience and applied for EEA's MVP Planning Grant in June 2022. During the application process, Middlefield became aware of the opportunity to update their HMP, as a single jurisdiction, as part of the MVP project through the same grant, allowing the HMP update to be completed prior to its expiration in 2024.

Funding for this Plan was made available by a grant through the Massachusetts Executive Office of Energy and Environmental Affairs. This combined grant provided funding for Middlefield to hire an MVP-approved consultant to work with the municipality and other stakeholders to plan and prepare this combined plan. Once the Town was awarded the grant, it solicited qualified vendors through a bid process, and chose Commonwealth Municipal Consulting, LLC to partner for the completion of this project.

OVERVIEW

The Town of Middlefield, Massachusetts, is in Hampshire County and is surrounded by the Towns of Peru, Washington, Chester, Becket, and Worthington. The Town was incorporated in 1783 from outlying areas of those neighboring communities. It is home to Glendale Falls, one of the state's beautiful waterfalls, which feeds into the Westfield River and has been federally designated as a Wild and Scenic River.

Middlefield is a rural community with 385 people according to the U.S. Census Bureau. Town records, though, indicate that 426 people currently reside in Town. It is an aging community with a median age just over 59 years old. There are 170 occupied housing units, with an average of 1.9 persons per household[2]. About 9.4% of the population were below the federal poverty level, including 66.7% of those under age 18 but none of those aged 65 or older[3]. Town officials and public comment both believe the Census data underestimates the number of individuals over 65 who are below the FPL.

[2] U.S. Census Bureau. (2020). *Occupancy characteristics, 2020 American Community Survey 5-year estimates*. Retrieved from https://data.census.gov/table?g=0600000US2501540990&tid=ACSST5Y2020.S2501

[3] U.S. Census Bureau. (2020). *Poverty status in the last 12 months, 2020 American Community Survey 5-year estimates*. Retrieved from https://data.census.gov/table?g=0600000US2501540990&tid=ACSST5Y2021.S1701

HMP/MVP COMMITTEE/CORE TEAM

MEMBERS

Name	*Title*	*Affiliation*	*MVP Role*
Anne Marie Visconti	Selectboard, Chair; Emergency Management Director	Town of Middlefield	Core Team Member
Tonya Santaniello	Selectboard, Member	Town of Middlefield	Core Team Member
Skip Savery	Highway Superintendent	Town of Middlefield	Core Team Member
Ron Radwich	Fire Chief	Town of Middlefield	Core Team Member
Curt Robie	Selectboard, Member	Town of Middlefield	Local Project Lead
Crystal Kruzyna	Emergency Medical Services, Director	Town of Middlefield	Core Team Member
Carol Waag	Conservation Commission, Chair	Town of Middlefield	Core Team Member
Jenny Dion	Police Chief	Town of Middlefield	Core Team Member
Adair Cafarella	Financial Committee Member, Business Owner	Town of Middlefield	Core Team Member
Joseph Kearns	Financial Committee, Chair	Town of Middlefield	Core Team Member
Doreen DeFazio	Principal	Commonwealth Municipal Consulting	Lead Facilitator
Rob Polsinelli	Director of Policy	Commonwealth Municipal Consulting	Facilitator
Sophie Protano	Sustainability Specialist	Commonwealth Municipal Consulting	Core Team Member

***Table 1**. Members of the Middlefield HMP/MVP Committee/Core Team*

GOALS

According to FEMA, the goals of a hazard mitigation plan strategy should include:

1. Organizing the Planning Process and Resources
2. Assess Risks
3. Develop a Mitigation Strategy
4. Adopt and Implement a Plan

The Town of Middlefield adopted this strategy by following the guidelines of implementing a local plan through Core Team meetings, discussions, and site visits on risk assessment and goals. The intention of these goals was the reduction of loss of life and property by proactively determining the risk of natural disasters and, in this report's case, also included the risk of climate vulnerability and adaptation of resources for a more sustainable future.

The Core Team made available reports, maps, and other information that relates to hazard

mitigation and climate change impacts in Middlefield. Information gathered from these reports was used to inform the HMP update process and as data sources regarding climate change, weather-related events, and details about Middlefield. These resources included:

- Middlefield Open Space and Recreation Plan (Draft, 2022)
- Middlefield, BioMap 2 (MassWildlife, 2012)
- Massachusetts Climate Change Projections (NECSC, 2018)
- Massachusetts Climate Change Adaptation Report (EEA, 2011)
- Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018)
- Local Mitigation Plan Review Guide (FEMA, 2022)
- National Center for Environmental Information (NOAA)
- US Census, 2020 American Community Survey

TASKS

The Town formed a Core Team in November 2022, to meet and review the existing plans and policies that were documented in the 2019 HMP. The Core Team's tasks included reaffirming included hazards, identifying new hazards, and revisiting action plan items from the previous HMP to determine current plan updates. The team also discussed the Town's infrastructure and prioritized a hazard list of areas that were concerns for emergency responders, Town leaders, and residents. These meetings took place between November 2022 and January 2023, prior to the Community Resilience Building (CRB) Workshop.

In January 2023, the Town held an all-day CRB Workshop to discuss the effects of climate change on the town's vulnerabilities to hazards. The Workshop included all members of the Core Team as well as local representatives and regional stakeholders. The workshop was held at Middlefield Town Hall and utilized small and large group discussions to create consensus on priority actions.

Drafting of the plan began in earnest following the CRB Workshop and continued through March 2023. One final Core Team meeting was held in March 2023 to review a preliminary draft of the report and clarify any information in question.

PARTICIPATION BY STAKEHOLDERS

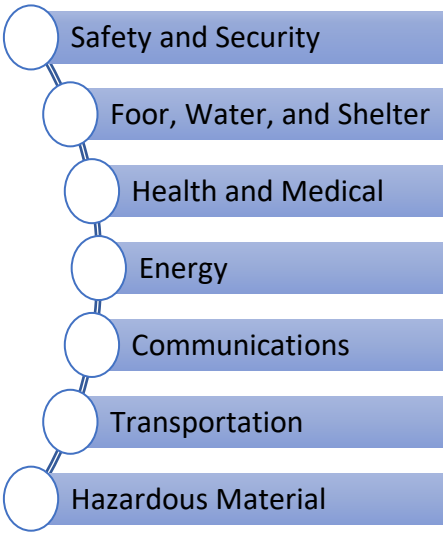
A variety of stakeholders were invited to participate in Middlefield's HMP/MVP planning process to meet FEMA and EEA requirements and to seek their insight, support, and cooperation. A brief overview of the various groups and categories of stakeholders is provided below, as well as the outreach methods used to solicit their feedback.

As part of the planning process, the Core Team discussed options for soliciting feedback from a variety of stakeholders including, but not limited to, the public at large, members of climate vulnerable populations, community-based organizations (CBO), local businesses, church leaders, local academia, utilities, and leaders of neighboring communities. Because Middlefield is a small rural community, members of some stakeholder groups are also members of other groups. For

example, the owner of the largest business in Middlefield is also a member of the Town's Financial Committee. Where relevant, those holding multiple roles were noted as such.

There was a particular focus on stakeholders representing *community lifelines*. Community lifelines are defined by FEMA[4] as "the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Community lifelines include the following:

- Safety and Security
- Food, Water, Shelter
- Health and Medical
- Energy
- Communications
- Transportation
- Hazardous Material" (FEMA, 2022).



The Core Team identified the Selectboard, Police Chief, Fire Chief, Emergency Medical Services Director, Highway Superintendent, and electric utility provider, Eversource, as being the key community lifeline representatives for Middlefield. There are no grocery stores, local water suppliers, public transportation providers, or medical providers in town. The Blossom Center is the sole CBO actively supporting town residents. Adair Caferella is the owner of The Blossom Center/Azure Green. Although the community center is not a town owned facility, the residents benefit from the contributions of the business in terms of back up water supply, shelter facilities and community center events. There are mixed feelings among the core team regarding these benefits, as the town has no control over what is offered, who is identified as a resident of the town or other locations, and whether or not this will continue to be a standing benefit for the future. For now, the community utilizes the resources and is grateful for the support of this business, while looking for other independent methods to assist the town with hazard mitigation long term. The Blossom Center was a key element of the Core Team to determine how to prioritize actions.

The Core Team discussed how best to encourage feedback from each group during the November Core team meetings (November 2, 16, and 30, 2022). Based on previous experiences, the Core Team decided to utilize multiple methods to best reach all the desired stakeholders. The four methods used were:

- Core Team participation
- Surveys
- Public Comment Opportunities
- Workshop participation

[4] Federal Emergency Management Agency. (2022). *Local mitigation policy planning guide*. U.S. Department of Homeland Security. Retrieved from https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-policy-guide_042022.pdf

The Core Team and public surveys were particularly successful methods in obtaining a wide array of information and opinions from relevant, local stakeholders. Core team meetings were all well attended and generated robust conversations about the topics at hand.

LOCAL AND REGIONAL AGENCIES

Middlefield is a small community and Town officials sometimes hold more than one position within the local government. Evidenced by the size of the Core Team, there are a significant number of resident volunteers who are involved in the Town's functioning. A devoted core group are responsible for most of the Town's operations. There are also a few paid employees that contribute to the Town's ongoing functions, including a Highway Superintendent and a Town Clerk. Members of these groups formed the core planning group.

Beyond local officials and employees, the Town can and does access support from regional agencies, particularly the Pioneer Valley Planning Commission (PVPC), who can provide support directly for planning activities if requested as well as regional assistance including grant access and awareness, resource sharing and coordination, or additional planning activities. PVPC was invited to the Workshop to provide input on this plan. Additionally, utility companies operate regionally in this part of the State, and the electric supply agency, Eversource, was invited to the Workshop to participate in this process due to the critical nature of its service as well as its vulnerability to several hazards.

WORKSHOP

On January 21, 2023, Middlefield hosted a Community Resilience Building Workshop led by Commonwealth Municipal Consulting, LLC, a State-approved MVP vendor. Members of Middlefield's Selectboard, Police Department, Highway Department, Conservation Committee, Council on Aging, Finance Committee, and Emergency Medical Services attended. A local business representative also attended the event, and a representative of the Wild and Scenic Westfield River Committee attended a portion of the event. Representatives from neighboring communities, a utility provider, the regional school district, a local college, and the regional planning commission were also invited to participate. A complete list of those invited and those in attendance can be viewed in ***Appendix F***.

AGENCIES THAT CAN REGULATE DEVELOPMENT

The Town's Planning Board is the primary agency that regulates development within town. The Planning Board was apprised of this plan's development and updated on progress during the planning process. Middlefield can also access support for its development activities from the PVPC.

There is a substantial amount of forest in Middlefield, and the Massachusetts Department of Conservation and Recreation (DCR) has authority over most of the area. DCR was not invited to attend the Workshop based on a standing arrangement with DCR indicating their willingness to answer any questions or discuss any concerns that were outcomes of the planning process.

PUBLIC, BUSINESS, AND NEIGHBORING COMMUNITIES

To solicit feedback from the citizens of Middlefield, the Town conducted several outreach activities as part of the plan development process.

Surveys

The first outreach method was a survey offered to residents during the early stages of plan development to obtain direct feedback from citizens. The public survey was an outcome of discussion and planning by the Core Team. Its success was, in large part, due to a recent survey conducted by the Middlefield Conservation Committee to produce an Open Space Plan. Because that survey elicited a high number of responses, the Core Team decided to model survey outreach for this project after that one. A notice was included in the fourth quarter property tax bill, and it invited participants to complete the included paper survey or to complete the survey online. It was hoped that this method would reach both full-time residents of Middlefield as well as those who reside in town seasonally. Information about the survey and a link to an online version was also posted on the Town's website. Additional paper copies of the survey were made available to residents in the Town Hall, the Council on Aging building, and online via a link on the website. Completed paper surveys could be mailed to Town Hall or returned there at a locked drop-box located outside the front entrance to Town Hall. The outreach strategy resulted in a total of 39 survey responses.

The survey consisted of multiple choice and open-ended response questions asking opinions about hazards and vulnerabilities in town as well as perceptions of the Town's ability to deal with hazard related emergencies. A copy of this survey can be found in ***Appendix N***.

Results of this survey aligned in large part with the outcomes of the CRB Workshop and products of the Core Team, but there were some notable differences. The most striking difference was the ranking of the hazards. The respondents were asked to rank the hazards from most to least concerning. The results, in ***Figure 1*** below, indicate the outcome. When compared to the CRB Workshop's top four hazards, Severe snow/ice storm and Severe thunderstorm/ wind/tornado/microburst align. Extreme temperature and Wildfire/brushfire, ranked 3 and 4 by public survey respondents, do not match the CRB participants' hazards of Flooding and Drought. Despite the disagreement, it is not difficult to see how Extreme temperature, Drought, and Wildfire/brushfire are interrelated, which likely accounts for the discrepancy.

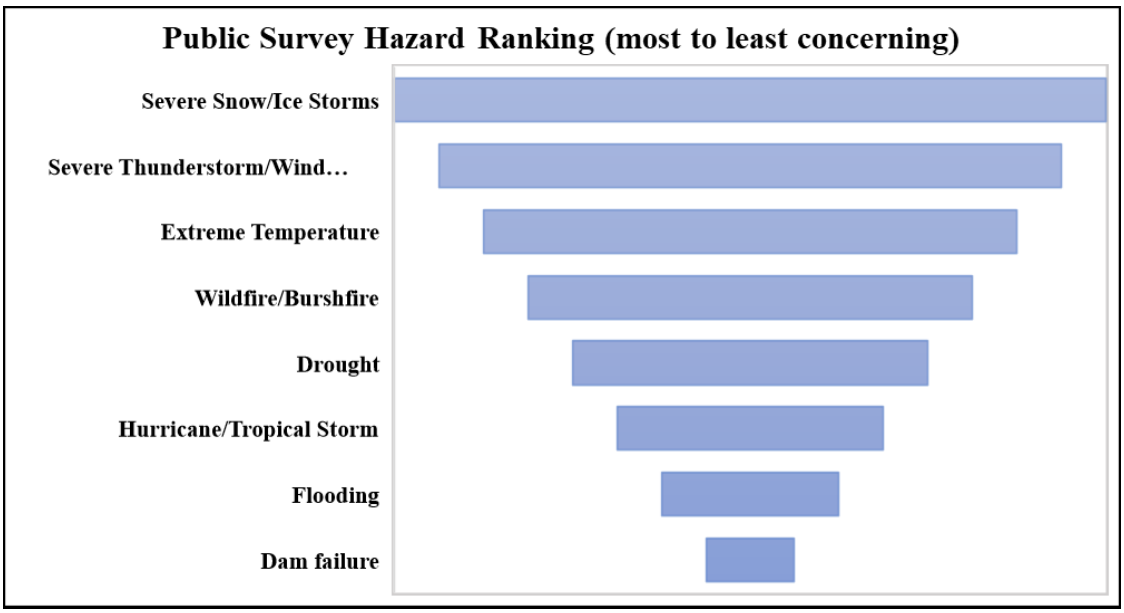


Figure 1*. Hazards to Middlefield as ranked by public survey response*

Most respondents indicated that the Town would be able to be resilient and manage the situation (average 3.6 on 1 – 5 scale). Similarly, just over half are concerned about climate change (average 3.5 on 1- 5 scale), and there is an overall willingness to prioritize Town spending on hazard mitigation and climate reliance over other Town spending (average 2.7 on a 1 - 4 scale). Many respondents shared helpful comments about the community in addition to the ranking questions. Comments will be incorporated into the report where appropriate, but several topics were repeated frequently. Some respondents tied one or more of the topics together (e.g., falling trees cause power outages), but they are separated here because they were not always linked. The topics are listed here in no purposeful order:

- Increased expectation of severe weather events
- Falling trees
- Localized flooding
- Power outages
- Blocked, impassable, or washed-out roads
- Need for dirt road maintenance or paving

To obtain more detailed information from Climate Vulnerable (CV) populations within town, a second survey invitation was included at the end of the public survey. Participants who believed they met one or more of the criteria to be considered in a climate vulnerable population were invited to complete a secondary survey, and seven (7) people participated by completing it. The CV survey asked a series of additional questions related to their experiences and opinions about the intersection of hazards with the conditions that qualify them as a member of a CV population. A link to an online version of this survey was also available on the Town's website, and paper copies were available at the Council on Aging Building and Town Hall. A copy of this survey can be found in ***Appendix O***.

Six of the seven respondents were aged 65 or older, and the other respondent reported a limited income. Responses here indicated a similar hazard ranking to the CRB Workshop participants and public survey responses (the top four being Severe snow/ice storm, Severe thunderstorm/ wind/tornado/microburst, Drought, and Flooding). Their direct experience aligned closely with their rankings, as indicated in ***Figure 2***, below. Importantly, only two of the respondents indicated that their status as a CV population member would negatively impact their ability to receive necessary supports and services due to a weather hazard event.

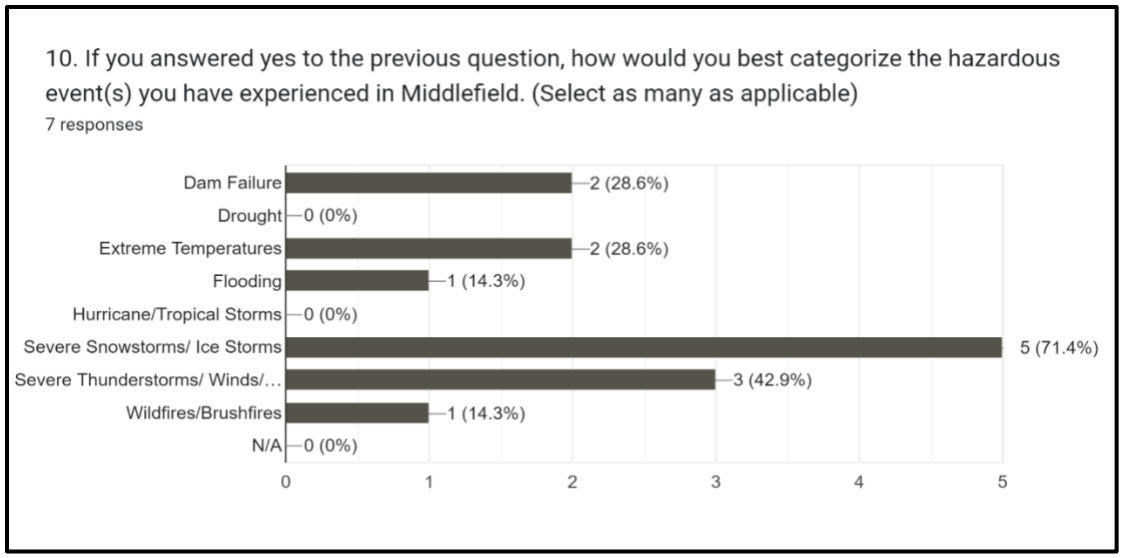


Figure 2*. CV Population's experience with natural hazards in Middlefield*

Public Comment

A public comment opportunity was provided on January 21, 2023, prior to the Workshop. Citizens were notified of the meeting by online posting of the details on the Town's website, posting in Town Hall, and press release in the local newspaper, the Country Journal. Citizens were invited to submit questions in advance or to attend the meeting to ask them directly. No one elected to participate in this public comment opportunity.

The second public comment session was held on April 5, 2023, following the posting of the draft report. The methods to notify the town's citizens were the same for this opportunity as they were for the initial public comment session. Two email responses received from Core Team members prior to the meeting clarified facts in the document, notably the number and location of the existing dams in Middlefield, clarification of the dispatch location and sequence, and further detailing of mutual aid agreements. Other feedback from these emails resulted in the expansion of the invasive species risk assessment and additional explanation on the town's demographics.

The second public comment opportunity included 11 participants from the community and 4 members of the Core Team. Feedback covered topics ranging from loss of electric

and broadband services during severe storms, the resulting loss of 9-1-1 capability and other emergency notifications, the importance of varied land use for the community, the need for forest management, and a discrepancy between U.S. Census population estimates versus the Town's census information. All the comments not previously addressed were incorporated into the plan by clarifying or expanding on the existing narrative.

Local Businesses and CBOs

The Town lists 13 businesses based in Middlefield. There are several farms, including Garacyn Farm, Left Field Farm, and Blue Haven Blueberry and Raspberries, private contractor services, a kennel, a bed and breakfast, a car sales dealership and an excavation company. The largest employer in Middlefield is Azure Green, a retail and wholesale distribution business. The building's heating and cooling is not reliant on utility companies. The facility also has a 500,000-gallon cistern that is actively used by the Fire Department via dry hydrant as a water supply. As previously mentioned, owner of Azure Green/The Blossom Center was on the Core Team (and is also a member of the Finance Committee), and the other business owners were invited to participate via public comment opportunities.

Community-based organizations, or CBOs, are local organizations that provide solutions to local issues of need with involvement from residents. Azure Green supports the community by hosting free community lunches and dinners through their non-profit center, The Blossom Center, with food prepared on site and in coordination with a local co-op, as well as weekly community events. The Blossom Center is the only active CBO, in Middlefield. The Blossom Center is also available, free of charge, as an accessible regional emergency shelter, including showers, nine restrooms, a commercial kitchen, washers/dryers, shelter supplies including cots and blankets, and back-up power. A representative of the Blossom Center was invited and participated in the CRB Workshop.

Neighboring Communities

Middlefield and the neighboring Town of Washington have partnered to hire and share a Town Administrator position to assist both communities with the management of day-to-day operations. It has been a complex undertaking, but if they are successful, the capacity of both Towns will increase by having a dedicated public employee alleviating some of the burden now placed on the respective Selectboards.

Middlefield relies on neighboring communities for some services and has intermunicipal agreements for mutual aid. Middlefield shares firefighting services with the neighboring towns of Beckett, Chester, Hinsdale, and Peru (first alarm); Huntington, Otis, and Worthington (second alarm); and Lee, Montgomery, Russell, and Windsor (third alarm). Mutual aid agreements are also established for police services to support the Town's Police Chief and three officers as needed. Middlefield also belongs to the Hilltown Resource Management Collective, a regional organization supporting sustainability, recycling and solid waste disposal needs for ten Hilltowns. Representatives from all

Middlefield's border communities were invited to participate in the HMP update process via the CRB Workshop, but none attended the workshop.

LOCAL PROFILE AND PLANNING CONTEXT

COMMUNITY SETTING

The Town of Middlefield is a Hilltown located just east of the Berkshire Mountains. It is bordered by the neighboring Towns of Peru, Worthington, Chester, Becket, and Washington. The closest city is Pittsfield to the west. Middlefield is 119 miles west of Boston and 59.6 miles east of Albany, New York.

Middlefield is a rural community, detached from major commercial attractions or suburban sprawl. The residents take pride in the history of the town, the farming culture, and its quiet and down to earth lifestyle it brings. The town does not have any major highways going through it and does not attract any major attractions except for tourists seeking the quiet landscape, particularly in the summer and autumn months.

DEMOGRAPHICS

According to the 2020 U.S. Census[5], Middlefield has a population of 385, but Town officials disagree with this estimate. Town records indicate that 426 people currently reside in Middlefield. The source of the disagreement, according to the public and Town officials, is the Census Bureau's reliance on identifiers like zip codes in sorting their data. Because Post Offices in rural communities may establish delivery routes that cross borders, the zip code on a mailing address may not align with the home's municipal location. The Town has elevated this discrepancy to state officials, but neither local nor state officials have had success in modifying the U.S. Census estimate.

The town is largely composed of White, Non-Latino people (94%). The remaining people are categorized as being 3.6% of two or more races, 2.9% Hispanic or Latino, 1% Asian, 0.3% American Indian and Alaska Native, and 1% some other background. The median age of a Middlefield resident is 59.4[6] years. 96.5% of the town's people live in owner-occupied homes, and the remaining 3.5% rent[7]. Median income is $73,636 per year with 17% earning 150% or less of the Federal Poverty Level (FPL) in 2020[8].

[5] U.S. Census Bureau. (2020). *P1: Race, 2020 Decennial census*. Retrieved from https://data.census.gov/profile/Middlefield_town,_Hampshire_County,_Massachusetts?g=0600000US2501540990

[6] U.S. Census Bureau. (2020). *Age and sex, 2020 American Community Survey 5-year estimates*. Retrieved https://data.census.gov/table?q=middlefield+ma&tid=ACSST5Y2020.S0101

[7] U.S. Census Bureau. (2020). *Households and Families, 2020 American Community Survey 5-year estimates*. Retrieved from https://data.census.gov/cedsci/table?g=0600000US2501342530&tid=ACSST5Y2020.S1101

[8] U.S. Census Bureau. (2020). *Poverty status in the last 12 months, 2020 American Community Survey 5-year estimates*. Retrieved from https://data.census.gov/table?q=middlefield+ma&tid=ACSST5Y2021.S1701

There are 246 housing units in Middlefield, and 164 are estimated as being owner occupied while 6 are occupied by renters. Of the 164 owner-occupied homes in Middlefield, 90 are owned outright while 74 have a mortgage. The median home value is $230,700[9]. The private property value of the Town of Middlefield is estimated at $56,752,200.

DEVELOPMENT

The center of town contains the Town Hall, library, Fire Department, Highway Department, Council on Aging building, and Middlefield Congregational Church. Despite the size of the population over 65, there is no environmental justice population because those individuals are dispersed across the community. Middlefield has limited commercial development and no schools within the town. There is no current consideration for growth within the community in terms of industrial or commercial development. Residents utilize other towns within the region to access other resources.

Middlefield has established Bylaws and Zoning Bylaws that focus on limiting new development through permitting processes. The Town is zoned as either Agricultural-Residential or Commercial with both a River Protection Overlay and Floodplain Overlay District. The Zoning Bylaws impose restrictions on the creation of new homes, subdivision of current/existing lots, and commercial use of land. Any development in the River Protection or Floodplain Overlay Districts would require special permitting. Additional limitations apply to the construction of wireless telecommunication towers and solar arrays. To protect floodways and floodplains, particularly, the Town adheres to and enforces State regulations.

Since the 2019 HMP, there has been no development. Several homes have undertaken renovations during that time, resulting in a minor increase in the average property value in Middlefield. Those changes are reflected in the U.S. Census information used as the basis for estimating the property value in town, therefore the change in vulnerability is accounted for in that estimate. Specifically, no development has occurred within the 100- or 500-year floodplains or other locations in town noted as being especially vulnerable to one or more hazards (e.g., dam failure).

Future development on all parcels would affect the Town's vulnerability to hazards uniformly except for those within either overlay district, as the latter would increase the Town's vulnerability specifically to flooding. At present, vacant parcels in Middlefield that could be developed in the future are not located within the River Protection or Floodplain Overlay Districts.

There is no plan for development within the Town for the foreseeable future. If the Town abides by the bylaws and permitting processes as established, there is no expectation that new development would substantially increase or decrease the Town's vulnerability to any hazards. Should future development in the River Protection or Floodplain Overlay District be considered,

[9] U.S. Census Bureau. (2020). Selected housing characteristics, 2020 American Community Survey 5-year estimates. Retrieved from https://data.census.gov/table?g=0600000US2501540990&tid=ACSDP5Y2020.DP04

it is recommended that the planned development's impact on the Town's vulnerability to flooding be reassessed.

ZONING

Currently, the Town of Middlefield has adopted three zoning districts, Agricultural/residential, Commercial, and Overlay Districts for floodplain and river protection. According to the Town's Zoning Bylaws, the following uses are allowed by-right: agricultural, forestry and nursery, outdoor recreation, conservation, wildlife management, and buildings existing prior to the adoption of the overlay district. Uses allowed by special permit include single family residences (not including mobile homes), residential accessory uses, excavation of earth materials and improvement to existing structures that exceed 25% of the overall square footage of the structure.[10]

NFIP REGULATIONS

Currently, the Emergency Management Department, under the authority of the Selectboard, are responsible for addressing the commitments required of the NFIP. The Highway Department/Emergency Management enforces the flood plain regulations for the community. Below is how the Town carries out improvements and damage provisions of the NFIP regulations.

Program/Method	Yes/No	Description and Effectiveness for Hazard Risk Reduction
Responsible water use, fire safety, household preparedness	YES	Middlefield has education and outreach through its Council on Aging for preparedness training and the conservation commission educates the community through outreach the importance of water use and preservation.
Natural disaster school related program	N/A No public school	N/A
Storm ready certification	NO	N/A
Firewise USA certification	NO	N/A
Public-private partnership initiatives addressing disaster related issues	YES	Potential for Blossom Center and Town to have an official partnership, but one is not currently in place
Other program/Methods	YES	Town uses website, social media, community outreach

[10] Town of Middlefield, MA. (1994). *Zoning Bylaws*. Town of Middlefield, MA. Retrieved from https://www.middlefieldma.site/wp-content/uploads/documents/bylaws/By-laws5.pdf

		and education as ways to reach residents

The NFIP is a federal program created by Congress to mitigate future flood losses nationwide through sound, community-enforced building, and zoning ordinances and to provide access to affordable, federally backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is "based on an agreement between local communities and the Federal Government that states that if a community will adopt and enforce a Middlefield floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community as a financial protection against flood losses"[11].

According to the Town of Middlefield's 1993 Flood Insurance Study, there were 15 documented incidents of flooding in the Westfield River Basin prior to the year 1900[12]. However, the data concerning these events is minimal. The 1993 study also concluded that while flooding could occur during any season, it has historically occurred most commonly in the fall with major floods identified in November 1927, September 1938, and October 1955[13]. Additional major floods following the year 1900 also occurred in March of 1936 and August of 1955. All of the aforementioned floods with the exception of the September 1938 flood were caused by heavy rainfall associated with tropical storms and hurricanes[14].

INFRASTRUCTURE

Transportation

There are no public transportation options within the town.

Public Water Service

There is no public water service in Middlefield. Residents rely on local wells for their water supplies.

Public Sewer Service

[11] Institute for County Government. (n.d.). Retrieved on October 28, 2022, from https://flicg.org/national-flood-insurance-program/

[12] *Flood Insurance Study: Town of Middlefield, Hampshire County, Massachusetts*, Federal Emergency Management Agency, 1993.

[13] *Flood Insurance Study: Town of Middlefield, Hampshire County, Massachusetts*, Federal Emergency Management Agency, 1993.

[14] *Flood Insurance Study: Town of Middlefield, Hampshire County, Massachusetts*, Federal Emergency Management Agency, 1993.

There is no public sewer service in Middlefield. Residents use septic systems for disposal of wastewater.

Schools

There are no public schools in Middlefield. Students are educated through the Gateway Regional School District. The District's schools are in the neighboring Towns of Chester and Huntington.

Critical Facilities and Infrastructure

There have been no changes in critical facilities or infrastructure since the 2019 HMP. ***Table 2*** contains a listing of those facilities and infrastructure.

Facility/Infrastructure/Use	***Location***
Emergency Operation Center (EOC), Shelter, Town offices, Police Department	188 Skyline Trail
First responder activities and secondary shelter; Alternate EOC	Fire Station, 6 Bell Road
DPW activities, storage of road materials, fuel station	Highway Garage, 4 Bell Road
Cell Towers	Closest tower is in Chester; coverage is spotty
Internet Service	Comcast available to customers across town
Public water supply for Town facilities	Bancroft and Factory Brook serve as surface water supplies that can be used. Access via fire truck is difficult, but the fire department has portable pumps that they can bring to the site as needed.
Dry hydrant	Azure Green – 16 Bell Road – Private water supply shared with the town for fire department as well as private consumption using carry out containers
Primary Evacuation Routes	Skyline Trail Chester Road Town Hill Road East River Road
Bridges on Evacuation Routes	Chester Road (1 bridge, replaced in 2020)

	Town Hill Road (4 bridges)
Helicopter Landing Sites (Lifeflight & Lifestar approved)	Fair Grounds-7 Bell Road Azure Green- 16 Bell Road
Hospitals	Berkshire Medical Center - Pittsfield Baystate Noble - Westfield Cooley-Dickenson - Northampton
Level 1 Trauma Centers via helicopter	Baystate Medical Center- Springfield Albany Medical Center- Albany, NY

***Table 2**. Critical facilities and infrastructure in Middlefield*

During the public comment session, participants raised concern about access to emergency communications during weather related emergencies. Due to Verizon ceasing to replace the battery back-up on the telephone supply lines, there is no longer land line service available. Many residents have switched over to VOIP phone service through Verizon, but this service is more susceptible to service interruptions. Cellular service in town has coverage gaps, and the Town is working on addressing them. Additionally, when an electrical or IP transmission line is taken down by extreme weather, residents cannot send or receive emergency communication. Residents would like to have landline access renewed. In an emergency, it is usually the only way to communicate. These situations occur sporadically on all the dirt roads in town, but a more widespread and prolonged outage occurred during Tropical Storm Irene.

ECONOMY

Due to Middlefield's limited commercial development, most of the residents in Middlefield work outside of the town. The Town employs limited positions to run the operations of local government, but most private business entities are in neighboring cities within the region. As reported in the 2019 HMP, Middlefield residents commute an average of 30 minutes to jobs outside of their town according to the Massachusetts Department of Employment and Training. The unemployment rate was 1.9% in 2022.

NATURAL RESOURCES

The Town of Middlefield takes pride in its open space and recreation planning, particularly when it comes to utilizing the town's natural resources. The Selectboard Chair attended a meeting where the forested areas of Western MA, including Middlefield's, were described as the "lungs of the state," providing a valuable resource to counter the emissions from population, traffic, and industry in the eastern part of the state.

Glendale Falls is the town's most popular location with visitors and residents, with trails, streams, and brooks colliding over mountainous views. The town offers almost 16,000 acres of land and much is protected for outdoor use. The spaces are used for hiking and swimming, as well as drawing attention for foliage seekers and hunting season in the fall. The town takes pride in its historical, varied land use. Decades ago, there were more meadows and pastures than today as many have been overgrown with trees. Public comment from one resident noted that the tree canopy is clearly an important asset of the town, but that it is also important to retain other land uses as there is value in the access and views offered by open space.

There are two watersheds under the protection of the municipality. The Skyline Trail and the Coles and Factory Brook systems flow to the West Branch of the Westfield River. The Conservation Committee Act (M.G.L. c.40 §8C) for open space protection, the Wetlands Protection Act (M.G.L. c.131, §40) for protecting wetlands and waterways, and the home rule provisions of the state constitution for non-zoning wetland bylaws fall under the Conservation Committee.

According to the Regional Planning Commission, there are approximately 5,130 acres of state land in Middlefield, including: Walnut Hill Wildlife Management Area, 814 acres; Middlefield State Forest, 2,388 acres; Fox Den Wildlife Management Area,1,512 acres; Peru State Forest, 414 acres; and Westfield River Access Area, 2.5 acres. These areas are largely available to the public for hiking, hunting, skiing, nature study and other outdoor activities.

IMPACTS OF CLIMATE CHANGE

Middlefield, like other cities and towns throughout the Commonwealth, has seen an increase in climate hazards throughout the past few decades, and particularly, in the past few years. Extreme temperature changes have caused more likely scenarios of drought or excess precipitation, both causing concern for the community and region. These threats have affected how Middlefield plans municipal budgets, highway staff and their routine activities, natural threats from downed trees and power outages, and most importantly, its impact on the residents.

SUMMARY OF COMMUNITY RESILIENCE BUILDING (CRB) WORKSHOP FINDINGS

Recognizing the importance of both mitigation and adaptation strategies to deal with the challenges of climate change, Middlefield is utilizing the MVP Planning Grant as a tool to incorporate climate objectives into potential regional partnerships or larger collaborations. This report provides an overview of the top hazards, current concerns and challenges, strengths, and proposed actions to improve Middlefield's resilience to natural and climate-related hazards today and in the future.

CRB WORKSHOP

Middlefield held their CRB workshop on January 21, 2023. The Workshop's central objectives were to:

- Define top local natural and climate-related hazards of concern,
- Identify existing and future strengths and vulnerabilities,
- Develop prioritized actions for the Community, and
- Identify immediate opportunities to collaboratively advance actions to increase resilience.

At the workshop, climate change data at the national, state, and municipal level were presented to participants. Additionally, a summary of Core Team/Committee meetings, including a review of preliminary hazard rankings, was shared with those in attendance. The workshop attendees applied this information to come to consensus on the top hazards for Middlefield.

Following the Community Resilience Building Workshop Guide, small breakout groups then completed individual matrices and reported their priority actions when the whole group reconvened. These actions were developed by the workshop participants to reduce the impact of natural hazards and to build resiliency. The lead facilitator then moderated a whole group activity to combine the ideas into a comprehensive list of possible actions. Each participant then voted for their top four actions. The votes were tallied and announced. The Lead Facilitator sought and obtained consensus from the participants in supporting the final list of priority actions and affirmed the report would contain the other important actions that were identified.

TOP HAZARDS/VULNERABLE AREAS

To facilitate the discussion of climate change resilience, stakeholders identified the top four hazards to Middlefield before discussing vulnerabilities and strengths. The hazards for the Town of Middlefield are:

- dam failure,
- drought,
- earthquake,
- extreme temperature,
- flooding,
- hurricane & tropical storm,
- invasive species,
- landslide,
- severe snowstorm & ice storm,
- severe thunderstorm & wind & tornado & microburst, and
- wildfire & brushfire.

Small groups ranked the hazards to Middlefield, and then the results were compared in the large group. Consensus was not immediate as each small group listed a unique set of four hazards. Following continued discussion and subsequent voting, the large group eventually agreed on four hazards. The top four hazards were identified as follows:

- Severe snowstorms and ice storms
- Flooding
- Severe Thunderstorms, winds, tornadoes, and microbursts
- Drought

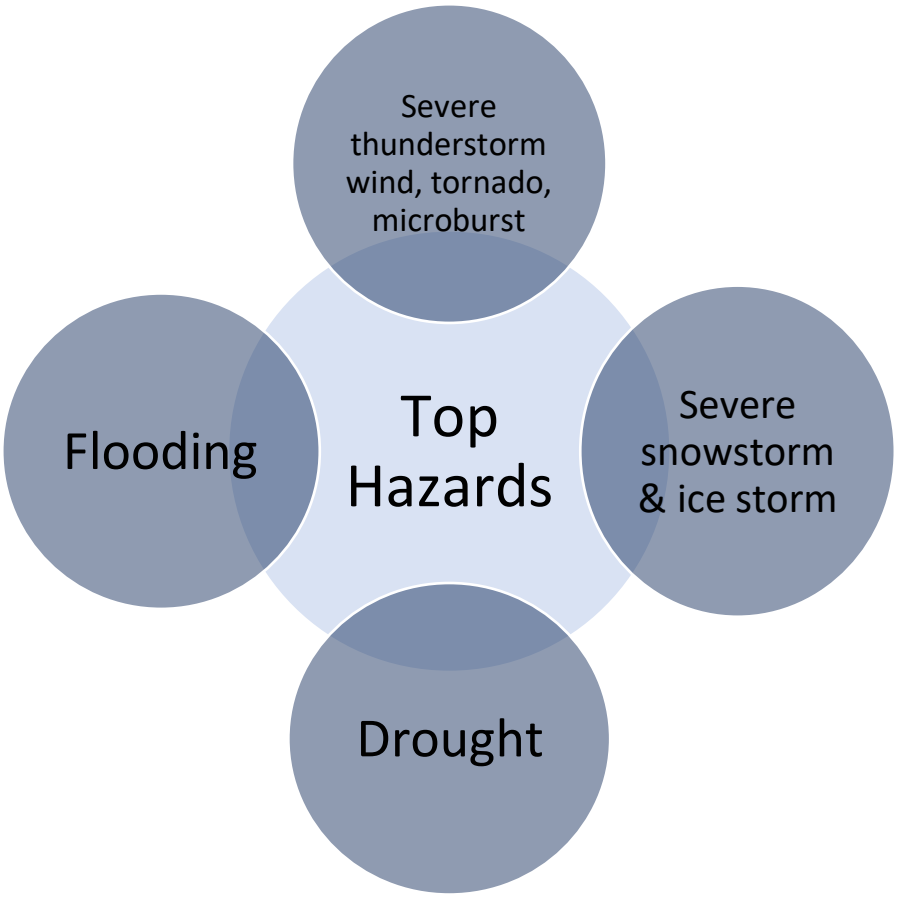


Figure 4*. Top four hazards to Middlefield*

AREAS OF CONCERN

The primary concern voiced by both the Core Team and Workshop participants was the need to improve high-capacity drainage on roads and improve pavement on roadways. There has been flooding and damage to Middlefield's 23 miles of gravel surfaced roads due to minor flooding. Flooded or damaged roads isolate residents by preventing them from travelling to work, preventing evacuation during an emergency, and/or preventing emergency services from reaching them.

Other areas where waterways intersect with built infrastructure also present flooding hazards. Beaver dams accentuate several of these locations, including properties adjacent to Skyline Trail and Arthur Pease Road. Another location of concern is on Reservoir Road where two undersized culverts were installed to replace a dam. There is also a potential for flooding of Root Road if beaver dams breach on a major pond in the Peru State Forest that feeds a stream that flows under the road and sends water to Glendale Falls.

Another concern is the communication systems. The Town must ensure important communications are received in times of emergencies or disasters as well as ensure residents are adequately prepared and supported for extreme weather events. Dispatch comes from the Berkshire County Sheriff's Office in Pittsfield, as the Town has regionalized emergency communications, but they feel those responses are not always timely. Additionally, there is a concern about tree damage caused by heavy winds. When trees near supply lines fall, the results are blocked roads, major power outages, damage to the electric infrastructure system in town, and the loss of telephone and internet communications The combination of these outcomes limit communication and access to residents in emergency situations.

CURRENT CONCERNS AND CHALLENGES

Middlefield will be impacted by climate change like the rest of Massachusetts. Average temperatures are expected to continue to rise, resulting in fewer days below freezing, the loss of growing green days, and more days over 90 degrees.

Based on the existing challenges due to natural hazards, flooding is the most concerning to the Town. Extreme precipitation events regularly impact Middlefield. Flooding along the east and west branch of the Westfield River and additional smaller streams has caused damage to homes and has resulted in the death of one person. Falling trees due to soft, saturated soil can interrupt power and telecommunications. Localized flooding cuts off evacuation routes, slows emergency responders, and further deteriorates the affected roadways.

These events also increase the chances of a beaver dam breaching. Beavers have built dams in swamps along stream beds, backing up water. This has also contributed to the flooding of roads and the potential damage to adjoining roads.

This damage is also a major concern in winter months during heavy ice and snowstorms, which cause even more damage to infrastructure as the result of severe weather.

SPECIFIC CATEGORIES OF CONCERNS AND CHALLENGES

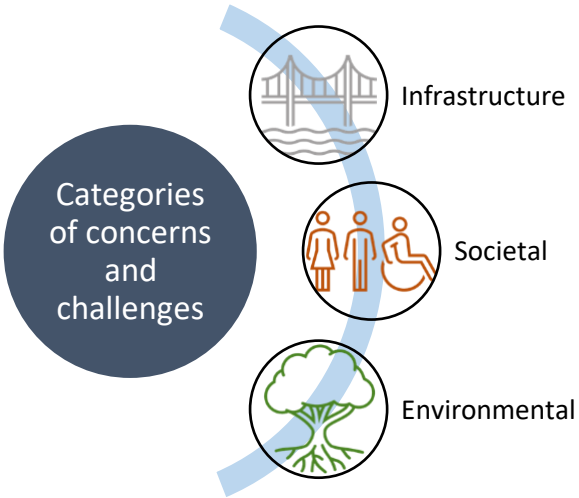
Infrastructure

Workshop participants expressed that unpaved roads and drainage are priorities during the CRB Workshop. Storms in all seasons have had a direct impact on most residents. There is a need for the replacement or repair of five bridges and upsizing of culverts across town.

The improvement of the communication system is needed because there are still several areas of town where there is no cell access even during non-emergency times. Additionally, the Town has a regional contract for dispatch via the Berkshire County Sheriff's Office in Pittsfield during an emergency, who calls emergency responders (e.g., fire, ambulance), which residents see as an indirect option. This system can cause delays or miscommunications. The outcome is that residents are left to rely on telecommunication lines and electric power to work effectively for notifications via landline phone, television or radio announcements, or internet access.

Access to a water supply is another concern, as the town relies on private wells. Due to droughts increasing in the area, the lack of public water supply has become an issue, especially to those in agriculture. Residents communicated the Town's lack of a back-up water source for residents is a concern. During periods of drought or in the event of a disaster that restricts residents' access to their private wells, there is no other viable water source in town for them to access water. Septic was also mentioned in this discussion as an issue.

Debris that falls off trains during railway operations is not routinely or regularly cleared by CSX. That debris pollutes the ecosystem because it washes into nearby waterways. There is major concern about hazardous and dangerous materials, potential derailment, and fires. The fire concerns are related to both train travel and track cleaning operations throwing sparks that have ignited fires in the past.



Lastly, the electricity is vulnerable in town due to overhead lines surrounded by trees and potential hazards. The Core Team agreed that underground wiring would resolve a lot of the electrical hazard issues they have in town.

Societal

The Core Team noted several societal challenges. A large proportion of the citizens are aged 65 or older. People 65 and older are considered a Climate Vulnerable Population because they tend to be especially impacted by natural hazards. The elderly in town can be reluctant to evacuate their homes due to mobility issues and property concerns. During the Workshop, residents reported that there can be feelings of anxiety and isolation that can be enhanced by the risk of being trapped by weather hazards. Access to schools, work, and stores are limited, particularly during the winter months.

There is also a growing concern about the well-being of emergency responders, who are limited in number, due to the low population in the area. The workshop participants voiced the need for training grants and operational funding for climate emergencies to support them.

The town has "summer residents" that are seasonal and change the culture of the town during these months. There is a need for better inclusion and communication with these residents because they do not always share the same hazard concerns as full-time residents, focusing more on the hazards that affect them during their time of residency.

Environmental

Environmental vulnerabilities in Middlefield relate to a lapse in consistent communication with DCR, Division of Fisheries and Wildlife (DFW or MassWildlife), The Nature Conservancy Land Trust, and CSX. These entities are responsible for their trees and forested area. Diseased and fallen trees decrease the tree canopy in remote areas, in turn decreasing the Town's resilience to increasing temperatures and precipitation. Also, the resulting dead wood increases the potential of wildfires. Invasive species that target trees in the area compound this effect.

Farms in town are vulnerable to weather hazards, particularly drought, causing the inability to water food and animals.

The beaver population continues to be a concern. The beaver population is expanding, resulting in more and larger beaver dams. The beaver population contributes some benefits to the natural environment. Beaver activity supports valuable and productive wetlands resources, creating habitat for a diversity of species. Their impoundments reduce erosion, trap sediment, and may reduce stream power downstream which can mitigate the potential for flash flooding downstream. Alternately, the beaver dams can increase the danger of localized flooding by altering the natural water flow and drainage in the immediate area. When those dams are breached by severe storms or extreme precipitation, the resulting sudden, uncontrolled water overwhelms culverts and natural drainage resulting in localized flooding.

CURRENT STRENGTHS AND ASSETS

The Town functions and operations are managed by a dedicated core group of individuals. Most of these individuals hold multiple roles and/or have been volunteering for extended periods of time. These people will continue to be invaluable resources to share lessons previously learned as well as leaders to mitigate the impact of future climate change.

Azure Green, a private business, opens itself up for community events through The Blossom Center. The owner has offered that space as shelter space in times of need. The Blossom Center holds many events during the year, attracting residents to the establishment and bringing a sense of community and support.

Middlefield is in the beautiful mountains of Western Massachusetts. The remote nature of the community results in less pollution, cleaner air and water, and an overall healthier environment for residents of all ages compared to larger metropolitan areas.

The Town has a well-supported Senior Center that is active in assisting the town's Senior population.

Within town, there is a strong sense of community and mutual support. When a disaster or emergency occurs, those who can help are quick to respond. Neighbors help each other when and however they can during emergencies or other disasters. Because the Town is limited in numbers and resources, mutual aid agreements between municipalities are a necessary asset to ensure basic functions.

Middlefield has continued to update its Hazard Mitigation and other important plans in a timely manner and has Boards and Commissions that are well organized and effective.

TOP RECOMMENDATIONS AND STRATEGIES TO IMPROVE RESILIENCE

The recommendations, in the order voted by Workshop participants, were as follows.

Improve High-Capacity Drainage on Roads and Improve Paving. The impact of improving roadways is felt by every resident in town. As mentioned above, flooding and other severe weather events damage Middlefield's gravel surfaced roads. The resulting road closures and restricted access isolate residents and cause major disruption in the ability of residents to go to work or evacuate in emergency situations, as well as for emergency services to reach residents.

Establish a Townwide Communication System. Due to the impact of climate change in the community, one of the Town's greatest concerns is its inability to reach residents in certain areas, particularly those who identified as climate vulnerable populations. Understanding that every second counts in terms of emergency situations caused by climate catastrophe, the Town would like to take measures to prioritize the safety of their citizens. The Town is looking for a system that can effectively communicate real time information to all residents.

Identify Funding for Garaging Emergency Vehicles. The Town has a small operational budget with limited tax resources and fees in the jurisdiction and relies on grants and debt exclusion to fund expensive emergency vehicles for Emergency Management Services, which, in turn, protect all residents from climate hazards and disaster events in time of need. These fleets are worn and have a much shorter life span due to the severe weather the town experiences. To continue to fund new fleet vehicles cuts into other necessary services or mitigation actions in Town, and that expense is more dramatic than finding a solution to protect these critical assets.

The remaining strategies considered are listed below, in the order they were voted on by the Workshop participants.

- Replace and repair bridges and culverts
- Better tree trimming/underground electric supply
- Training grants for emergency management
- Fix impacts of beaver dams
- Perform feasibility study for drainage of rivers to reduce erosion
- Foundation repair at Senior Center
- Charging Stations built in public spaces
- Access to water supply

HAZARD IDENTIFICATION AND RISK ASSESSMENT

INTRODUCTION

To begin the risk assessment for Middlefield, the Core Team reviewed the environmental hazards included in the Town's 2019 HMP. The Core Team discussed whether the same hazards remain relevant and if any other hazards should be added to the assessment. Additionally, the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP)[15] was used as a source for other potential hazards to include in this HMP. The Core Team agreed that the previous list of hazards remained relevant for Middlefield, and three hazards were added from the SHMCAP's list of hazards. The hazards not added were deemed not to pose a threat to Middlefield, largely based on its location (e.g., coastal hazards). Core Team members affirmed the risk assessment methodology used in the 2019 HMP, and they ranked the hazards by their frequency of occurrence, area of impact (location) and severity of impact. Those results were used as a source of information for the risk assessment.

In addition to the discussions during Core Team meetings concerning the hazards, a public survey was made available to the public that included the opportunity to rank the agreed-upon hazards as well as to suggest additional hazards if necessary. The public was mailed a paper copy of the survey with their quarterly tax bill. An online option was also available. Responses were collected and summarized using *Google Forms*, and the data were reviewed and factored into the final risk assessment.

An additional survey was also made available for Climate Vulnerable (CV) populations living in town. The primary hazard survey concluded with a brief definition of Climate Vulnerable populations and an invitation to a secondary survey for CV individuals in town. Respondents were invited to use the link on the Town's website to complete the survey online. Copies were also available at the Council on Aging building. The CV survey sought impressions of prior experiences and expectations of future experiences in dealing with emergency situations due to natural hazards in Middlefield. It included questions about how belonging to a CV population might change their experience when compared to other residents that are not a part of a CV population. Responses for this survey were also collected and summarized on *Google Forms* and used in completing the risk assessment.

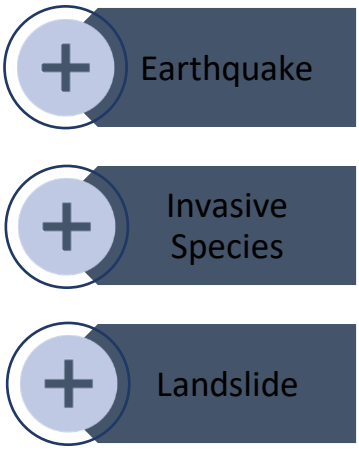
[15] Commonwealth of Massachusetts. (2018). *Massachusetts state hazard mitigation and climate adaptation plan (SHMCAP)*. Retrieved from https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf

NATURAL HAZARD RISK ASSESSMENT METHODOLOGY

The relevant hazards were reviewed based on the historical data available, the previous HMP, the SHMCAP, and the feedback and experiences of the members of town that contributed to the risk assessment. To determine the risk posed by each hazard, information was gathered concerning the description of the hazard, the location affected, the extent, previous occurrences, and the probability of future events. The vulnerability of the Town to each hazard was then determined based on the area of impact, frequency of occurrence, and magnitude or severity of the hazard.

HAZARD DESCRIPTION

The natural hazards for the Town of Middlefield are dam failure, drought, earthquake, extreme temperature, flooding, hurricanes/tropical storms, invasive species, landslide, severe snowstorm/ice storm, severe thunderstorm/wind/ tornado/microburst, and wildfire/brushfire. Earthquake, invasive species, and landslide were added to the hazards included in the 2019 HMP per the Core Team. Many hazards will have a similar impact or can be interrelated within the community. For example, extreme high temperatures often involve prolonged drought conditions that can, in turn, lead to a wildfire or brushfire.



It should be noted that the following hazards, assessed in the 2018 SHMCAP, are not applicable to the Town of Middlefield:

- Coastal Flooding,
- Coastal Erosion, and
- Tsunami.

These hazards are not applicable to Middlefield since it is not a coastal community.

LOCATION

The location is a statement of the area impacted by the hazard. Three categories were used during the risk assessment.

Rank	*Approximate Size of Area of Town Affected*
Low	Less than 10% of Town
Medium	10 to 50% of Town
High	More than half of Town

EXTENT

The extent of the hazard is measured based on existing measures of strength, magnitude, or severity. Each hazard category's scale is unique to that hazard. The measure of extent is done retroactively, meaning after the natural hazard event has taken place.

PREVIOUS OCCURRENCES

Data for previous occurrences were collected from NOAA or other authorities that collect and publish historic weather-related data. Core Team members and survey responses were then reviewed to detail how significant events affected the town.

PROBABILITY OF FUTURE OCCURRENCES

Trends in historic data were used to project the likely probability of future events for hazards. Projections from ReslientMA.org were also reviewed to account for the impact of climate change on future trends. The following categories were used:

Rank	*Annual Probability of Future Events (estimated)*
Very low	Less than 1% chance in the next year
Low	1 - 10% chance in the next year
Moderate	10 – 40% chance in the next year
High	40 - 70% chance in the next year
Very high	70 - 100% chance

CLIMATE CHANGE IMPACT

Relevant data concerning climate change were collected and reviewed. The anticipated impact of climate change for the hazard was then assessed.

IMPACT

The impact of each hazard was categorized. Impact incorporates the extent measure, but it makes a prediction about the expected effect on the town in the event of a future natural hazard event. The impact is expressed in injuries/lives, dollars (property damage), critical facilities/ infrastructure, and interruptions to quality of life or services, as applicable, per the descriptions below.

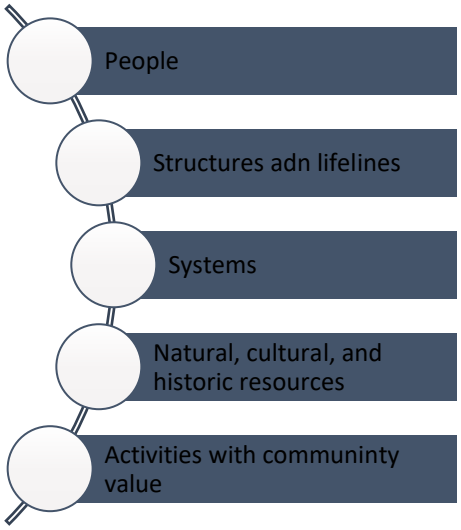
Rank	*Description of impact of hazard event*
Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of facilities.
Limited	Minor injuries only.

	More than 10% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 day.
Critical	Multiple injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 week.
Catastrophic	Multiple deaths and injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of facilities for 30 days or more.

VULNERABILITY

The Town's vulnerability to each hazard was determined based on the above measures while considering how Middlefield's people, structures, systems, resources, and/or community activities are at risk.

The ranking applied to each hazard is not derived from a specific formula. Instead, it is an assessment made by reviewing available data and relating that information to discussions with the Core Team, CRB Workshop participants, and public input. While not strictly quantitative, the ranking is derived from estimated damages, probability of future events, expected impacts, and/or climate change projections to the extent feasible. It also reflects more qualitative information like the concerns of the Town based on their experiences and local knowledge.



A final ranking was assigned according to the following scale:

Rank	***Vulnerability to hazard***
1	Very low
2	Low
3	Medium
4	High
5	Very high

RISK ASSESSMENT SUMMARY TABLE

Hazard	*Location*	*Probability of Future Events*	*Impact*	*Vulnerability*
Dam Failure	Small	Very low	Minor	Very low
Drought	Large	Very high	Limited	High
Earthquake	Large	Low	Minor	Low
Extreme Temperature	Large	Very high	Limited	High
Flooding **(General – *G* & Localized - *L*)**	Small	Low (*G*) High (*L*)	Critical	High
Hurricanes & Tropical Storms	Large	Low	Limited	Medium
Invasive Species	Large	High	Minor	Low
Landslide	Small	Very low	Minor	Very low
Severe Snowstorm/ Ice Storm	Large	Very high	Minor	High
Severe Thunderstorm/ Wind/Tornado/Microburst	Medium	High	Critical	High
Wildfire/Brushfire	Large	Moderate	Critical	High

***Table 3**. Summary of risk assessment by hazard*

DAM FAILURE

DESCRIPTION

Dam failures refer to several types of events involving a dam rapidly losing some or all the water it is retaining. The water then floods lower lying land called inundation areas. Inundation areas are often populated; therefore, the flooding has a direct impact on the people and structures below the dam.

A complete list of dam failure events is provided by the U.S. Army Corps of Engineers in ***Table 4*** below. Different failure events are associated with different types of dams.

Failure Mode	*Earthen/ Embankment*	*Concrete Gravity*	*Concrete Arch*	*Concrete Buttress*	*Concrete Multi-Arch*
Overtopping	x	x	x	x	x
Piping/Seepage	x	x	x	x	x
Foundation defects	x	x	x	x	x
Sliding	x	x		x	
Overturning		x	x		
Cracking	x	x	x	x	x
Equipment Failure	x	x	x	x	x

Table 4*. Possible failure modes for various types of dams*[16]

Most categories of dam failure are structural failures. Structural failures typically result from the deterioration of the structure over time, especially when the dam is not properly maintained, or from excessive forces acting on the dam. These events can be the result of a large influx of water from a severe weather event or flooding upstream that results in a sudden increase in the forces exerted on an already compromised or weak dam. The Massachusetts Office of Dam Safety (ODS) requires dams in the Commonwealth, both public and private, to be assessed by qualified engineers every two, five, or 10 years based on the hazard rating of the dam. Hazard ratings are assessments of the potential damage a failure of the dam would cause. The higher the hazard rating, the more frequently the dam is required to be inspected. The U.S. Army Corps of Engineers maintains a National Inventory of Dams (NID)[17] listing the most recently reported condition of all registered dams.

In addition to structural dam failures, many dams can also shed water without an underlying structural problem. Many have a built-in failure mechanism called a spillway. A spillway is designed to allow excess water (i.e., above a certain depth) to escape the dam in a controlled manner, thereby decreasing the forces exerted on the dam to prevent a structural failure. The

[16] U.S. Army Corps of Engineers. (n.d.). *Causes and types of dam failures: Possible failure modes for various types of dams*. Retrieved on October 27, 2022, from https://www.hec.usace.army.mil/confluence/rasdocs/ras1dtechref/latest/performing-a-dam-break-study-with-hec-ras/estimating-dam-breach-parameters/causes-and-types-of-dam-failures

[17] U.S. Army Corps of Engineers' *National Inventory of Dams*. Available at https://nid.usace.army.mil/#/

escaping water is directed to a channel or other area to control the flow away from populated areas. Overtopping, or breaching, is a similar event caused by the water level exceeding the height of the dam. Breaching is less desirable than a spillway event when breaching releases water into an area not specifically designed to control or direct the overflowing water.

LOCATION

There are currently two dams located in Middlefield. The Virginia Lake Shore Dam, located along the western border between Middlefield and Washington (see ***Figure 6***) is privately owned by Preston Pond, LLC. The NID lists this dam as a low hazard dam in poor condition[18]. The date of the last dam inspection is not listed, but, because it is a low hazard dam, inspections should occur every 10 years at the owner's expense. According to local officials, this earthen dam was purchased by Preston Pond, LLC to prevent the dam's removal.

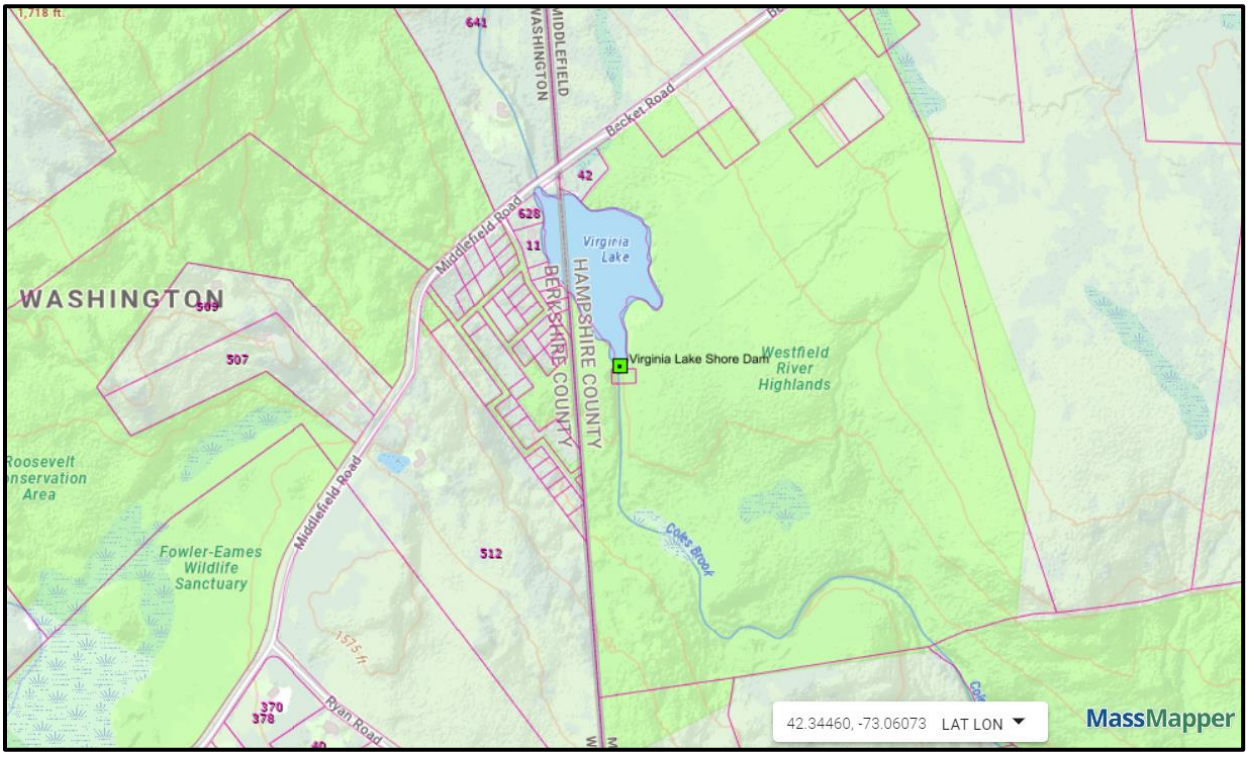


Figure 6*. Location of the Virginia Lake Shore Dam (green square)*[19]

The second dam listed by the NID and confirmed by local officials as actively retaining water is the Coles Brook Pond Dam (see ***Figure 7***). This dam is listed as a low hazard dam in fair condition based on the last assessment dated 4/23/3009[14]. Local officials indicate the Coles Brook Pond Dam is located at the end of Reservoir Road on the Town's border with Washington, but the NID lists the dam as being on the Washington side of the border. Also, local

[18] U.S. Army Corps of Engineers. (n.d.). *National Inventory of Dams: Virginia Lake Shore Dam*. Retrieved on February 1, 2023, from https://nid.usace.army.mil/#/dams/system/MA00494/inspections

[19] Massachusetts Office of Dam Safety. (n.d.). *MassMapper GIS*. Retrieved on January 30, 2023, from https://maps.massgis.state.ma.us/MassMapper/MassMapper.html

officials indicate the dam is privately owned by the Trustees of Reservations, but the NID lists The Nature Conservancy as the owner. Whether this dam is located in Middlefield or Washington, the natural water flow in the event of a failure would be toward Middlefield, therefore inclusion of this dam in the risk assessment is appropriate.

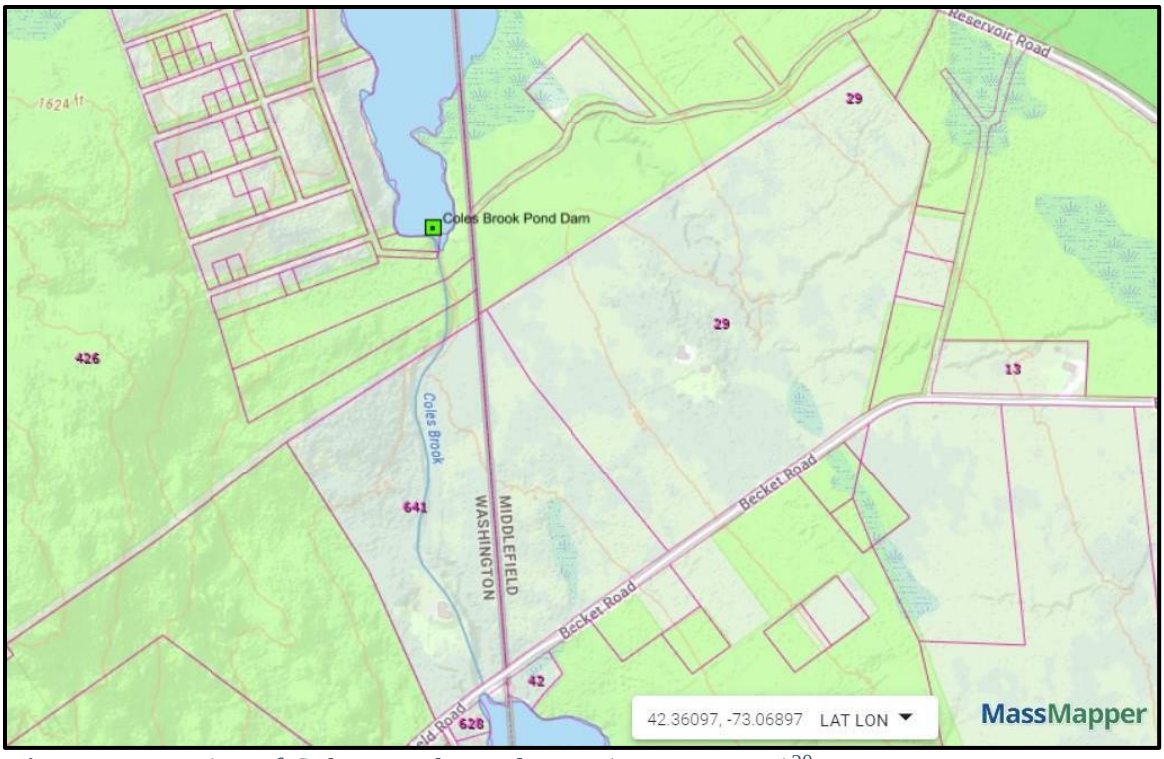


Figure 7*. Location of Coles Brook Pond Dam (green square)*[20]

There was previously one other dam located in Middlefield that is not included in the National Dam Inventory that bears mention. According to ODS, the Upper Reservoir Dam (see ***Figure 8***) is located along the southern border of Middlefield with neighboring Becket. According to the 2019 HMP, the dam located along the southern border with Becket no longer is holding water or has washed away, along with the Golden Fleece and Paper Manufacturing Company Dams, prior to the completion of that report.

Because the Virginia Lake Shore Dam and Coles Brook Pond Dam are low hazard dams, either's failure would impact less than 10% of town, so the location rating for dam failure is **small**.

[20] Massachusetts Office of Dam Safety. (n.d.). *MassMapper GIS*. Retrieved on April 4, 2023, from https://maps.massgis.digital.mass.gov/MassMapper/MassMapper.html

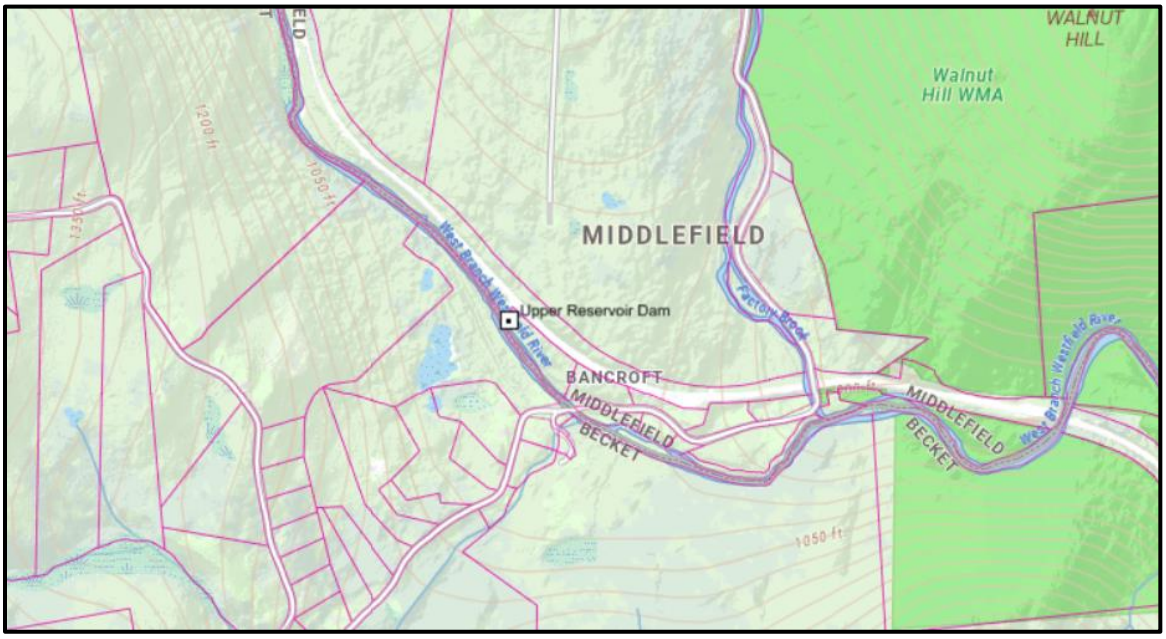


***Figure 8**. Former location of the Upper Reservoir Dam (white square)*[21]

EXTENT

The Virginia Lake Shore Dam is the only dam of concern in town. The ODS identifies this dam as a low hazard potential dam because of the limited potential risk it poses in the event of its failure. A low hazard potential dam is a "dam located where failure may cause minimal property damage to others. Loss of life is not expected." (M.G.L. c.21 §65(a), 2012)[22]. Given this rating, a failure would affect less than 10% of town. Middlefield does not have access to a current assessment of the expected inundation area of this dam. Because the water would naturally flow downstream largely along Coles Brook, it is assumed that no homes in Middlefield would be in the inundation area.

PREVIOUS OCCURRENCES

There have been several dam failures in Middlefield as detailed in the 2019 HMP. The catastrophic dam failure of the Reservoir Dam and flood of 1874 took out most of the mills in town. The dam and mills were rebuilt, but another dam failure in 1901 destroyed the mills again. Further attempts at rebuilding the dam and mills were then abandoned. The 2019 HMP also records that the Upper Goose Pond Dam (no longer listed as a dam with the Office of Dam Safety) failed twice in the town's history washing away the rail lines. No dam failures resulting in injury, loss of life, or property damage in Middlefield have occurred since the 2019 HMP.

[21] Massachusetts Office of Dam Safety. (n.d.). *MassMapper GIS*. Retrieved on January 30, 2023, from https://maps.massgis.state.ma.us/MassMapper/MassMapper.html

[22] Massachusetts General Laws ch. 21, § 65(a). (2012).

PROBABILITY OF FUTURE EVENTS

The likelihood of a dam failure in Middlefield is **very low**, with only a 1% chance of a dam failure each year. The registered, privately owned dam is in *fair* condition, though the date of the last assessment is unknown. Assuming ongoing assessment according to the required schedule and corresponding maintenance activities, there is little reason to expect the dam to fail, even with predicted increases in extreme precipitation events.

CLIMATE CHANGE IMPACT

The impact of climate change on dam failure primarily results from changes to expected precipitation. There are expected increases in annual precipitation and days with more than 1 inch of precipitation. These data indicate an increase in more severe precipitation events where there is more rain or snowfall in a shorter period of time. An increase of severe precipitation events will slightly increase the potential of dam failure in the coming decades, but the overall risk is not greatly affected due to the limited number and size of the dams in Middlefield.

IMPACT

In the event of a failure of the Virginia Lake Shore Dam, less than 10% of town would be impacted, and that area is unpopulated. Due to the very limited nature of this dam's failure, the impact of a dam failure on the town would be **minor**. Future conditions with impacts of climate change would increase the impact of dam failure as stated above.

VULNERABILITY

Given the location affected, probability of future events, and expected impact, the risk assessment of Middlefield's vulnerability to dam failure is rated as **very low**. There are only three small dams remaining in town, the potential affected locations are small, and the predicated impact is minor.

People

There are no homes in the expected flood zone of the Virginia Lake Shore Dam. If the dam were to fail, injuries or deaths would not be likely given the size and location of the dam. The LLC that owns the dam could incur minor cleanup costs or repair costs should it choose to rebuild the dam.

Structures and lifelines

There is no anticipated impact on travel or access to critical lifelines because the waterflow from the reservoir would flow south and away from nearby roads and properties in neighboring Washington.

Systems

There is limited to no anticipated impact on existing systems in the event of a dam failure in Middlefield.

Natural, cultural, and historic resources

There would be a minor effect on the Westfield River Highlands, where most of the floodwater would pool. This could result in some tree loss due to the unusually soft soil, but this effect would be limited.

DROUGHT

DESCRIPTION

NOAA defines drought as dry weather patterns dominating an area. Low water supply becomes evident, especially in streams, reservoirs, and groundwater levels, usually after many months of drought. Agricultural drought happens when crops become affected. And socioeconomic drought relates the supply and demand of various commodities to drought. Some droughts can begin and end rapidly, while others take much longer to develop and then recover. Based on past events, it appears that Western Massachusetts may be more vulnerable than Eastern Massachusetts to severe drought conditions.

LOCATION

Drought affects the entire region, and that is why it is generally categorized regionally. The conditions impact the entire town. Therefore, the location ranking is **large**. Areas of Middlefield may experience minor differences in levels of drought based on vegetation, altitude, and proximity to water supplies.

EXTENT

Many different indices have been developed over the decades to measure drought in these various sectors. The U.S. Drought Monitor depicts drought integrated across all time scales and differentiates between agricultural and hydrological impacts.

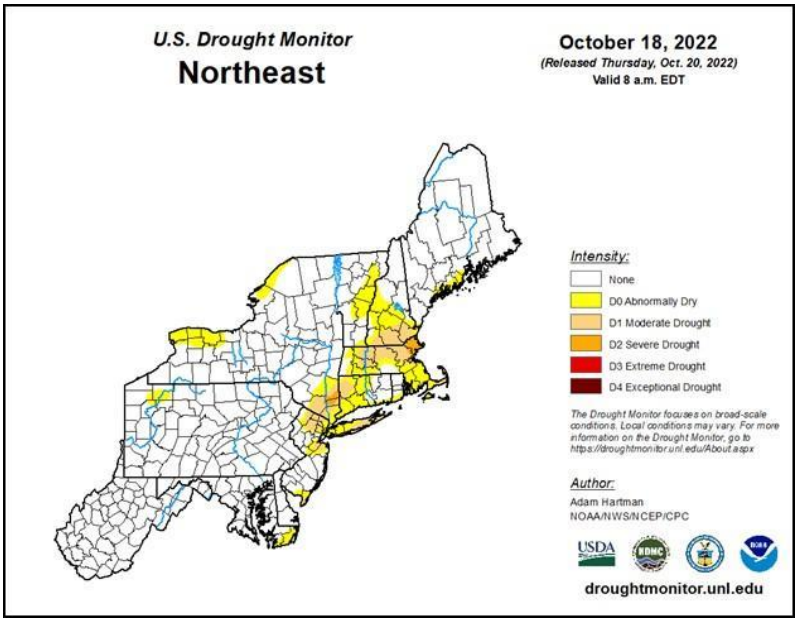


***Figure 9**. Drought intensity in northeastern U.S., October 2022*[23]

Table 5, below, indicates what percentage of locations in Hampshire County were in various categories of drought over the last year, according to the U.S. Drought Monitor. The U.S. Drought Monitor identifies the intensity of the drought by the following scale:

- None
- D0, Abnormally Dry
- D1, Moderate Drought
- D2, Severe Drought
- D3, Extreme Drought
- D4, Exceptional Drought

Based on this data, some level of drought was recorded in 34 out of 52 weeks, equaling 65% of the year.

Week	None	D0-D4	D1-D4 [z]	D2-D4	D3-D4	D4
2/1/2022	100	0	0	0	0	0
2/8/2022	100	0	0	0	0	0
2/15/2022	100	0	0	0	0	0
2/22/2022	100	0	0	0	0	0
3/1/2022	100	0	0	0	0	0
3/8/2022	100	0	0	0	0	0
3/15/2022	100	0	0	0	0	0
3/22/2022	100	0	0	0	0	0
3/29/2022	100	0	0	0	0	0

[23] National Drought Mitigation Center. (2022). *U.S. Drought Monitor Northeast: October 18, 2022*. University of Nebraska-Lincoln. Retrieved from https://droughtmonitor.unl.edu

4/5/2022	100	0	0	0	0	0
4/12/2022	100	0	0	0	0	0
4/19/2022	100	0	0	0	0	0
4/26/2022	100	0	0	0	0	0
5/3/2022	100	0	0	0	0	0
5/10/2022	100	0	0	0	0	0
5/17/2022	100	0	0	0	0	0
5/24/2022	91.17	8.83	0	0	0	0
5/31/2022	53.69	46.31	0	0	0	0
6/7/2022	1.25	98.75	0	0	0	0
6/14/2022	1.25	98.75	0	0	0	0
6/21/2022	0	100	0	0	0	0
6/28/2022	0	100	100	0	0	0
7/5/2022	0	100	100	0	0	0
7/12/2022	0	100	100	0	0	0
7/19/2022	0	100	100	0	0	0
7/26/2022	0	100	100	0	0	0
8/2/2022	0	100	100	0	0	0
8/9/2022	0	100	100	0	0	0
8/16/2022	0	100	100	100	0	0
8/23/2022	0	100	100	100	0	0
8/30/2022	0	100	100	100	0	0
9/6/2022	0	100	100	77.4	0	0
9/13/2022	0	100	100	77.4	0	0
9/20/2022	0	100	100	76.04	0	0
9/27/2022	0	100	100	42.3	0	0
10/4/2022	0	100	100	42.3	0	0
10/11/2022	0	100	100	3.83	0	0
10/18/2022	0	100	59.21	0	0	0
10/25/2022	0	100	2.66	0	0	0
11/1/2022	0	100	2.66	0	0	0
11/8/2022	0	100	2.66	0	0	0
11/15/2022	0	100	0.01	0	0	0
11/22/2022	0	100	0.01	0	0	0
11/29/2022	0	100	0.01	0	0	0
12/6/2022	0	100	0.01	0	0	0
12/13/2022	0	100	0	0	0	0
12/20/2022	17.54	82.46	0	0	0	0
12/27/2022	17.54	82.46	0	0	0	0
1/3/2023	17.54	82.46	0	0	0	0
1/10/2023	24.19	75.81	0	0	0	0
1/17/2023	100	0	0	0	0	0
1/24/2023	100	0	0	0	0	0

***Table 5**. Percent of Hampshire County in each drought category from 2/1/22 – 1/27/23*[24]

In Hampshire County, drought conditions have occurred regularly over the past 23 years. ***Figure 10***, below, shows the percent of the county in each drought category over time, from January 2000 to present. Drought occurred in 83% of those years (19 of the 23 years).

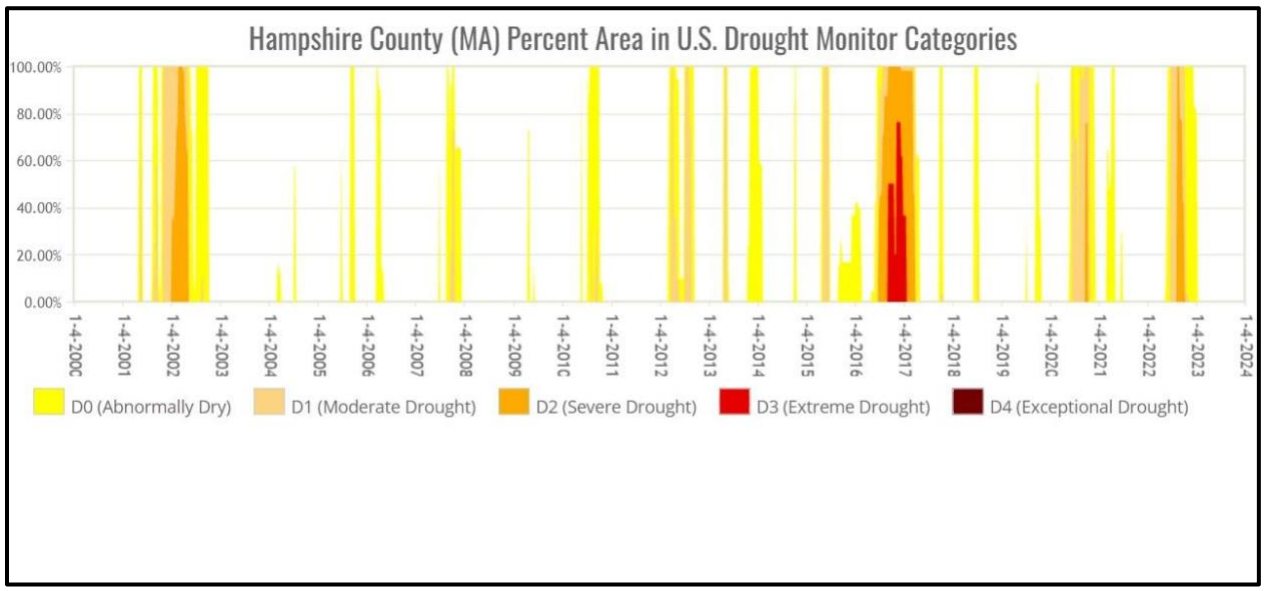


***Figure 10**. Percent of Hampshire County in various drought categories from 2000 – 2023*[25]

PREVIOUS OCCURRENCES

The Massachusetts Drought Management Plan was developed in response to a period of deficient precipitation that began in 1999. The most severe drought of modern times was the drought of the 1960s, equivalent to a drought emergency. A less severe drought occurred in the early 1980s. The Commonwealth experienced another impactful drought in 2016-2017 with drought levels reaching a Level 4 Drought (Warning) out of five levels of drought; the drought impacted the agricultural sector, some water supplies, the natural environment and many habitats and species.

Massachusetts maintains a record of the drought status by region from 2001 thru 2022 that can be found at https://www.mass.gov/doc/drought-status-history-0/download.

[24] National Drought Mitigation Center. (n.d.). *U.S. Drought Monitor: Data tables: Percent area in U.S. drought categories: Hampshire County, MA*. University of Nebraska-Lincoln. Retrieved from https://droughtmonitor.unl.edu/DmData/DataTables.aspx

[25] National Drought Mitigation Center. (n.d.). *U.S. Drought Monitor: Time series: Hampshire County, MA*. University of Nebraska-Lincoln. Retrieved from https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx

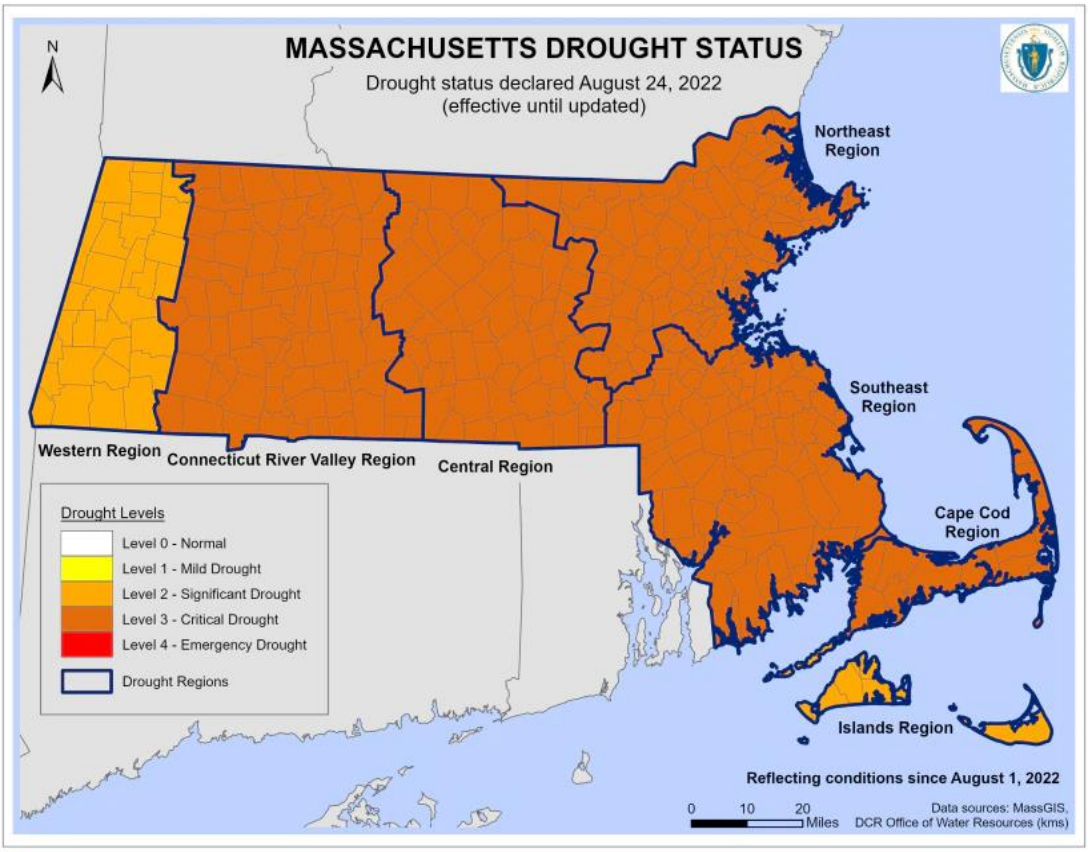


***Figure 11**. Regional drought status at the height of the summer of 2022 drought*[26]

PROBABILITY OF FUTURE EVENTS

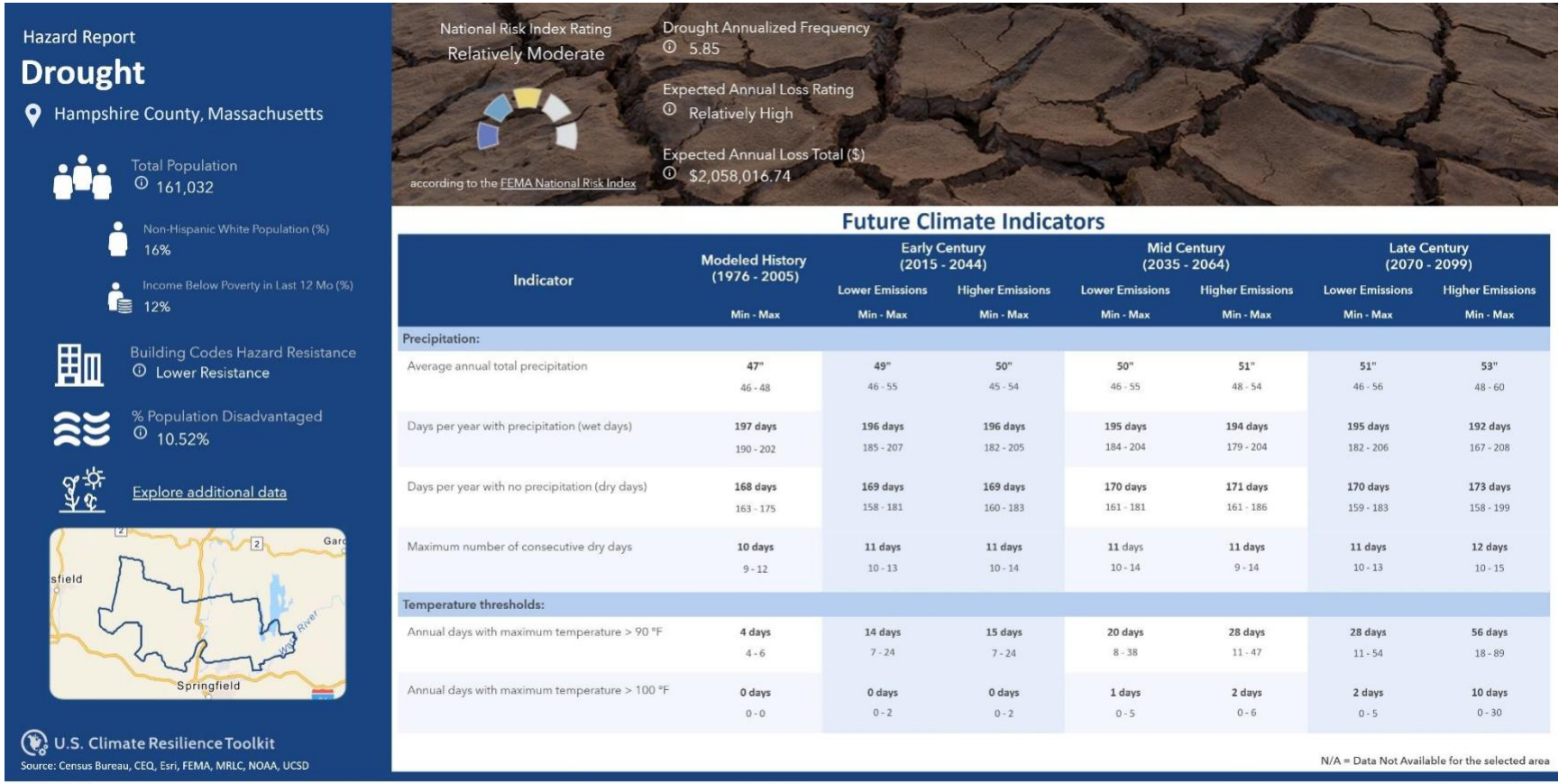
Based on previous occurrences, there is an 83% chance, or **very high** probability, of drought in Middlefield on an annual basis. Climate change is causing a change in precipitation patterns, warmer summers, and longer dry seasons.

CLIMATE CHANGE IMPACT

The impact of climate change on the risk of drought for Hampshire County is limited. Even under high emission conditions, the expected change in the annual number of dry days, consecutive dry days, and days above 100°F each only increase by a few days per year through the mid-century. The largest predicted increase is in the number of days above 90°F, which could increase by over 20 days in the same timeframe. Because there is already a very high chance of a drought annually, climate change will not significantly change the likelihood of drought in the coming decade. Please see ***Table 6*** for more detail.

[26] Massachusetts Office of Water Resources. (2022). *Massachusetts drought status*. Massachusetts Department of Conservation and Recreation. Retrieved from https://www.mass.gov/news/risk-of-wildland-fires-increases-as-drought-persists

Since Middlefield is an aging population with a median age of over 59, as time progresses more members of the population will be considered elderly and thus, climate vulnerable. Elevated temperatures and drought conditions could create debilitating conditions for the elderly and less mobile. While there is a limited concern for climate change exacerbating drought conditions, the existing concerns will become more pressing as members of the community continue to age.



Hazard Report

Drought

Hampshire County, Massachusetts

Total Population
161,032

Non-Hispanic White Population (%)
16%

Income Below Poverty in Last 12 Mo (%)
12%

Building Codes Hazard Resistance
Lower Resistance

% Population Disadvantaged
10.52%

Explore additional data

U.S. Climate Resilience Toolkit

Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

National Risk Index Rating
Relatively Moderate

according to the FEMA National Risk Index

Drought Annualized Frequency
5.85

Expected Annual Loss Rating
Relatively High

Expected Annual Loss Total ($)
$2,058,016.74

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Average annual total precipitation	47" 46 - 48	49" 46 - 55	50" 45 - 54	50" 46 - 55	51" 48 - 54	51" 46 - 56	53" 48 - 60
Days per year with precipitation (wet days)	197 days 190 - 202	196 days 185 - 207	196 days 182 - 205	195 days 184 - 204	194 days 179 - 204	195 days 182 - 206	192 days 167 - 208
Days per year with no precipitation (dry days)	168 days 163 - 175	169 days 158 - 181	169 days 160 - 183	170 days 161 - 181	171 days 161 - 186	170 days 159 - 183	173 days 158 - 199
Maximum number of consecutive dry days	10 days 9 - 12	11 days 10 - 13	11 days 10 - 14	11 days 10 - 14	11 days 9 - 14	11 days 10 - 13	12 days 10 - 15
Temperature thresholds:							
Annual days with maximum temperature > 90 °F	4 days 4 - 6	14 days 7 - 24	15 days 7 - 24	20 days 8 - 38	28 days 11 - 47	28 days 11 - 54	56 days 18 - 89
Annual days with maximum temperature > 100 °F	0 days 0 - 0	0 days 0 - 2	0 days 0 - 2	1 days 0 - 5	2 days 0 - 6	2 days 0 - 5	10 days 0 - 30

N/A = Data Not Available for the selected area

February 28, 2023

***Table 6**. Hazard report, drought*[27]

This table includes projections for drought potential in Hampshire County across the century given either low or high emission scenarios. There are minor changes expected in the number of wet and dry days, consecutive dry days, and days above 100F. The largest change is for the number of days above 90F. Given the expected changes, the likelihood of Middlefield experiencing drought each year will remain very high.

[27] National Oceanic and Atmospheric Administration. (n.d.). *Climate Mapping for Resilience and Adaptation: Hampshire County*. Retrieved on February 28, 2023, from https://cmra-reports.s3.amazonaws.com/county/25015.html

IMPACT

Drought has affected Middlefield, particularly over the past few years, as it has become a recurring pattern in the warmer months. Severe and recurrent droughts can lead to emergency conditions. One major change is the increase in the fire hazard. As droughts increase, the town's tree canopy decreases. The increased supply of dead trees raises the probability of structure fires and wildfires, and the reduced canopy further increases temperatures in the area. In the case of fires, drought's impact is compounded by also decreasing the water supply available for firefighting activities. Finally, extreme temperatures are now the leading cause of death from weather-related causes.

Drought and extreme temperatures also reduce water levels. The deceased water supplies impact natural vegetation and wildlife as well as the agriculture in the region. The impact on agriculture includes decreased crop yield as well as increased mortality rates for livestock, including Left Field Farms and Blue Haven Blueberry and Raspberry Farm. Finally, residents rely on private well water for residential uses, and the Fire Department's water supply for firefighting is also diminished in these conditions.

Without back up water supplies, an extended or severe drought could result in loss of livestock and crops; continued loss of the town's tree canopy; interruptions to critical lifelines, notably the Town's ability to fight fires; and detrimental health impacts, especially to Climate Vulnerable populations. To prepare for an extended or severe drought, Middlefield would require improved water saving resources as well as secondary water supplies for residents and agriculture use.

Taken together, the factors above indicate that extreme temperatures and drought events would have a **limited** impact on Middlefield.

VULNERABILITY

Based on the above assessment, Middlefield has a hazard index rating of **high** risk from drought. Climate change is driving the temperature up and increasing the consecutive dry days as precipitation events become fewer and more severe. As droughts increase in intensity or duration, more trees die. The increased fuel load in heavily wooded areas will also increase the risk of wildfire or brushfires. Given the high percentage of forested area in town, the reliance on private wells, and lack of back-up water supply for public use or firefighting activities, drought is becoming a greater concern to Middlefield.

People

Because 93% of Middlefield is forested, the increased likelihood of a wildfire or brushfire with the increased fuel load puts the people in town at risk. Drought also decreases the groundwater supply, leading to private wells drying up and decreasing the available public supply for firefighting. This puts all residents at risk, but the elderly population would be at an even greater risk since it would be more difficult to afford and obtain water to supplement well water when needed.

Structures and lifelines

As stated above, 93% of Middlefield is forested, so the increased likelihood of a wildfire or brushfire due to drought conditions puts the built structures in town at risk. Outdoor construction and repair services, including highway department work, could also be impacted by ongoing drought. Drought is not as likely to impact community lifelines as some other hazards, but local agriculture would be heavily affected. Farmers would incur additional expenses to water crops and/or animals, and they would also experience a decreased yield.

Systems

Various systems in Middlefield would be affected by ongoing drought. The elderly, as mentioned above, could be at higher risk for losing water access, so the COA would be tasked with identifying and remediating access issues. Because a drought is often paired with extreme heat, those same individuals could also be facing dangerous heat, requiring relief by way of a cooling station. The electrical network would be strained with the increased load across town. The increased load can lead to brownouts while the supply lines themselves would simultaneously be at greater risk of falling trees.

Another concern during periods of extended drought is the diminished water supply for firefighting as mentioned above. This decreased capacity puts the people of town at greater risk of fires, but also makes fighting forest fires even more challenging.

Natural, cultural, and historic resources

Droughts cause more trees to die as they dry out because of insufficient water. As more and more trees die, the increased fuel load in heavily wooded areas increases the risk of wildfires and brushfires. In times when the trees are generally healthy and sufficiently watered, wildfire can be devastating due to the extreme heat they generate. The impact on compromised trees compounds the impact.

Federal and State disasters in Middlefield

Middlefield's most recent Hazard Mitigation Plan was approved on March 8th, 2019. According to the FEMA Disaster Declarations for States and Counties data tool, since the previous plan was approved, only two disasters have been declared in Hampshire County. One on March 13th, 2020, and one on March 27th, 2020[28]. Both disasters were categorized as biological and were declared because of the COVID-19 pandemic. The disaster categories available on the FEMA Disaster Declaration tool include flood, hurricane, severe ice storm, severe storm, and snowstorm which can be contrasted with the identified hazards laid out in this updated plan (dam failure, drought, earthquake, extreme

[28] Federal Emergency Management Agency. "Disaster Declarations for States and Counties ." 2023, https://www.fema.gov/data-visualization/disaster-declarations-states-and-counties.

temperatures, flooding, hurricanes & tropical storms, invasive species, landslide, severe snowstorm/ice storm, severe thunderstorm/wind/tornado/microburst, and wildfire/brushfire). The FEMA Disaster Declaration data tool makes no mention of any disaster events in any other category aside from biological in Hampshire County in the period following the adoption of Middlefield's 2019 plan. Thus, no state or federally declared disaster declaration additions should be made to the hazard categories outlined in this plan.

EARTHQUAKE

DESCRIPTION

New England is not generally a place that most residents think of earthquakes as a concern, but the increase in earthquake activity throughout the past two decades has increased, although it is not always noticeable. Earthquakes are caused by the shifting of rocks and plates beneath the Earth's surface. Although earthquakes have historically been categorized by activity below the surface, induced quakes can also be caused by human activity, such as underground construction or fracking projects.

LOCATION

Due to the nature of the earthquake and its risks, the entire town would be considered within the occurrence. Because the entire jurisdiction would be affected by the event, the location ranking is **large**. Earthquakes can be felt for hundreds of miles and, depending on the intensity of the Modified Mercalli Scale, any earthquake nearby would likely include the entire region.

EXTENT

Earthquakes are measured using the Richter Scale. Earthquake intensities are numerical values assigned to the effects of earthquakes on people and their works, and on the natural environment.

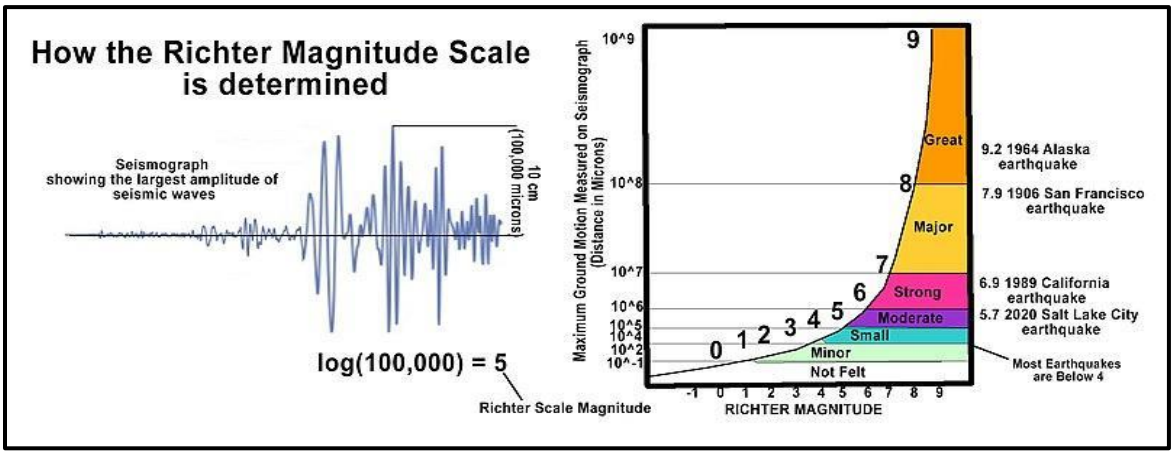


***Figure 12**. How the Richter Magnitude Scale is determined*

Intensities can also be evaluated using the Modified Mercalli Intensity Scale of 1931, which contains levels of effects ranging from intensity I, barely perceptible, to intensity XII, total damage.

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest,especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

***Table 7**. Modified Mercalli Intensity Scale of 1931*[29]

PREVIOUS OCCURRENCES

There have been no earthquakes in Middlefield since the 2019 HMP. Historically, earthquakes are rare in Western MA. The closest recorded earthquake occurred in 2012 in the Town of Northampton. The extent of this earthquake in Northampton is the closest occurrence of earthquake data identified to Middlefield. No data of occurrences have happened directly in the Town.

[29] United States Geological Survey. (n.d.). *The Modified Mercalli Intensity Scale of 1931*. Retrieved from https://www.usgs.gov/programs/earthquake-hazards/modified-mercalli-intensity-scale

Number of Felt Earthquakes in the Northeast States			
State	**Years of Earthquake Record**	**Number of Felt Earthquakes**	**Years with Damaging Earthquakes**
Connecticut	1678-2016	115	1791
Maine	1766-2016	454	1973, 1904
Massachusetts	1668-2016	408	1727, 1755
New Hampshire	1638-2016	320	1638, 1940
New Jersey	1738-2016	98	1884
New York	1737-2016	551	1737, 1929, 1944, 1983, 2002
Rhode Island	1766-2016	34	
Vermont	1843-2016	50	
Total Number of Felt Earthquakes		2030	

***Table 8**. Number of felt earthquakes in the northeastern states*[30]

PROBABILITY OF FUTURE EVENTS

FEMA's National Risk Index uses the Earthquake Index Value[31] to predict the risk of earthquake activity. The index compares earthquake activity by region and assesses the risk by region, in this case the Northeast region of the United States. Despite recent activity in 2020 in Southeastern Massachusetts, the risk of occurrence of an earthquake for the Middlefield area is assessed as *relatively* to *very low*, so there is a **low** probability of future events annually.

CLIMATE CHANGE IMPACT

The SHMCAP does not identify any impact on the risk from earthquakes due to climate change. Since Middlefield's previous Hazard Mitigation Plan was approved in 2019, there have been no changes in land use and development. Thus, the magnitude of earthquake risks remains as stated. However, since Middlefield is an aging population, as time progresses more members of the population will be considered elderly and thus increases risk of natural disaster harm due to limited mobility.

IMPACT

Earthquakes can impact the destruction of infrastructure including roadways, bridges, and buildings. Before 1975 there were no building codes in place that adhered to standards that

[30] The Northeast State Emergency Consortium. (2022). *Massachusetts earthquakes: History of earthquakes in Massachusetts*. Retrieved from https://nesec.org/massachusetts-earthquakes/

[31] Federal Emergency Management Agency. (n.d.). *National Risk Index: Earthquake*. Retrieved from https://hazards.fema.gov/nri/earthquake

would help in the mitigation of earthquake damage. Since most structures in town, particularly municipal buildings, and homes, were built before the 1980's, much of the town's building infrastructure does not meet the updated specifications to improve risk from impacts caused by earthquakes.

Despite the structures in town being susceptible to earthquake damage, the limited number of buildings in town and the generally weak nature of earthquakes in Western Massachusetts decreases the anticipated impact. Few, if any injuries would be expected, and only minor damage to structures or interruptions in services are likely. Therefore, the impact of earthquakes in Middlefield is **minor.**

VULNERABILITY

Based on the above analysis, Middlefield has a **low** vulnerability to earthquakes. The low likelihood and impact of an earthquake, especially due to the limited structures in town, mean that Middlefield and its residents are not particularly vulnerable to earthquakes.

People

Persons with limited financial means or stockpiles of goods could face some short-term challenges if a major earthquake impacts community lifelines. Given the low likelihood of earthquakes, and the expectation that they would be relatively weak events, means the people are most likely to face minor inconveniences in the event of an earthquake.

Structures and lifelines

Because Middlefield's community lifelines include businesses (e.g., grocery stores, hospitals, support services) located in neighboring communities, minor disruptions in these lifelines are possible if an earthquake causes one of more road closures. It is anticipated that any interruption would be short-term because anticipated earthquakes in Western MA would have limited strength. Should a much stronger earthquake unexpectedly affect Middlefield, private owners could face breaks in their water or septic systems.

Systems

Like other hazards, the electric supply and telecommunication lines represent the weakest link in Middlefield's systems in the event of an earthquake. Communication disruptions are the most likely outcome of an earthquake, either as a direct result of the movement of the tectonic plate causing a wire to fall or from a telephone pole or tree falling and taking out a line during the event.

Natural, cultural, and historic resources

Due to the volume of trees across Middlefield, an earthquake is likely to cause trees to fall. Other factors like drought, invasive species, and severe precipitation could create favorable conditions for a greater number of trees to fall than under less favorable conditions.

EXTREME TEMPERATURES

DESCRIPTION

Extreme heat is defined as a prolonged period of excessive heat above the average high for that time of year. For most of the United States, including Massachusetts, these conditions are considered met when there are two consecutive days above 90°F. Often, these periods are very humid, resulting in oppressive conditions. The Heat Index, a calculation of the "real feel" temperature, reflects what temperature it feels like by considering the temperature and humidity.

Since the beginning of the 20th century, the average temperature in Massachusetts has risen almost 3.5 degrees Fahrenheit according to NOAA. The number of warmer days has been increasing since 1995, with the highest averages experienced in the last seven years. The average daily temperature for the months of June through August has increased for all of Hampshire County, as has the number of warmer nights. These extreme temperatures can influence drought activity throughout the region.

During periods of extreme heat, residents are more at risk if they are inside buildings that lack cooling systems, work outdoors, or have underlying health issues. This threat to the population can typically be found in more vulnerable areas. Identifying these populations can be done by also understanding that hot weather conditions and extreme temperatures have claimed more lives in the past ten years than any other weather-related event, as hot weather contributes to unhealthy air quality.

Extreme cold, like extreme heat, is relative to average temperatures in the area for that time of year. Sustained temperatures below the average constitute extreme cold. Increases in extreme low temperatures have also been trending since the early 1990's. This period includes the severe winter of 2014 – 2015 that brought heavy snowfall and colder than normal temperatures.

LOCATION

Extreme temperatures affect the entire region, so they are generally categorized regionally. These conditions impact the entire town; therefore, the location ranking is **large**. It is important to note that different areas of Middlefield may experience different levels of heat or cold based on vegetation, altitude, and proximity to water supplies.

EXTENT

There are countless ways to measure temperature change over time. The primary measures include average temperatures across various scales (e.g., day, month, year) and record high and low temperatures. These temperatures are reported at the local, regional, national, or global level.

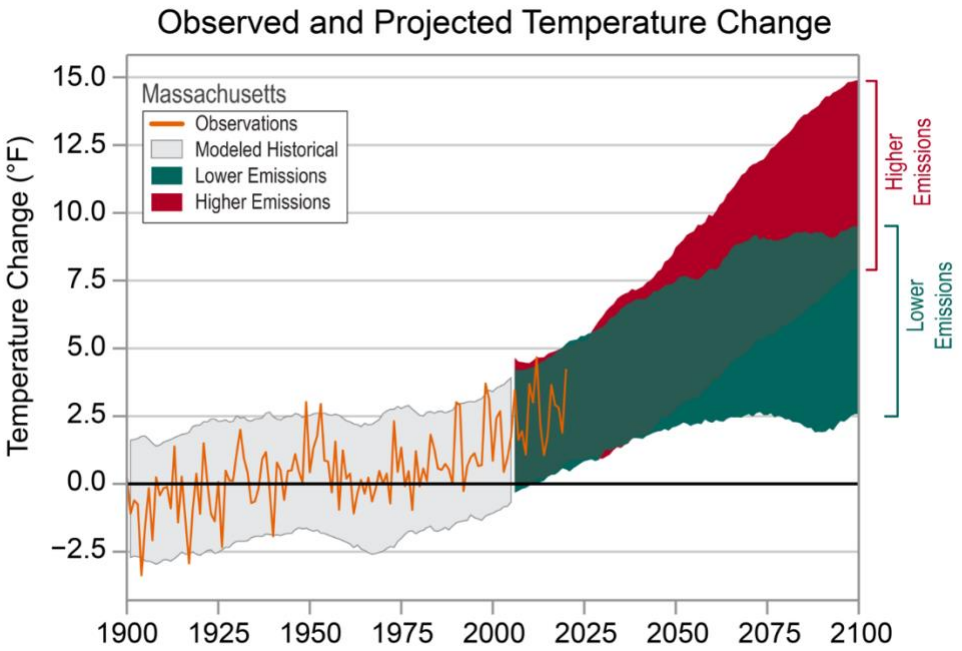


***Figure 13**. Observed and projected temperature change in Massachusetts since 1900*[32]

PREVIOUS OCCURRENCES

According to the National Weather Service[33], the total number of high temperature daily records from 2018-2022 in the Town of Middlefield (data recorded at Worthington station) is 39 days, and 94 high temperatures were set during the last decade (2013 -2022). That equates to 11% of daily high temperature records being set in the last 5 years and 26% in the last decade. Daily minimum record temperatures were greater. 134 daily minimum records were recorded in the last decade and 49 in the last 5 years, representing 37% and 13% of possible days, respectively. Extreme temperature patterns have increased in both directions within the course of the past decade.

PROBABILITY OF FUTURE EVENTS

In Middlefield as in the rest of the state, extreme temperatures have a **very high** probability of occurrence in the next year. Climate change is causing a change in precipitation patterns, warmer summers, and longer dry seasons.

CLIMATE CHANGE IMPACT

Climate change data have unambiguously indicated a rise in global temperature. In Hampshire County, the predicted increase in temperature is not as extreme as other regions in the country

[32] National Centers for Environmental Information. (n.d.). *State climate summaries 2022: Massachusetts*. Retrieved from https://statesummaries.ncics.org/chapter/ma/

[33] National Weather Service. (n.d.). *NOWData*. National Oceanic and Atmospheric Administration. Retrieved on January 27, 2023, from https://www.weather.gov/wrh/Climate?wfo=box

but are nonetheless significant. There are noted increases in the number of days above 90°F and days above 95°F as well as in the expected high temperature over a five-day period. Because of the expected increases, there is a corollary increase in the number of cooling degree days. Cooling degree days are a metric that calculates days when the average temperature for the day is above 65°F. These days are predicted to result in increased energy use for indoor cooling. The estimates indicate an increase of more than 200 days per year for Hampshire County in the early part of the current century when compared to the average number of days per year from 1976 – 2005. This assessment indicates that extreme heat will become a more significant hazard through the decade and beyond.

Data has shown that extreme heat will become a more significant hazard as time progresses. This reality coupled with Middlefield's aging population creates concern for climate vulnerable elderly residents and their ability to adapt to safely rising temperatures.

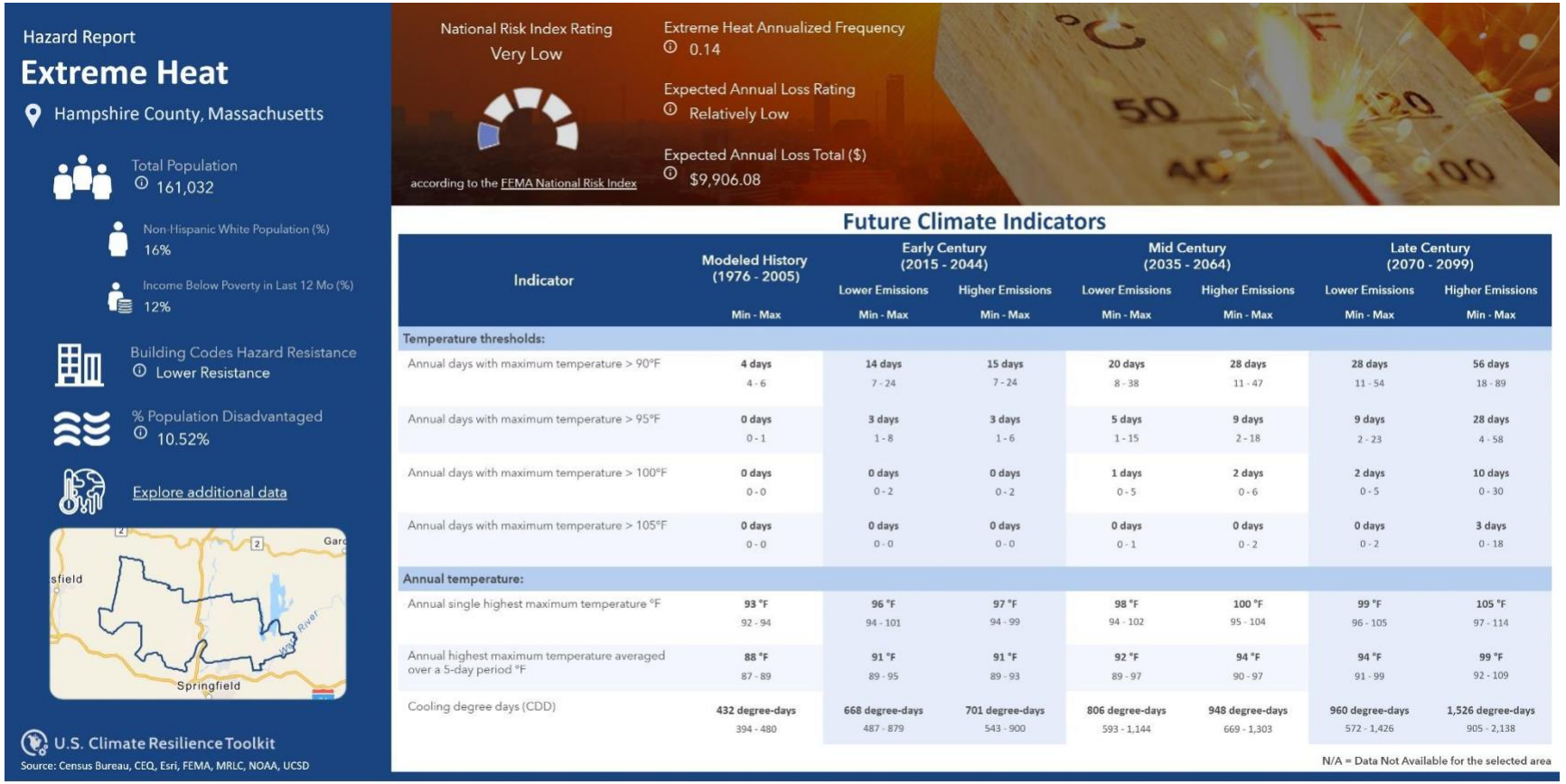


***Table 9**. Hazard report, Extreme heat*[34]

This table shows the future climate indicators that affect the potential for extreme heat in Hampshire County. The chart includes projections across the century given either low or high emission scenarios. There are significant changes in the number of days above both 90F and 95F expected. The largest expected change is in the number of cooling degree days, a measure of days when energy may be used to cool buildings.

[34] National Oceanic and Atmospheric Administration. (n.d.). *Climate Mapping for Resilience and Adaptation: Hampshire County*. Retrieved on February 28, 2023, from https://cmra-reports.s3.amazonaws.com/county/25015.html

IMPACT

The FEMA Risk Index Rating[35] is *Relatively Low* for Hampshire County, MA, when compared to the rest of the U.S. For both heat waves and cold waves, the expected annual loss is *Relatively Low*, social vulnerability is ranked *Relatively Low* and community resilience is *Very High*. Hampshire County scored *Very Low* (3.43) in the probability of heat waves being a hazard for the region, and *Relatively Low* (10.34) for cold waves. Risk Index scores are calculated using an equation that combines scores for Expected Annual Loss due to natural hazards, social vulnerability, and community resilience. Expected outcomes of increased excessive heat and excessive cold include negative health impacts, especially among Climate Vulnerable populations, and temporary interruption of some services or work. The interruptions include services provided at the Council on Aging building because it is not adequately air conditioned, Town Hall and Highway Department functions due to frozen pipes in extreme cold, and interruptions to jobs that require working outdoors like agriculture.

Taken together, the factors above indicate that extreme temperatures events would have a **limited** impact on Middlefield.

VULNERABILITY

Based on the above assessment, Middlefield has a vulnerability ranking of **high** from extreme temperatures. Extreme temperatures will increase the Town's vulnerability to other hazards like wildfires and drought, pose a greater risk to climate vulnerable populations, and strain the electric grid.

People

Expected outcomes of increased excessive heat and excessive cold include negative health impacts, especially among Climate Vulnerable populations. Services provided at the Council on Aging building could be interrupted because it is not adequately air conditioned, even at a time when senior residents are seeking cooler places as their homes become dangerously hot. Extreme cold, on the other hand, adds financial strain as costs to heat homes rise, especially for those with limited and/or fixed incomes.

Structures and lifelines

Town Hall and Highway Department functions could be interrupted due to frozen pipes in extreme cold. Outdoor construction and repair services, including highway department work, could also be impacted by extreme heat or cold. Extreme temperatures are not as likely to impact community lifelines as some other hazards, but local agriculture could be heavily affected due to work interruptions.

[35] Federal Emergency Management Agency. (n.d.). *National Risk Index: Map*. Retrieved on January 27, 2023, from https://hazards.fema.gov/nri/map

Systems

The electric supply would be strained with the increased load in extreme heat. The increased load can lead to brownouts, putting more people at risk of heat-related illness. Extreme cold can be paired with severe snow or ice storms that can also result in power interruptions.

Natural, cultural, and historic resources

Extreme heat often occurs with periods of drought. These combined conditions cause more trees to die as they dry out because of insufficient water. As more and more trees die, the increased fuel load in heavily wooded areas increases the risk of wildfires and brushfires. Additionally, the existing ecosystem is comprised of species that are habituated to the historic climate in Middlefield. As the temperatures continue to rise over time, invasive species from warmer climates are likely to thrive as Middlefield's climate becomes more like their native climate.

FLOODING

DESCRIPTION

Flooding occurs when a large quantity of water pools or collects in areas beyond natural water bodies. One possible cause of flooding is the failure of a man-made dam or beaver dam that results in a sudden release of water that overwhelms the existing water ways downstream. Interruptions in natural or normal water flows due to blockages or redirection of the water flow are another cause of flooding. These types of events can be caused by river or brook redirection as part of development, undersized or obstructed culverts, or the formation of beaver dams. In Middlefield, flooding is often caused by natural weather events including sustained precipitation, extreme precipitation, or excessive run-off from quick spring thaws.

Ice jams can also cause flooding. Ice jams are formed when cold temperatures freeze water on top of rivers, usually forming in clumps. These clamps slow the flow of the river, potentially leading to damming situations. When an ice jam quickly releases retained water, flooding can occur downstream.

FEMA produces maps that outline the predicted floodplains in the event of storms of varying degrees. A floodplain is an area, usually located along or downstream of natural waterways, that will be underwater given a surge or rise in the water level. These maps are referred to as FIRM, standing for Flood Insurance Rate Map, and are used by FEMA to set rates for properties as part of the National Flood Insurance Program (NFIP). These maps are also useful for planning activities at the state and local level as they can predict facilities that will likely be affected during various flooding scenarios.

Floodplains are important areas because they are part of the natural flood management system. Specifically, a floodplain will absorb excess water into its soil and then release it back as groundwater and surface water over time, helping to restore the original water boundaries. The soil in the floodplain is also naturally fertile, in part due to the flooding cycle. Flooding events leave deposits of sediment that provide nutrients to the soil. These areas, therefore, historically became popular areas to inhabit because the soil was good for agricultural use and the flowing water was used to power mills or transport goods. Unfortunately, development in floodplains has two undesired outcomes. First, the floodplain will flood regardless of development. Structures located in floodplains risk damage or loss, as well as a danger to the health and safety of people in those structures during a flooding event. Second, development in floodplains, by definition, means alterations to the floodplain and/or the adjoining waterway. Alterations of these types increase the risk of flooding and decrease the effectiveness of the floodplain. Therefore, as development in these areas increases, so do the risk and severity of flooding events.

LOCATION

Most flooding in Middlefield has historically been localized. Localized, or flash, flooding, occurs because of an extreme precipitation event or the failure of a beaver dam resulting in a sudden rush of water that overwhelms existing drainage systems. Localized flooding can also be due to the blockage of the existing drainage systems. Areas most prone to localized flooding are near

culverts, as is the case on Cone Road, highlighted my multiple survey respondents and members of the Core Team. As the annual precipitation as well as the frequency and intensity of extreme precipitation events have increased over time, the effectiveness of the culverts has decreased. Additionally, some of the culverts are aging and, therefore, have become less effective. These culverts represent the weak points in the Town's flood mitigation and waterway management system.

There are also several areas in town noted for localized flooding events. They include a portion of River Road where it intersects with the Middle Branch of the Westfield River. There are many tight corners along this river, and each represents another potential point of failure during a severe precipitation event. Also, bridges across town are aging and in need of upgrade. Five bridges were noted along the 23 miles of dirt road, and the bridges on Cone Road and Town Hill Road were also identified.

FEMA has identified several areas across the municipality as being in the 100-year floodplain. The largest areas run along the Middle Branch Westfield River on the eastern border of Town and along Factory Brook from the Town's northern border. Both floodplains run roughly north and south through town. Along the Middle Branch Westfield River, there are also several small areas on the western side of the 100-year floodplain that are part of the 500-year plain.

There are portions of Glendale and Tuttle Brooks near their joining with the Middle Branch Westfield River that are in the 100-year floodplain. Most of the remaining floodplains are along smaller contributary brooks or ponds or in wetlands beyond the inhabited part of town. Finally, there is a small area around Virginia Lake. Please see ***Figure 14*** for details.

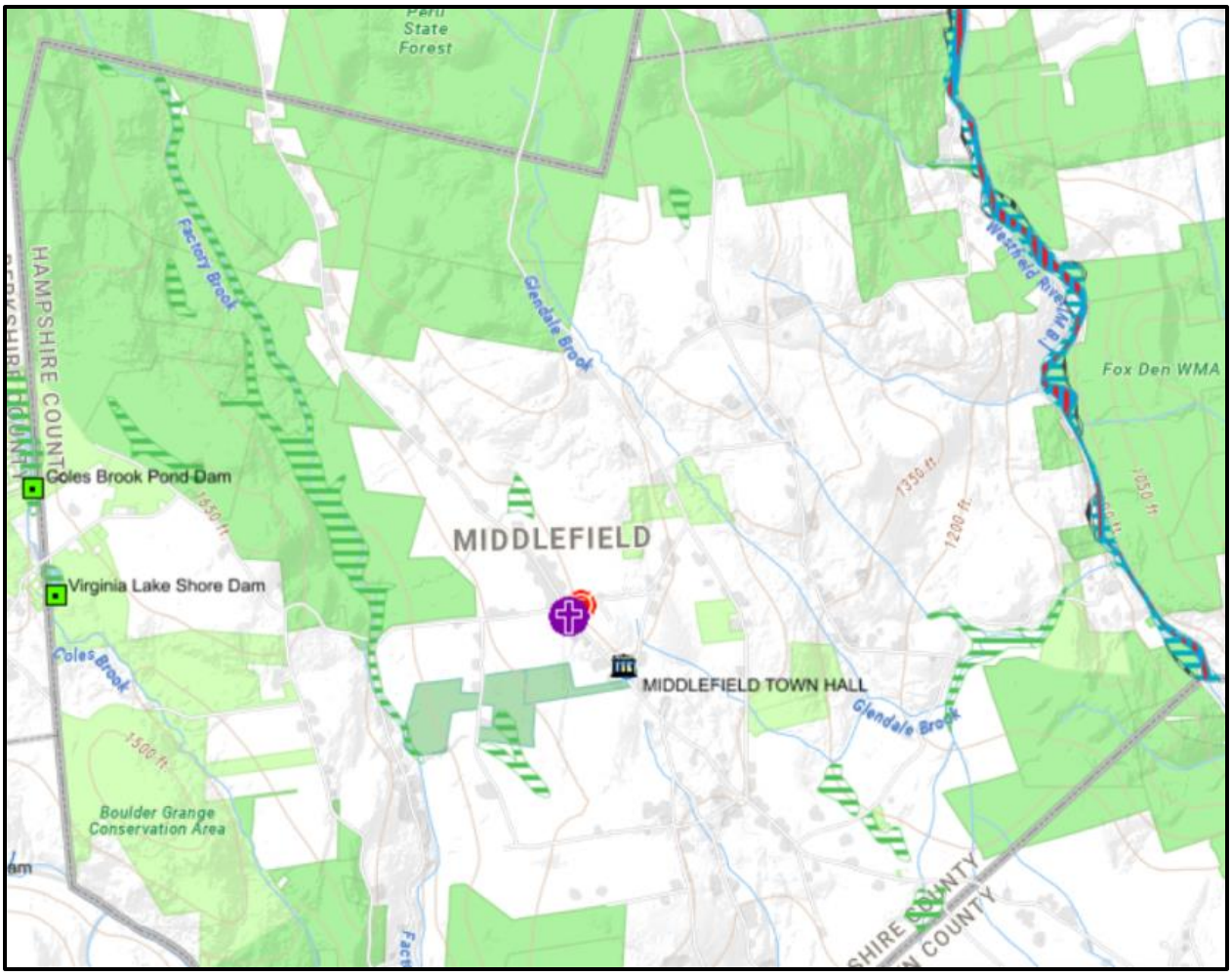
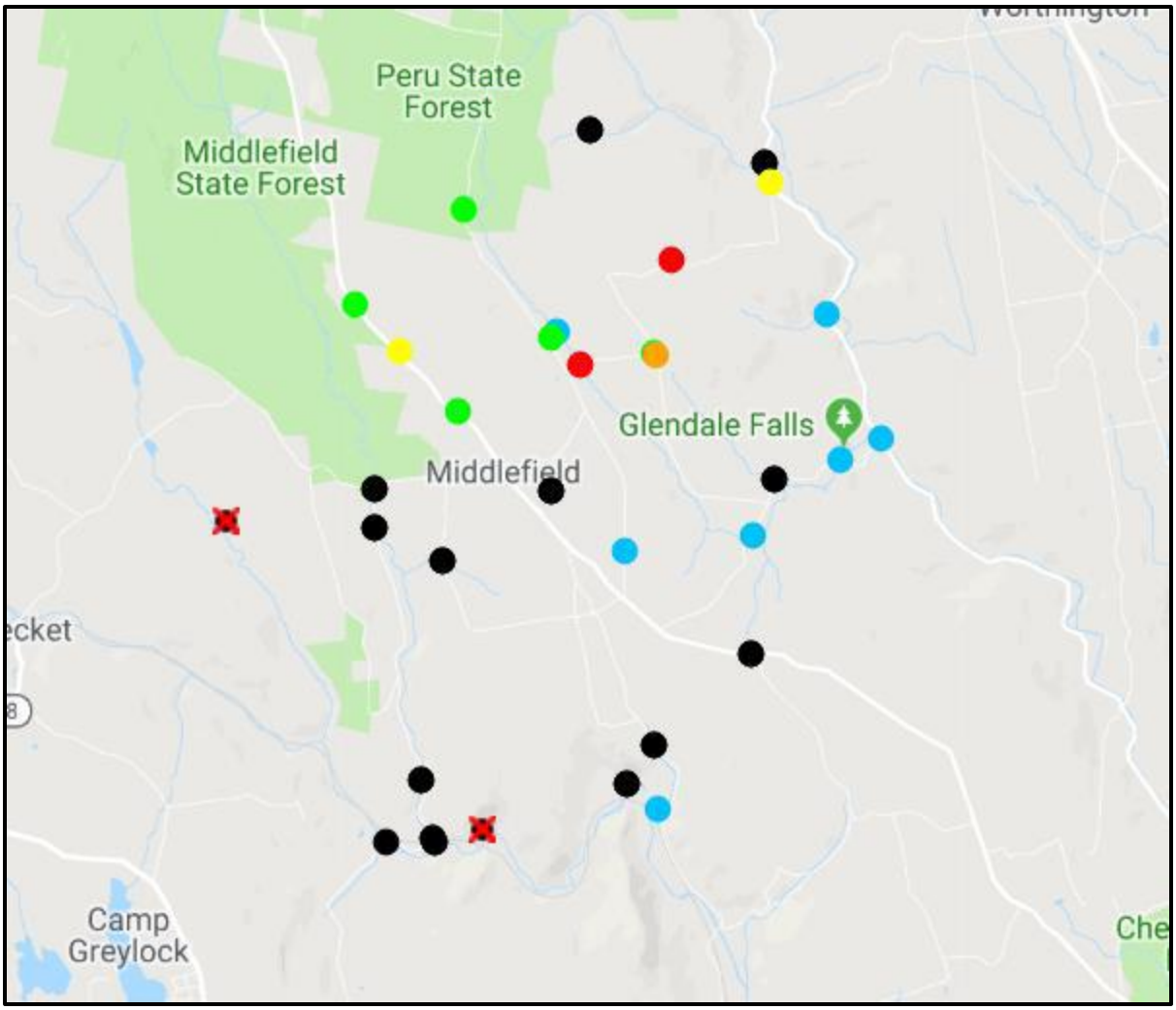


Figure 14*. 100-year floodplains in Middlefield, MA, indicated by green and red striped areas*[36]

There are no critical infrastructure buildings in the 100-year floodplains, but there are 3 private structures along Town Hill Road in Brush Hollow, 11 along East River Road, and one on Clark Wright Road that fall within the 100-year floodplain. Also, there is one private structure in the 500-year floodplain on East River Road. This is the only structure in Middlefield in the 500-year floodplain. These structures comprise about 6% of homes in Middlefield. Places where natural water bodies intersect with man-made roads (e.g., culverts, bridges) are another area that could experience localized flooding during extreme precipitation events. These crossings are indicated in ***Figure 15***, below. Using these structures and locations as areas of concern, the location impacted by a general or localized flood would be **small**.

[36] Massachusetts Office of Dam Safety. (n.d.). *MassMapper GIS*. Retrieved on February 3, 2023, from https://maps.massgis.state.ma.us/MassMapper/MassMapper.html



No barrier: blue
Insignificant barrier: blue green
Minor barrier: green
Moderate barrier: yellow
Significant barrier: orange
Severe barrier: red
Missing data: magenta
No crossing: black circle with bold red x
New crossing pending approval: black circle with red slash

TIP: To get the most recent information (i.e. most recent 'Date observed in field' AND most recent 'Last updated') for a surveyed crossing, click on it. Please be aware that to view all records for a surveyed crossing, you must use the "Search Crossings" page to search using the crossing code.

Black circles are unsurveyed crossings that have been assigned xy crossing codes by using Geographic Information System (GIS) software. Depending on the area covered by your search results, you may not see any black circles until you have zoomed in. When you hover over black points, the xy crossing code will appear.

Figure 15. *Culvert and stream crossings in Middlefield*[37]

[37] University of Massachusetts. (2018). University of Massachusetts stream continuity project. Retrieved from https://www.streamcontinuity.org/cdb2/naacc_search_map.cfm

EXTENT

Flooding events in Middlefield can be classified as either general or flash. General flooding occurs during sustained storms where ongoing precipitation raises water levels beyond their channels causing water to enter the floodplain. The risk of these events can be increased in Spring months if the precipitation is compounded by runoff from melting snow and ice in the mountains. A large dam failure can also cause general flooding. General flooding can take days or weeks to resolve and affects larger areas of town.

Flash or localized flooding occurs in a specific area and results from different situations compared to general flooding. These events can include the failure of a beaver dam, a blocked or undersized culvert, a dam failure, or a short, high-precipitation weather event that overwhelms existing drainage capabilities.

General floods are usually more severe than flash floods given the size of the area affected and the length of time it takes for the waters to recede and repairs to begin. Basic utilities are often unavailable during general floods, and travel though the affected area is limited. Additionally, mold and rot are possible in any structures that survive the flood itself.

A flash flood can be severe and deadly, especially when there is no warning allowing for evacuation of the area of impact. The force of the rushing water can overwhelm people or vehicles in its direct path. Recurrent flash flooding in the same area can also weaken structures or roads repeatedly in the flood zone.

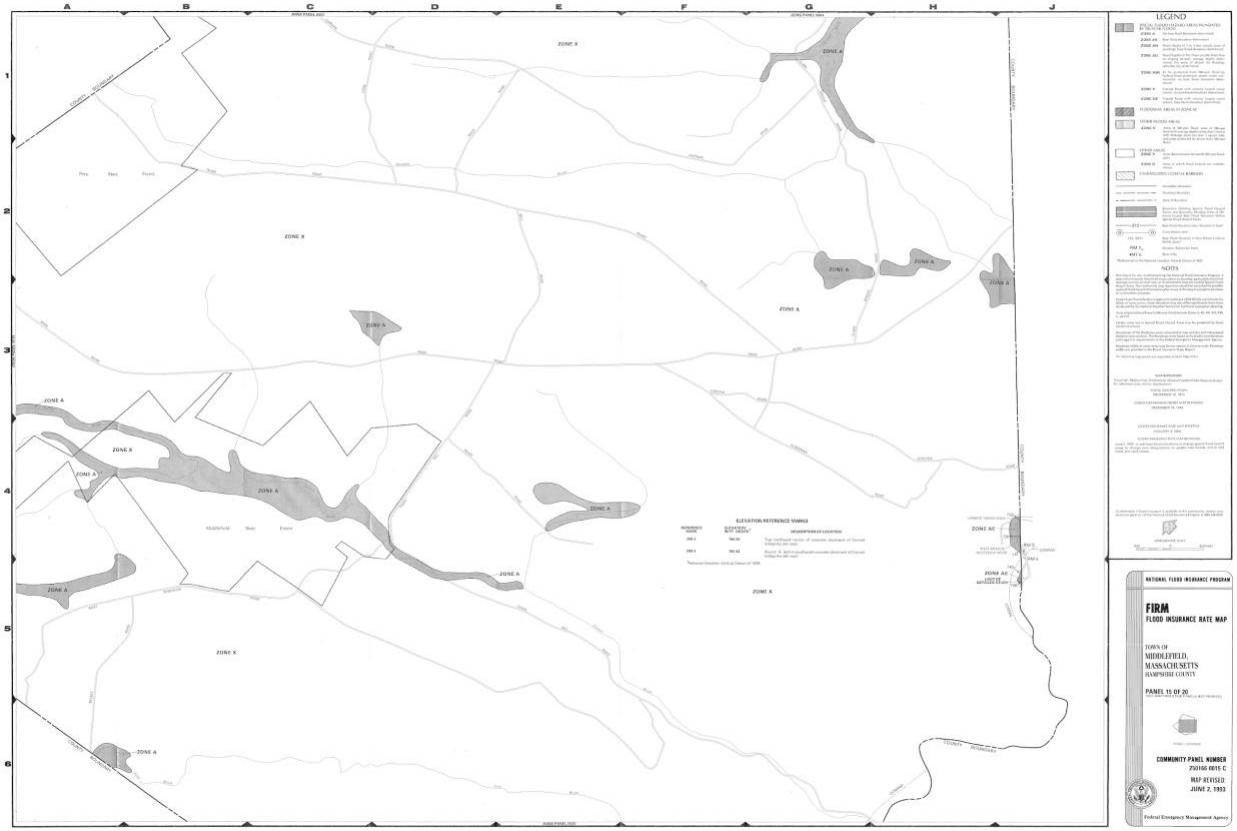


Figure 16*. FIRM (1993), Middlefield, MA*[38]

[38] Federal Emergency Management Agency. (1993). *FEMA Flood map service center*. Retrieved on January 27, 2023, from https://msc.fema.gov/portal/search?AddressQuery=middlefield%20ma#searchresultsanchor

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PREVIOUS OCCURRENCES

Middlefield and has experienced several notable flooding events. Less is known about the impact of the first two directly on Middlefield, but their effects regionally are well documented. The Great New England Flood of 1938 was the first, resulting in $200,000,000 dollars in damage and killing 10 people in Massachusetts. Decades later in August 1955, two hurricanes, Connie and Diane, passed through Massachusetts less than a week apart from each other. Connie deposited approximately 7 inches of rain, and Diane quickly followed, adding another 15 inches to the area. Many rivers across the state flooded, and towns experienced power outages, road closures, and bridge and culvert damage.

Middlefield has documented localized flooding events from two subsequent events. In 2003, a storm caused flooding that washed out Clark Wright Road near Glendale Falls. Then, in 2011, Tropical Storm Irene dropped approximately 10 inches of rain on areas that were already saturated during an especially rainy period. These factors resulted in localized flooding events in several flood-prone locations in town. The first was along two branches of the Westfield River. The other was on Cone Road where the flooding caused significant road erosion. Several survey respondents included Cone Road as being particularly vulnerable to flooding, indicating Cone Road continues to be a problematic area during times of heavy precipitation. Other respondents noted that Clark Wright Road, River Road, and Town Hill Road are also vulnerable. Finally, others stated that if primary roads are damaged or flooded then access for residents who live on secondary roads is cut off.

Localized flooding events occur frequently. As previously mentioned, most of these flooding events occur when culverts running under the roads become obstructed or fail, forcing water onto the roadway. Obstructed culverts in neighboring towns along shared roads can also impact roads or adjacent areas in Middlefield.

Table 10 contains the recorded flooding events for Middlefield and its neighboring communities, as recorded by NOAA, beginning in 1996.

Location	***Begin Date***	***Flood Type***	***Deaths/ Injuries***	***Property Damage ($)***
Western Hampshire County	1/9/1998	Flood	0	0
Becket	6/23/2003	Flash Flood	0	0
Becket	6/23/2003	Flash Flood	0	$1,000
Western Hampshire County	10/9/2005	Flood	0	$1,000,000
Washington	6/30/2021	Flash Flood	0	0
Becket	7/18/2021	Flash Flood	0	0
Total		***2 Floods; 4 Flash floods***	***0***	***$1,001,000***

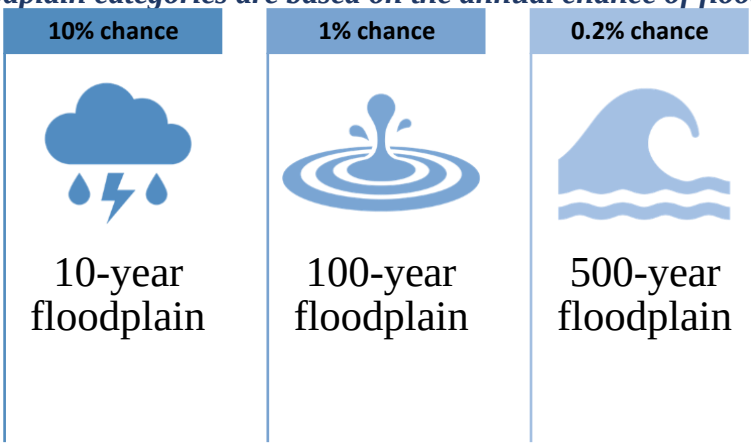
Table 10*. Flooding events in Middlefield and neighboring communities*[39]

[39] National Centers for Environmental Information. (n.d.). *Storm events database*. Retrieved January 27, 2023, from https://www.ncdc.noaa.gov/stormevents

PROBABILITY OF FUTURE EVENTS

FEMA defines floodplains in terms of the frequency that water will reach an area. A 10-year floodplain has a 10% chance of flooding annually. A 100-year floodplain will flood approximately once every 100 years, translating to a 1% chance annually. Flood waters will reach a 500-year floodplain once every 500 years, meaning there is 0.2% chance of occurrence annually. FEMA's current FIRM for Middlefield includes both a 100-year and 500-year floodplain, so the risk of riverine flooding in Middlefield is approximately 1% annually. Even with predicted increases in extreme precipitation events and annual rainfall, the general flooding potential in town is **low**.

Floodplain categories are based on the annual chance of flooding



Localized or flash flooding is a more probable occurrence. Middlefield makes ongoing efforts to clear culverts, manage beaver dams, and maintain other natural drainage, but the limited resources and remote nature of critical features can hamper these efforts. As noted previously, when an extreme precipitation event or failure of a beaver dam occurs, the drainage systems can be easily overwhelmed. These events result in localized flooding as the overflow fills relative low points in the immediate area. Allowing for the number of beaver dams and culverts in town and the expected increase in extreme precipitation events, the risk of localized flooding each year is **high**.

CLIMATE CHANGE IMPACT

The impact of climate change on flooding is more involved than most of the other hazards. In ***Table 11***, the data indicated a slight decrease in days with precipitation in the coming decades. The size of the change varies depending on how emissions are managed, but it is not expected to be more than a few days per year. The number of consecutive days with precipitation, similarly, is not predicted to increase. These data do not point toward the flood risk significantly increasing due to climate change.

The remaining climate change data suggest a different outcome. There are increases in annual precipitation and days with more than 1 inch of precipitation. These data, when paired with the

decrease in number of days with precipitation, indicate an increase in more severe precipitation events where more rain or snow fall in a shorter period. As noted above, it is these events that are more likely to result in localized flooding.

While the impact of flooding in Middlefield has been identified as critical, the threats that these events pose are not distributed evenly amongst populations. Demographic shifts that will result in more elderly residents in coming decades creates additional concern for ability to evacuate safely in the event of a flood.

Finally, there is a substantial decrease in the number of days with a maximum temperature below 32°F. That means that some of the precipitation that normally falls as snow will now fall as rain. It is unclear whether this shift is likely to increase the risk of flooding, in large part because the distribution across time of those precipitation events will play a major role in whether they increase or decrease the flood risk.

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Annual average total precipitation	47" 46 - 48	49" 46 - 55	50" 45 - 54	50" 46 - 55	51" 48 - 54	51" 46 - 56	53" 48 - 60
Days per year with precipitation (wet days)	197 days 190 - 202	196 days 185 - 207	196 days 182 - 205	195 days 184 - 204	194 days 179 - 204	195 days 182 - 206	192 days 167 - 208
Maximum period of consecutive wet days	12 days 11 - 13	12 days 11 - 14	12 days 11 - 14	12 days 10 - 14	12 days 10 - 14	12 days 11 - 14	12 days 10 - 15
Annual days with:							
Annual days with total precipitation > 1inch	6 days 5 - 7	7 days 6 - 8	7 days 5 - 9	7 days 6 - 9	8 days 7 - 10	8 days 6 - 10	9 days 6 - 12
Annual days with total precipitation > 2 inches	1 days 0 - 1	1 days 0 - 1	1 days 0 - 1	1 days 0 - 1	1 days 0 - 1	1 days 0 - 1	1 days 1 - 2
Annual days with total precipitation > 3 inches	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0
Annual days that exceed 99th percentile precipitation	6 days 5 - 7	7 days 6 - 9	7 days 6 - 9	8 days 7 - 9	8 days 7 - 10	8 days 7 - 10	10 days 9 - 12
Days with maximum temperature below 32 °F	40 days 36 - 44	29 days 13 - 36	28 days 17 - 35	24 days 10 - 32	21 days 12 - 30	20 days 7 - 29	11 days 2 - 22

N/A = Data Not Available for the selected area

***Table 11**. Hazard report, Flooding*[40]

This table shows the future climate indicators that affect the potential for flooding in Hampshire County. The chart includes projections across the century given either low or high emission scenarios. There are increases in the amount of total precipitation and days with more than 1 inch of precipitation, while simultaneously having decreases in the number of days with precipitation. This means more severe precipitation events are likely, creating favorable conditions for localized flooding.

[40] National Oceanic and Atmospheric Administration. (n.d.). *Climate Mapping for Resilience and Adaptation: Hampshire County*. Retrieved on February 28, 2023, from https://cmra-reports.s3.amazonaws.com/county/25015.html

IMPACT

The impact of any flooding event depends on the location and the amount of water involved. Currently, an estimated 6% of the town's dwellings are in Middlefield's 100-year floodplain, and, assuming 10% damage to those structures, the impact is estimated at $340,513.

Of greater concern to the community are the impacts of localized flooding. In the event of a severe precipitation event or repeated events in a short time, blocked, undersized, or failing culverts cause localized flooding, washout, and/or road closures that interrupt commutes to jobs outside of town or, in more severe situations, preventing evacuation or emergency services. In one prior event, one death resulted from such an occurrence when a swollen stream overtook them and led to their drowning.

In instances of localized flooding, the impact costs would include both the replacement and/or repair of the culvert and roadway that are not estimated here. Even without a culvert failure, localized flooding is an ongoing occurrence as noted above. The ongoing costs include road and bridge repairs, culvert cleanout, and traffic redirection activities. Taken together, the impact of flooding in Middlefield is **critical**.

VULNERABILITY

Based on the risk assessment of location, probability of future events, and impact, the vulnerability of Middlefield from flooding is rated as **high**. The Town's critical facilities are elevated and outside of the 100-year floodplain, but East River Road would be impacted as well as many secondary roads during a riverine flooding event. Additionally, the risk of localized flooding is increasing over time due to climate change, and the Town's vulnerability will continue to increase without mitigation efforts.

People

Localized flooding events interrupt daily activities when roads are affected. As noted above, the interruptions include preventing commutes to jobs outside of town, access to food and medical services, or, in more severe situations, preventing evacuation or emergency services. In one prior event, a death resulted from a flood when a swollen stream overtook a person and led to their drowning. The risk of personal injury or even death remains for those living in or travelling through flood-prone areas. Persons with limited resources or diminished mobility are more likely to be negatively impacted during these events.

In situations where evacuations are necessary, those with limited abilities or financial means will be less likely to leave their homes because of the challenges associated with evacuation. Additionally, these are the same people who would benefit from extra time or support to evacuate but are also most likely not to be notified or aware of an evacuation order.

If any private homes are flooded, mold is a secondary concern in addition to the obvious remediation of the water damage. Mold can lead to a host of health issues for the residents if proper steps are not taken to prevent or eliminate its growth.

Structures and lifelines

There are several historic, flash flood prone locations in town. One lies along the branches of the Westfield River and the other is on Cone Road where the flooding has caused significant road erosion. Survey respondents included Cone Road as being particularly vulnerable to flooding, indicating Cone Road continues to be a problematic area during times of heavy precipitation. Other respondents noted that Clark Wright Road, River Road, and Town Hill Road are also vulnerable.

Bridges on the roads noted above are vulnerable to severe flooding events. Cone Road bridge is currently closed due to its deteriorated condition as a result of flooding. With this part of Cone Road not passable, some residents as well as emergency responders attempting to reach them would need to add approximately 10 minutes to the drive time if Root Road were closed. In an emergency, those 10 minutes could be crucial for emergency responders to reach their destination, and that time would double for an ambulance transporting a patient from an impacted residence to a hospital.

Other town infrastructure is not located in flood-prone areas. Downstream culverts, too, are prone to damage from the increased waterflow or standing water. Community lifelines, again, are based out of town, so any road closures due to flooding will decrease access to those supports and services.

Systems

The town's electric supply is more vulnerable during flooding events, but that is because flooding is a likely outcome of heavy or repeated precipitation events. Those events soften the soil making trees more likely to fall, especially if there is ice buildup on leaves and/or heavy winds.

Natural, cultural, and historic resources

Flooding events cause erosion and washout in affected areas. The loosened soil will travel "downstream" where it can back-up culverts that are undersized or already partially blocked. Those blocked culverts, in turn, increase the risk for more localized flooding. Wildlife in the flooded areas will also be affected through loss of their habitat.

As previously noted, Middlefield is mostly forested. Because flooding is related to heavy or repeated precipitation events, there is a high risk of trees being lost during floods. The extreme precipitation events soften the soil making trees more likely to fall, especially when there is icy buildup on leaves and/or heavy winds.

HURRICANES AND TROPICAL STORMS

DESCRIPTION

NOAA defines hurricanes as tropical cyclones in which the maximum sustained surface wind (using the U.S. 1-minute average) is 64 kt (74 mph or 119 kmh) or more. The term hurricane is used for Northern Hemisphere tropical cyclones.

Damage caused by hurricanes is usually caused by the heavy wind which can reach speeds up to 200 mph. Flooding, power outages, structural damage and loss of life are threats of hurricanes, particularly common in the months of May through November.

LOCATION

Hurricanes generally form over regions; they are quantitatively large storms. That means a hurricane or tropical storm would affect all of Middlefield, so the location rank is **large**.

EXTENT

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

Category	*Wind Speed (mph)*	*Type of Damage*
1	74-95	Some damage
2	96-110	Extensive damage
3	111-129	Devastating damage
4	130-156	Catastrophic damage
5	157 and above	Catastrophic damage

***Table 12**. Saffir-Simpson hurricane wind scale*

PRIOR EVENTS

Year	Classification	Storm Name
1938	Hurricane (category 3)	Great Hurricane of 1938
1944	Hurricane (category 1)	Great Atlantic Hurricane
1954	Hurricane (category 3)	Carol
1955	Hurricane (category 1)	Edna
1960	Hurricane (category 1 or 2)	Diane
1985	Hurricane (category 1)	Gloria
1991	Hurricane (category 2)	Bob
1999	Tropical Storm	Floyd
2011	Tropical Storm	Irene
2020	Tropical Storm	Isaias

***Table 13**. Tropical storms and hurricanes in Hampshire County*[41,42]

PROBABILITY OF FUTURE EVENTS

Middlefield faces a **low** probability of hurricanes or tropical storms annually because it is in a region that does not experience hurricanes or tropical storms frequently. On average, a hurricane or tropical storm reaches Massachusetts once per decade, so there is a 10% chance of an event in the next year.

CLIMATE CHANGE IMPACT

The SHMCAP plan indicates the climate change will result in larger, stronger storms and increased rainfall rates. These factors point to an increase in hurricane/tropical storm intensity, but the effects of this increase will be largely focused on areas of the state that are closer to the coast. Because Middlefield is so far inland, the impact of these changes will be minor. There is a chance that the increase may increase the probability of future storms to **moderate** by the end of the decade (10 – 40% chance), but the strength of any storm will have diminished as it travels across land, resulting in it being no greater than tropical storm strength upon reaching Middlefield, as has been the pattern during previous storms.

[41] National Centers for Environmental Information. (n.d.). *Storm events database*. Retrieved August 2, 2022, from https://www.ncdc.noaa.gov/stormevents

[42] Blake, E., Landsea, C., and Gibney, E. (2011). *The deadliest, costliest, and most intense United States tropical cyclones from 1851 to 2010 (and other frequently requested hurricane facts)*. National Weather Service, Miami, FL. Retrieved from https://www.nhc.noaa.gov/pdf/nws-nhc-6.pdf

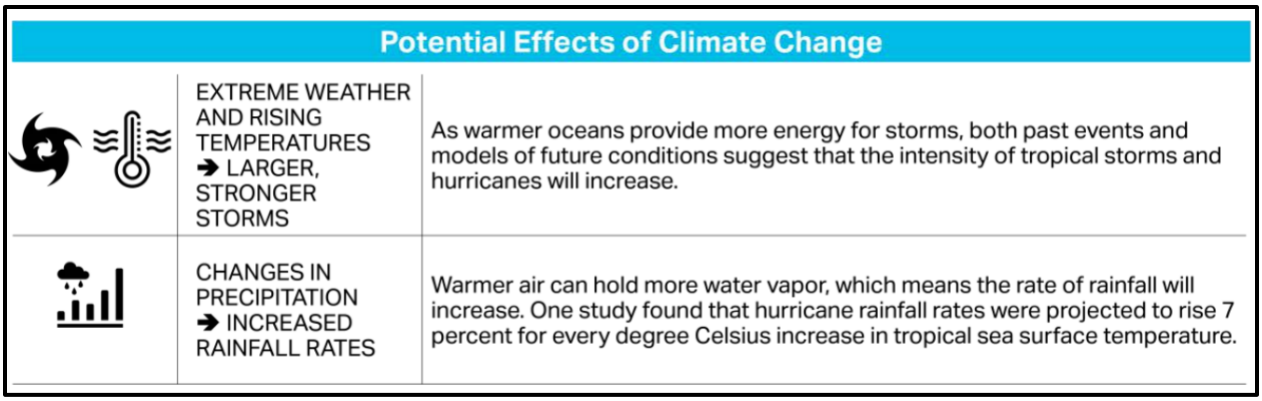


***Figure 17**. Effects of climate change on hurricane/tropical storms for Massachusetts*[43]

IMPACT

Irene is the most recent example of a tropical storm impacting Middlefield. The impact was due to the amount of prescription Irene brought, resulting in washout and erosion particularly on Cone Road.

The impact of a hurricane or tropical storm is typically greatest near the coast, decreasing in severity from east to west as it travels over land. Because Middlefield is so far inland, the severity of the event is relatively minor with wind damage and localized flooding being the most likely outcomes of a hurricane or tropical storm. The most likely outcome would be from a tree falling onto a roadway or taking out power supply lines. Some homes could suffer from wind damage, but most would not be affected. It is possible that a few minor injuries could occur, but severe injuries or fatalities would be unlikely. Given the lack of redundancy in supply lines, the limited number of customers, and the remote location of Middlefield, restoring power and/or reopening roads could take days, especially given that many neighboring communities would be dealing with similar problems at the same time. The impact ranking would, therefore, be **limited.**

VULNERABILITY

Based on the above assessment, Middlefield has a **medium** vulnerability from hurricanes and tropical storms.

People

Hurricanes and tropical storms historically create problems due to the precipitation involved because the wind speeds decreased substantially before reaching Middlefield. The effect on people in town, then, is most likely to be due to localized flooding events. These events interrupt daily activities when roads are forced to close, affecting travel within and outside of town. Persons with limited resources or diminished mobility are

[43] Commonwealth of Massachusetts. (2018). *Massachusetts state hazard mitigation and climate adaptation plan (SHMCAP)*. Retrieved from https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf

more likely to be negatively impacted during these events as they face more obstacles to remediate challenges or problems.

Should evacuations become necessary, those with limited abilities or financial means will be less likely to leave their homes because of the unique difficulties they have to overcome associated with evacuation. Additionally, these same people would most benefit from extra time or support to evacuate but are also least likely to be aware of an evacuation order.

Structures and lifelines

The same roads, bridges, and culverts referenced in previous sections would be similarly impacted by the heavy precipitation related to a hurricane or tropical storm. Community lifelines, again, are based out of town, so any road closures due to flooding will decrease access to those supports. There is also a chance for minor damage to buildings (e.g., roof shingles blow off, windows broken) due to heavy winds.

Systems

The town's electric supply is again vulnerable during heavy precipitation and wind events.

Natural, cultural, and historic resources

Heavy precipitation and wind events cause erosion and washout in affected areas. The loosened soil will travel downstream where it can back-up culverts that are undersized or already partially blocked. Those blocked culverts, in turn, increase the risk for more localized flooding. Wildlife in the flooded areas will also be affected through loss of their habitat.

As previously noted, Middlefield is mostly forested. Because flooding is related to heavy or repeated precipitation events, there is a high risk of trees being lost during floods. The extreme precipitation events soften the soil making trees more likely to fall, especially when there are heavy winds.

INVASIVE SPECIES

DESCRIPTION

Invasive species are defined as non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health[44]. The SHMCAP (2108) focuses primarily on plant-life, but the concerns in Middlefield and neighboring communities are greater for insect species that affect forested areas given their prevalence in Western MA. Among the most concerning is the Emerald Ash Borer (EAB). This beetle species was first identified in Michigan in 2002. Since then, it has moved north and east across the United States and into Canada. In 2018, it was confirmed in 35 states. It was first confirmed in Massachusetts in 2012.

The EAB larvae feed only on the inner bark of ash trees, prohibiting the natural flow of water and nutrients through the tree, resulting in the death of the tree. The EAB spread quickly, typically eradicating the majority of ash trees in the area they infest, decreasing the tree canopy and leaving a large volume of deadwood. Western MA has a large volume of ash trees, so the arrival of EAB poses a direct hazard to the region.

DCR, who controls much of the forest area in Middlefield, has been cutting breaks in tree lines in areas with infected ash trees, and biocontrol species have been released by the state as another mitigation action. Still, dead trees are evident when driving through Middlefield, increasing the risk of wildfires.

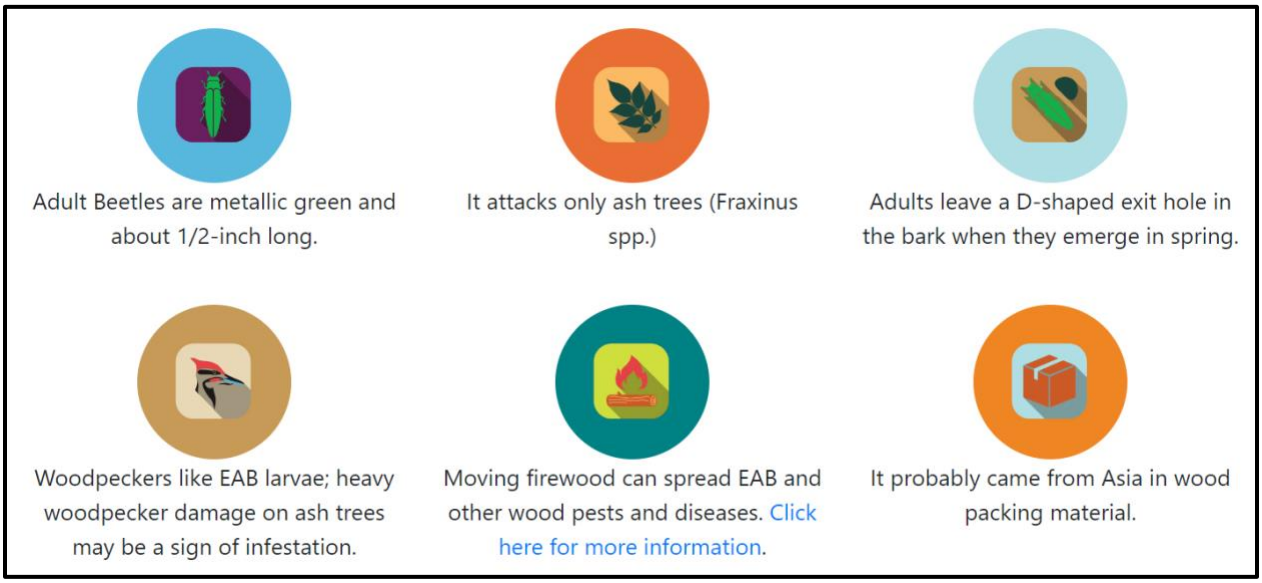


***Figure 18**. About the Emerald Ash Borer*[45]

[44] Executive Order 13112 (Invasive Species), February 3, 1999.

[45] Emerald Ash Borer Network. (n.d.). *About the Emerald Ash Borer*. Retrieved on February 22, 2023, from http://www.emeraldashborer.info/about-eab

An invasive plant species that warrants inclusion for Middlefield is Japanese Knotweed (Fallopia japonica). This species has been in the Northeastern United States for over a century. It is a hearty plant that takes over an area by inhibiting the growth of other plants and using more of the soil's nutrients. The plant is not directly dangerous to humans, but there are several ways that it impacts the environment where it spreads. First, it can grow from cracks in pavement, masonry, or concrete causing damage to infrastructure. Next, Japanese Knotweed favors waterway banks, yet the roots are not as effective at holding soil in place like native plants. As a result, in high water events or ice scour, the roots break off to re-colonize downstream, leaving the banks vulnerable to more erosion. Finally, its broad leaves can quickly block culverts or natural drainage leading to localized flooding when they break.

There are other species that pose a threat to trees and humans. Oriental bittersweet (Celastrus orbiculatus), a vine, climbs trees and can pull them down. This species has been spreading in Middlefield in recent years. Japanese barberry (Berberis thunbergii) favors pastures and adjoining forests. These shrubs harbor white-footed mice, resist grazing, and have been shown to support the proliferation of deer ticks and, consequently, tick-borne diseases. Burning bush (Euonymous alatus) has escaped gardens and is starting to form monocultures in bordering forests. Common reed (Phragmites australus) is displacing native species in a few Middlefield wetlands and spreading quickly.

Other known invasive species currently impacting Western MA are published by the Massachusetts Bureau of Forest Fire and Forestry. They are included in ***Table 14*** below.

Species	***Image***	***Origin***	***Host Tree(s)***	***DCR Management Strategy***
Beech Leaf Disease		Introduced 2012 in USA, 2020 in Massachusetts	American Beech, European Beech, and Oriental Beech	The DCR Forest Health Program is surveying beech trees across the state to determine the extent of the disease in Massachusetts
Gypsy Moth *Lymantria dispar*		Introduced 1869	Oaks, other deciduous species	Current management approach relies on natural population controls- naturally abundant virus and fungus populations regulate gypsy moth population cycles.

Hemlock Woolly Adelgid *Adelges tsugae*		Introduced 1989	Eastern hemlock	Two biocontrol species, Psedudoscymnus tsugae and Laricobius nigrinus, have been released in MA to limited establishment success.
Southern Pine Beetle *Dendroctonus frontalis*		Native	Pine pitch	Population densities are being monitored through annual trapping. The impacts of climate change could significantly alter southern pine beetle generation periods and devastate pitch pine stands.
Emerald Ash Borer *Agrilus planipennis*		Introduced 2012	All ash species	Three biocontrol species, Tetrastichus planipennisi, Spathius galinae, and Oobius agrili, have successfully been released in MA. Continued releases are planned.
White Pine Needlecast		Native	Eastern white pine	White pine defoliation is being monitored across the state. Needlecast has been identified to be caused by multiple fungal pathogens; the most prevalent agent in Massachusetts is Lecanosticta acicola.

***Table 14**. Invasive species in Western MA*[46]

[46] Bureau of Forest Fire and Forestry. (n.d.). *Current forest health hazards*. Massachusetts Department of Conservation and Recreation. Retrieved on February 22, 2023, from https://www.mass.gov/service-details/current-forest-health-threats

LOCATION

The area most prone to damage from invasive species in Middlefield are the forests. Because 93% of the town is forested, the location ranking for invasive species is **large**. Even though a mix of tree types comprises the forest, ash trees account for approximately 50% of them and are distributed among the others uniformly across the area. Additionally, the stock of other trees is at threat from the other invasive species identified in Massachusetts.

Japanese Knotweed is found in woodland sites, open spaces, ditches, roadsides, riverbanks, and it prefers moist, well-drained soil in full sun. Japanese knotweed can grow in any part of Middlefield that has sufficient sun. It is unlikely to grow in forest shade. As noted above, more recent arrivals are also beginning to inhabit wetlands and pastures, in addition to the forests, and it is already prevalent along many of the banks in town.

EXTENT

EAB has been identified in 66% of the municipalities in Massachusetts. Hampshire County has reported cases in all municipalities.

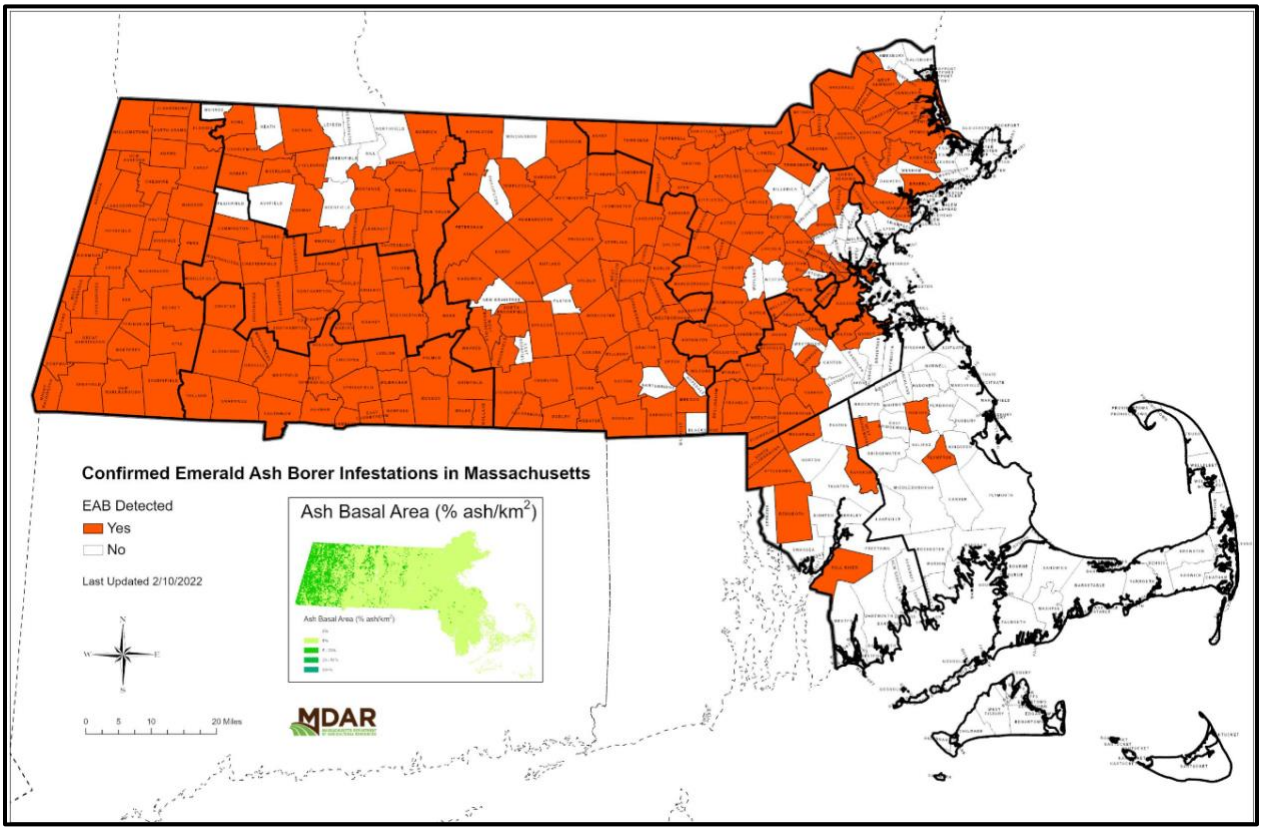


***Figure 19**. Confirmed EAB infestation*[47]

[47] Massachusetts Introduced Pests Outreach Blog. (2022). EAB update for February 2022. Retrieved on February 22, 2023, from https://massnrc.org/pests/blog/?p=2905

PREVIOUS OCCURRENCES

EAB has been confirmed in Middlefield since 2020. Gypsy moths have previously been identified as a serious concern in Massachusetts, but there are no large-scale mitigation efforts because the population has been largely controlled. Japanese knotweed is already prevalent in town. Other invasive species identified in Middlefield are Oriental bittersweet, Japanese barberry, Burning bush, and Common reed.

PROBABILITY OF FUTURE EVENTS

It is challenging to quantify the likelihood of new invasive species affecting Middlefield. Commercial activities (international shipping of goods and lumber, in particular) are primary agents of spread. Because the U.S. operates in a global economy, the potential for new species entering the ecosystem is high.

Invasive species that already exist within the larger ecological system are apt to continue to spread. Invasive species proliferate because the natural control mechanisms (e.g., limited food supply, natural predators, etc.) of their native habitat are not present. Treatments for invasive species sometimes incorporate the introduction of those control mechanisms. but caution must be used to ensure the introduction of a secondary species will not create a different or worse problem.

Because the EAB and Japanese Knotweed are already present in Middlefield, and because it is very difficult to control its spread, the likelihood of it continuing to be a hazard each year going forward is **high**.

CLIMATE CHANGE IMPACT

Generally speaking, climate change will bring warmer weather and new precipitation patterns to Massachusetts. In these conditions, Japanese Knotweed will result in greater erosion along the river and brook banks because its propensity for the roots to break off in high precipitation events compared to native plants. This leaves the soil more vulnerable to erosion and continues the spread of Japanese Knotweed.

The native ecosystem will be stressed by the predicted climate changes, too, so non-native species from warmer climates will be able to spread into the area more easily. While several species are already in Middlefield, the likelihood of more invasive species encroaching into Middlefield's forests will increase with changing weather conditions. As the temperatures rise, invasive species from warmer climates will thrive while native species struggle to survive in the new climate.

Potential Effects of Climate Change		
	RISING TEMPERATURES ➔ WARMING CLIMATE	A warming climate may place stress on colder-weather species, while allowing non-native species accustomed to warmer climates to spread northward.
	RISING TEMPERATURES AND CHANGES IN PRECIPITATION ➔ ECOSYSTEM STRESS	Changes in precipitation and temperature combine to create new stresses for Massachusetts' unique ecosystems. For example, intense rainfall in urbanized areas can cause pollutants on roads and parking lots to get washed into nearby rivers and lakes, reducing habitat quality. As rainfall and snowfall patterns change, certain habitats and species that have specific physiological requirements may be affected. The stresses experienced by native ecosystems as a result of these changes may increase the chances of a successful invasion of non-native species.

***Figure 20**. Effects of climate change on invasive species for Massachusetts*[48]

IMPACT

Like predicting future occurrences, accounting for the potential impact of invasive species is challenging. While these species spread quickly, the effect of their encroachment into new areas can take years to be fully realized. For example, the EAB is spreading through the forest area at present and is already responsible for some tree loss. But, existing mitigation efforts have slowed this spread, and some forest areas have not been infected yet.

A secondary challenge in calculating the impact is that the damage occurs most often in remote areas that do not directly impact residents. The impact, instead, is the decrease in tree canopy, disruption of natural ecological balance, and increased risk to wildfires as each healthy tree is lost and dries out. There is also a decrease in the opportunity cost of the forest area for lumber and recreational uses.

Because the estimated cost of damage and risk of injury are quite limited, the impact of invasive species on Middlefield in a given year is **minor**.

VULNERABILITY

The vulnerability of Middlefield to invasive species is **low** based on the location, impact, and probability of future events. Still, the risk of invasive species could change very quickly with the introduction of a new threat, weather conditions that encourage faster spread, and lack of mitigation activities. Most important among the mitigation activities is a comprehensive forest management program focused on slowing the spread of invasive species, limiting the fuel load of dead wood, and maintaining fire roads for firefighting activities.

People

The population in Middlefield is expected to be affected by invasive species in one of two ways. First, people who rely on the ecosystem for their livelihood (e.g., farmers,

[48] Commonwealth of Massachusetts. (2018). *Massachusetts state hazard mitigation and climate adaptation plan (SHMCAP)*. Retrieved from https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf

loggers) can be affected if an invasive species impacts their crops, livestock, or supply. None of the current invasive species are targeting crops or livestock, and commercial logging is not currently a primary industry in the community despite some recent logging activity on Reservoir Road.

The other pathway is that invasive species indirectly increase the risk of other hazards. As discussed previously, the EAB is killing ash trees and increasing the fire supply in the town's forests. These dead trees make wildfires more likely by producing more fuel for fires. They have the additional effect of decreasing the tree canopy which, in turn, will push temperatures in the area up. Nature trails could also become obstructed if infected trees fall on them.

Structures and lifelines

EAB-infected trees increase the wildfire risk across the community, and that can impact buildings and infrastructure if they become severe. More likely, though, falling trees can obstruct fire roads or fall on supply lines if they are not pro-actively managed at early signs of infection.

Japanese knotweed, again already present in Middlefield, can also degrade built structures and roads by growing through cracks in those structures. When this occurs, smaller, innocuous cracks get larger and, if not dealt with, can impact the integrity of the structure or road. It also allows for more water intrusion that can freeze and expand in the colder months, further impacting those structures.

Systems

The town's electric supply is again vulnerable to infected trees when they fall if not properly managed at early signs of infection.

Natural, cultural, and historic resources

Invasive species are a direct threat to Middlefield's forests. Ash trees are already infected, and the EAB is spreading across the community. Some efforts to cut breaks and remove infected trees have slowed the spread.

LANDSLIDE

DESCRIPTION

According to NOAA, a landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting," which denotes any down-slope movement of soil and rock under the direct influence of gravity. The term "landslide" encompasses five modes of slope movement: falls, topples, slides, spreads, and flows. These are further subdivided by the type of geologic material (bedrock, debris, or earth). Debris flows (commonly referred to as mudflows or mudslides) and rock falls are examples of common landslide types.

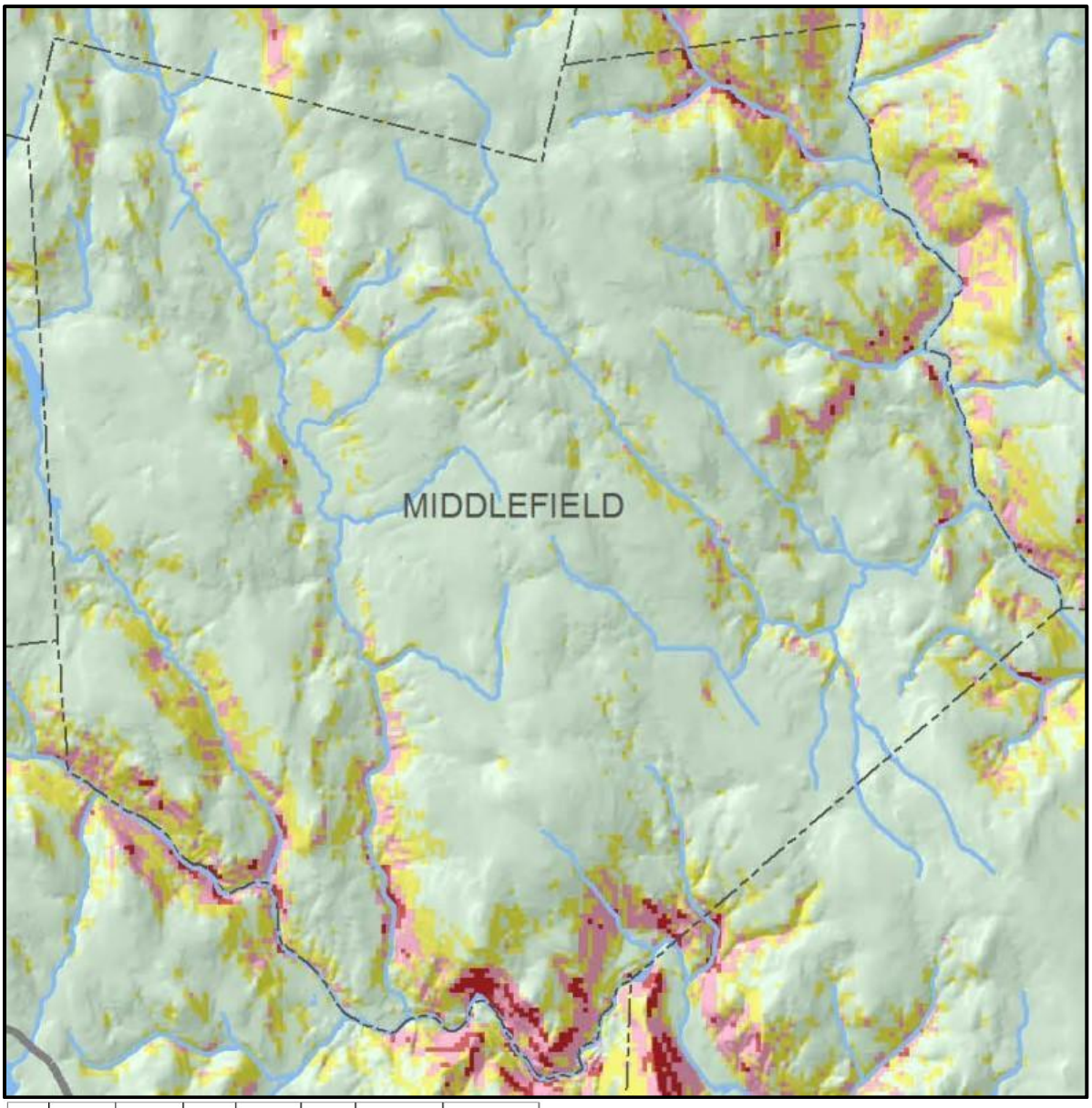
LOCATION

The issue that makes predicting when and where landslides will occur is that the earth's materials are multifaceted. Regions with steeper slopes are more prone to landslides, but in the Berkshire region of Massachusetts, the strength of the earth's materials minimizes the risk relative to regions that have volcanic activity, changes in water, extensive earthquake activity, or a large population mass in an area.

If Middlefield has a landslide event, it would be very localized. It is possible that a landslide could cause a road closure affecting a small location of town, but it is as likely that the damage would occur in the forested area beyond the inhabited parts of town. Because of the limited area involved, the location ranking for landslides is **small**.

EXTENT

The extent of potential landslide activity is based on several variables including soil properties, topographic position and slope, and historical incidence. Information about previous landslides can provide insight as to both where landslides may occur and what types of damage may result. These insights are limited, though, because they only identify areas that are prone to landslide activity without providing information on when that activity can occur. The slope stability map for New Ashford (***Figure 21***), indicates areas of higher slope instability (indicated in red) that are considered more susceptible to the landslide hazard.



Map Color Code	Predicted Stability Zone	Relative Slide Ranking[1]	Stability Index Range[2]	Factor of Safety (FS)[3]	Probability of Instability[4]	Predicted Stability With Parameter Ranges Used in Analysis	Possible Influence of Stabilizing or Destabilizing Factors[5]
	Unstable	High	0	Maximum FS<1	100%	Range cannot model stability	Stabilizing factors required for stability
	Upper Threshold of Instability		0 - 0.5	>50% of FS1	>50%	Optimistic half of range required for stability	Stabilizing factors may be responsible for stability
	Lower Threshold of Instability	Moderate	0.5 - 1	≥50% of FS>1	<50%	Pessimistic half of range required for instability	Destabilizing factors are not required for instability
	Nominally Stable	Low	1 - 1.25	Minimum FS=1	_	Cannot model instability with most conservative parameters specified	Minor destabilizing factors could lead to instability
	Moderately Stable		1.25 - 1.5	Minimum FS=1.25	_	Cannot model instability with most conservative parameters specified	Moderate destabilizing factors are required for instability
	Stable	Very Low	>1.5	Minimum FS=1.5	_	Cannot model instability with most conservative parameters specified	Significant destabilizing factors are required for instability

[1]**Relative Slide Ranking** - This column designates the relative hazard ranking for the initiation of shallow slides on unmodified slopes.

[2]**Stability Index Range** - The stability index is a numerical representation of the relative hazard for shallow translational slope movement initiation based on the factors of safety computed at each point on a 9 meter (~30 foot) digital elevation model grid derived from the National Elevation Dataset. The stability index is a dimensionless number based on factors of safety generated by SINMAP that indicates the probability that a location is stable considering the most and least favorable parameters for stability input into the model. The breaks in the ranges of values for the stability index categories are the default values recommended by the program developers.

[3]**Factors of Safety** - The factor of safety is a dimensionless number computed by SINMAP using a modified version of the infinite slope equation that represents the ratio of the stabilizing forces that resist slope movement to destabilizing forces that drive slope movement (Pack et al., 2001). A FS>1 indicates a stable slope, a FS<1 indicates an unstable slope, and a FS=1 indicates the marginally stable situation where the resisting forces and driving forces are in balance.

[4]**Probability of Instability** - This column shows the likelihood that the factor of safety computed within this map unit is less than one (FS<1, i.e., unstable) given the range of parameters used in the analysis. For example, a <50% probability of instability means that a location is more likely to be stable than unstable given the range of parameters used in the analysis.

[5]**Possible Influence of Stabilizing and Destabilizing Factors** - Stabilizing factors include increased soil strength, root strength, or improved drainage. Destabilizing factors include increased wetness or loading, or loss of root strength.

Pack, R. T., Tarboton, D. G. and Goodwin, C. N., 2001, Assessing terrain stability in a GIS using SINMAP, in 15th annual GIS conference, GIS 2001, Vancouver, British Columbia, February 19-22.

***Figure 21**. Slope stability map of Middlefield*[49]

[49] Mabee, S.B. and C.C. Duncan. (2013). *Slope stability map of Massachusetts*. Massachusetts Geological Survey, Miscellaneous Map 13-01. Scale 1:125,000. 3 sheets. Adobe PDF and ESRI ArcGIS map data files. Retrieved from

PREVIOUS OCCURRENCES

Middlefield does not have any recorded landslides to date. There have been a couple of notable landslides in Massachusetts over the course of the last decade, but none of them have resulted in attention on the national scale.

Two landslides were reported following Tropical Storm Irene in Deerfield, Massachusetts. Residents reported that one landslide caused light gray mud to appear in streams. Nearby roadways were temporarily closed in response as a safety measure. Tropical Storm Irene also caused a landslide on Route 2 in Western Massachusetts and caused additional flooding damage on slopes of the highway, causing road closures. Further, Goshen and Williamsburg both experienced mudslides in July 2015 resulting from heavy precipitation during a severe thunderstorm. In each case, a portion of Route 9 was closed. In Williamsburg, the damage was more extensive. A section of Route 9's eastbound lane was washed out by the mudslide.

PROBABILITY OF FUTURE EVENTS

In U.S. Landslide GIS data, Middlefield ranked lowest on the confidence probability of landslide activity. Additionally, the U.S. Geological Survey's (USGS) U.S. Landslide Inventory[50] does not indicate any areas in Middlefield where landslides are probable, so the probability for future events is **very low**. Landslides typically occur because of extreme flooding and/or tropical storm damage. Although flooding and extreme storms are a concern in the region, the soil in New England is strong enough to prevent landslides except in the most extreme circumstances.

CLIMATE CHANGE IMPACT

The SHMCAP indicates two effects of climate change that can impact the likelihood of landslides. They are increased drought conditions and increased severe storms. The more frequent drought conditions will reduce the amount of vegetation that typically helps to anchor the soil, and the predicted increase in severe storms will create more heavily saturated soil conditions more often. Together, these conditions make landslides more likely, but, because it does not contain areas that are already favorable for landslides, the effect of climate change will not be significant for Middlefield.

http://www.geo.umass.edu/stategeologist/Products/Landslide_Map/SSIM_Sheet1v2_print.pdf?_gl=1*1w0xtpd*_ga*NzE4NjkyNjk0LjE2ODA1MzQ3ODQ.*_ga_21RLS0L7EB*MTY4MDUzNDc4My4xLjAuMTY4MDUzNDc4OC4wLjAuMA..&_ga=2.19071359.650734730.1680534784-718692694.1680534784

[50] United States Geological Survey. (n.d.). *U.S. Landslide Inventory*. Retrieved from https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=ae120962f459434b8c904b456c82669d

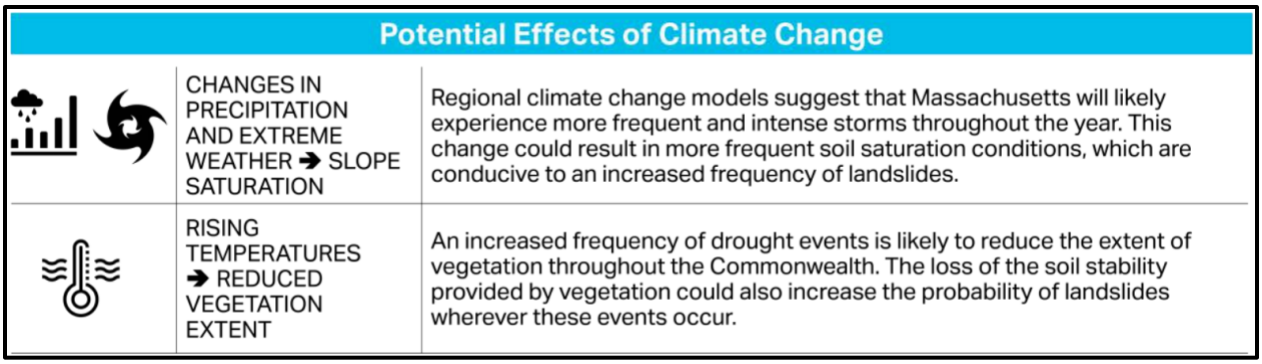


***Figure 22**. Effects of climate change on landslides for Massachusetts*[51]

IMPACT

The expected outcome of a landslide event in Middlefield would be washout of a section of dirt roadway along steeper sections of mountainsides. Given the localized nature of a landslide, homes or public buildings would not likely be impacted due to their location relative to the steeper slopes where landslides are likely. Residents and commuters could be inconvenienced by temporary road closures, as occurred during the damage-causing landslides in nearby Deerfield and Williamsburg. There would be no expected injuries associated with a landslide, and less than 10% of town would be affected. Therefore, the impact ranking would be **minor**.

VULNERABILITY

The vulnerability of Middlefield to landslides is **very low** based on historical data. Any impact on the community would be due to road closures, but homes on mountain cliffs should be evacuated in major tropical storms or hurricanes to eliminate loss of life threats.

People

People are at little risk from landslides in Middlefield. Road closure is the most likely impact, and that can result in being cut off from community lifelines temporarily.

Structures and lifelines

No structures in town are immediately at risk of landslides, but it is possible that some dirt roads in town could be closed as part of a landslide.

Systems

Supply lines could be affected if a nearby tree or telephone pole is felled by a landslide.

[51] Commonwealth of Massachusetts. (2018). *Massachusetts state hazard mitigation and climate adaptation plan (SHMCAP)*. Retrieved from https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf

Natural, cultural, and historic resources

Some trees could be lost in a landslide event. The soil moved in the landslide could also block waterways or drainage systems depending on the specific location.

SEVERE SNOWSTORM/ICE STORM

DESCRIPTION

Severe snowstorms include winter storms, nor'easters, blizzards, heavy snow, blowing snow, ice storms, or any other form of extreme winter precipitation.

Snow is water that falls as solid crystal formations due to the temperature of between the ground and cloud levels being at or below freezing (32° Fahrenheit or 0° Celsius). Heavy snow reflects an increased rate of snowfall and blowing snow results from wind moving the snow that has already fallen. Blizzards are considered the most extreme type of severe snowstorm. Blizzards are defined by the National Weather Service as a storm where the following conditions are expected to prevail for a period of 3 hours or longer:

- sustained wind or frequent gusts to 35 mph or greater and
- considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than ¼ mile)[52].

A Nor'easter is described by the National Weather Service as a strong low-pressure system that affects the Mid-Atlantic and New England States. It can form over land or over the coastal waters. These winter weather events are notorious for producing heavy snow and rain. Wind gusts associated with these storms can exceed hurricane force in intensity. A nor'easter gets its name from the continuously strong northeasterly winds blowing in from the ocean ahead of the storm and over the coastal areas. Nor'easters can bring substantial amounts of snowfall as they draw moisture from the ocean and deposit it onto the land. Nor'easters also tend to be more hazardous to coastal communities because they also cause heavy waves that batter the coast, but the resulting snowfall can also have a tremendous impact on inland areas.

Ice storms refer to winter storms where the precipitation falls as rain then freezes when it contacts the ground. The ice buildup must reach ¼ inches to be considered an ice storm.

LOCATION

Any severe snow or ice storm that impacts Middlefield will affect the entire town, therefore the location impacted by this hazard is **large**.

EXTENT

The Northeast Snowfall Impact Scale (NESIS) developed by Paul Kocin and Louis Uccellini of the National Weather Service (Kocin & Uccellini, 2004[53]) characterizes and ranks high-impact Northeast snowstorms. These storms have large areas of 10-inch snowfall accumulations and

[52] National Weather Service. (n.d.). *National Weather Service: Glossary: Blizzard.* National Oceanic and Atmospheric Administration. Retrieved on November 7, 2022, from https://w1.weather.gov/glossary/index.php?word=blizzard#:~:text=(abbrev.,to%20less%20than%20%C3%82%C2%BC%20mile)

[53] Kocin, P. J. and Uccellini, L. W. (2004). A snowfall impact scale derived from northeast storm snowfall distributions. *Bulletin of the American Meteorological Society*, *85*, pp. 177-194.

greater. NESIS has five categories: *Extreme*, *Crippling*, *Major*, *Significant*, and *Notable*. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS gives an indication of a storm's societal impacts. This scale was developed because of the impact Northeast snowstorms can have on the rest of the country in terms of transportation and economic impact.

The NESIS scale, values, and categories are summarized in ***Table 15***.

Category	NESIS Value	Description
1	1—2.499	Notable
2	2.5—3.99	Significant
3	4—5.99	Major
4	6—9.99	Crippling
5	10.0+	Extreme

Table 15*. NESIS categories, their corresponding NESIS values, and a descriptive adjective*[54]

Below, ***Table 16*** contains severity infraction on winter storms affecting Middlefield calculated using the NESIS. Events are arranged based on severity rather than date, and the range of storms included are from 1956 - 2021.

Date	*NESIS Value*	*NESIS Category*	*NESIS Classification*
3/12/1993	13.20	5	Extreme
3/2/1960	8.77	4	Crippling
2/15/2003	7.50	4	Crippling
2/2/1961	7.06	4	Crippling
1/21/2005	6.80	4	Crippling
1/19/1978	6.53	4	Crippling
12/25/1969	6.29	4	Crippling
2/10/1983	6.25	4	Crippling
2/14/1958	6.25	4	Crippling
2/5/1978	5.78	3	Major
2/23/2010	5.46	3	Major
2/8/1994	5.39	3	Major
1/9/2011	5.31	3	Major
3/12/2017	5.03	3	Major
1/30/2021	4.93	3	Major
2/18/1972	4.77	3	Major

[54] National Centers for Environmental Information. (n.d.). *The Northeast snowfall impact scale (NESIS)*. National Oceanic and Atmospheric Administration. Retrieved on November 7, 2022, from https://www.ncei.noaa.gov/access/monitoring/rsi/nesis

12/11/1960	4.53	3	Major
2/7/2013	4.35	3	Major
2/22/1969	4.29	3	Major
1/18/1961	4.04	3	Major
2/8/1969	3.51	2	Significant
2/5/1967	3.50	2	Significant
3/5/2018	3.45	2	Significant
4/6/1982	3.35	2	Significant
3/4/2013	3.05	2	Significant
3/15/2007	2.54	2	Significant
3/31/1997	2.29	1	Notable
1/3/2018	2.27	1	Notable
2/2/1995	1.43	1	Notable
1/25/1987	1.19	1	Notable

***Table 16**. Severity of winter storms impacting Middlefield based on NESIS severity*[55]

PREVIOUS OCCURRENCES

Severe snowstorms are common in the winter months in New England. As recently as March 2023, a severe snowfall event deposited three feet of snow on Middlefield. In keeping with the concerns voiced by survey respondents, public comment participants, and the Core Team, it took days for many residents to be plowed out and have power restored after trees took out power supply lines.

NOAA collects historical occurrences of severe snowstorms in three categories. They provide data on occurrences of blizzards, ice storms, and winter storms. ***Table 17*** contains the reported storms in Hampshire County from 1996 through 2022, the years of data available at the time of this report. No noted deaths or injuries were recorded during these events.

Begin Date	***Event Type***	***Property Damage (dollars)***
1/2/1996	Heavy Snow	0
1/7/1996	Heavy Snow	800,000
1/12/1996	Heavy Snow	0
2/16/1996	Heavy Snow	0
3/2/1996	Heavy Snow	0
3/7/1996	Heavy Snow	0
4/9/1996	Heavy Snow	0
12/6/1996	Heavy Snow	0

[55] National Centers for Environmental Information. (n.d.). *The Northeast snowfall impact scale (NESIS)*. National Oceanic and Atmospheric Administration. Retrieved on August 2, 2022, from https://www.ncei.noaa.gov/access/monitoring/rsi/nesis

12/7/1996	Heavy Snow	1,360,000
3/31/1997	Heavy Snow	0
4/1/1997	Heavy Snow	0
12/23/1997	Heavy Snow	0
1/15/1998	Heavy Snow	0
1/23/1998	Heavy Snow	0
3/22/1998	Heavy Snow	0
12/29/1998	Heavy Snow	0
1/14/1999	Heavy Snow	0
3/6/1999	Heavy Snow	0
1/13/2000	Heavy Snow	0
1/25/2000	Heavy Snow	0
2/18/2000	Heavy Snow	0
12/30/2000	Heavy Snow	0
2/5/2001	Heavy Snow	0
3/5/2001	Heavy Snow	0
3/9/2001	Heavy Snow	0
3/30/2001	Heavy Snow	0
12/8/2001	Heavy Snow	0
1/6/2002	Heavy Snow	0
3/20/2002	Heavy Snow	0
11/16/2002	Ice Storm	150,000
12/11/2002	Heavy Snow	0
12/25/2002	Winter Storm	15,000
1/3/2003	Winter Storm	0
2/17/2003	Winter Storm	0
12/5/2003	Winter Storm	0
12/14/2003	Winter Storm	0
1/27/2004	Winter Storm	0
3/16/2004	Heavy Snow	0
1/5/2005	Winter Storm	0
1/22/2005	Winter Storm	0
3/1/2005	Winter Storm	0
3/8/2005	Winter Storm	0
3/12/2005	Winter Storm	0
3/23/2005	Heavy Snow	0
2/13/2007	Winter Storm	0
3/16/2007	Winter Storm	0
4/15/2007	Heavy Snow	10,000
12/13/2007	Heavy Snow	0
12/16/2007	Heavy Snow	0
12/31/2007	Heavy Snow	0
1/14/2008	Heavy Snow	20,000

2/22/2008	Heavy Snow	0
3/1/2008	Heavy Snow	0
12/11/2008	Ice Storm	3,000,000
12/19/2008	Heavy Snow	0
12/31/2008	Heavy Snow	0
1/11/2009	Heavy Snow	0
3/1/2009	Heavy Snow	0
12/9/2009	Heavy Snow	0
2/23/2010	Heavy Snow	15,000
2/26/2010	Heavy Snow	0
12/26/2010	Winter Storm	0
1/11/2011	Heavy Snow	0
1/18/2011	Winter Storm	0
1/21/2011	Winter Storm	0
1/26/2011	Heavy Snow	0
2/1/2011	Winter Storm	10,000
10/29/2011	Heavy Snow	50,000
2/29/2012	Winter Storm	0
3/1/2012	Winter Storm	0
12/26/2012	Heavy Snow	0
12/29/2012	Heavy Snow	0
2/8/2013	Heavy Snow	0
3/7/2013	Heavy Snow	0
12/14/2013	Heavy Snow	0
1/2/2014	Heavy Snow	0
2/5/2014	Heavy Snow	0
2/13/2014	Heavy Snow	0
11/26/2014	Heavy Snow	25,000
1/27/2015	Heavy Snow	0
2/2/2015	Heavy Snow	0
2/8/2015	Heavy Snow	0
12/11/2016	Heavy Snow	0
12/17/2016	Winter Storm	0
12/29/2016	Heavy Snow	0
2/9/2017	Winter Storm	0
2/12/2017	Winter Storm	0
3/14/2017	Heavy Snow	0
1/4/2018	Winter Storm	0
1/16/2018	Winter Storm	0
3/2/2018	Winter Storm	0
3/7/2018	Winter Storm	0
3/13/2018	Winter Storm	0
11/15/2018	Heavy Snow	0

1/19/2019	Winter Storm	0
3/3/2019	Winter Storm	0
12/1/2019	Heavy Snow	0
12/30/2019	Ice Storm	10,000
2/10/2020	Heavy Snow	0
12/16/2020	Heavy Snow	0
1/16/2021	Heavy Snow	0
2/1/2021	Heavy Snow	0
4/16/2021	Heavy Snow	0
1/16/2022	Heavy Snow	0
2/25/2022	Heavy Snow	0
Total	***127 Heavy Snow Events*** ***48 Winter Storms*** ***5 Ice Storms***	***$5,465,000***

Table 17*. Heavy snow, winter storms, ice storms, and blizzards in Hampshire County*[56]

PROBABILITY OF FUTURE EVENTS

Given the historical data, severe snowstorms or ice storms occur at a rate of 6.7 per year (180 storms in 27 years). Therefore, there is an almost 100% chance of a winter storm annually, meaning the annual probability of a severe snowstorm or ice storm is **very high**.

More severe snowstorms and ice storms can be defined by being ranked as *Major*, *Crippling*, or *Extreme* using the NESIS. Twenty (20) of the 30 storms rated using the NESIS over 65 years were listed as *Major*, *Crippling*, or *Extreme*, resulting in a 31% chance of a winter storm with at least a *Major* rating every year.

CLIMATE CHANGE IMPACT

The SHMCAP includes additional information about the impact of climate change on future winter storm events, summarized in ***Figure 23*** below. Though there is already a very high change of winter storms every year, the intensity and frequency will both likely increase due to climate change.

Since climate vulnerable populations are more negatively impacted by winter storm events, Middlefield's overall vulnerability will increase due to the aging of their population and the rising intensity and frequency of winter storms resulting from climate change. Furthermore, power outages as a result of severe winter weather could serve as a further detriment to elderly or disabled residents who require refrigerated medications.

[56] National Centers for Environmental Information. (n.d.). *Storm events database*. Retrieved January 27, 2023, from https://www.ncdc.noaa.gov/stormevents

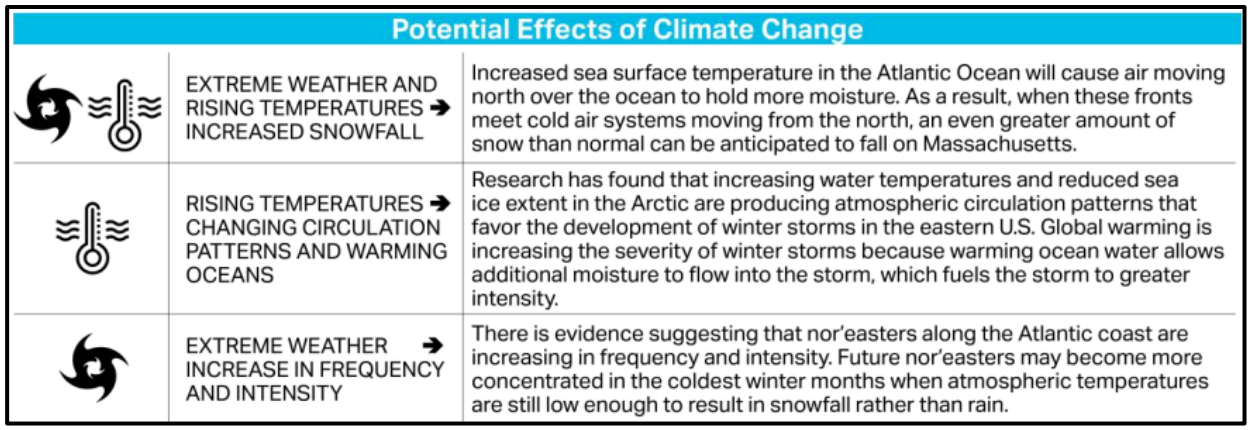


***Figure 23**. Potential effects of climate change*[57]

IMPACT

The impacts of a severe snowstorm or ice storm are well known to inhabitants of New England. Among the most common are:

- dangerous driving conditions resulting in decreased or loss of access to emergency services, evacuation routes, or access to critical lifelines (e.g., specialty support services, food);
- loss of work productivity due to the need to remain home when schools cancel services for the day or driving to non-essential jobs is prohibited;
- downed trees and limbs that obstruct roadways;
- interruptions to utilities, including electricity and telecommunication, because of downed lines;
- shortages of food or other basic provisions in the days leading up to and immediately following the severe weather event; and
- damage to structures from ice dams on roofs or the resulting flooding if enough snow melts quicker than it evaporates or is absorbed in the ground.

In the most extreme, these events can lead to injuries and death. Injuries can prove more fatal in these conditions because emergency responders have a more difficult time responding to calls then. As is the case with most hazards, Climate Vulnerable populations are disproportionately impacted by these events.

Massachusetts is more prepared for winter weather than some other regions of the United States, but the more severe snow and ice storms can still have a substantial impact. Winter storms that are rated as *Notable* or *Significant* using the NESIS typically have little or no significant effect on Massachusetts communities due to their preparedness for these types of events.

[57] Commonwealth of Massachusetts. (2018). *Massachusetts state hazard mitigation and climate adaptation plan (SHMCAP)*. Retrieved from https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf

Using the combined property value of Middlefield, $56,752,200, as a base, and assuming a 20% loss to approximately 10% of structures in the event of an event of *Major*, *Crippling*, or *Extreme* magnitude, the monetary impact of severe snow and ice storms is approximately $1,055,044.

When combined, the factors indicated above reflect a **minor** impact on Middlefield in the event of a severe snowstorm or ice storm.

VULNERABILITY

Given the location impacted, probability of future events, and expected impact, the risk assessment of Middlefield's vulnerability to severe snowstorms and ice storms is rated as **high**. Town Hall with its flat roof and the town's tree canopy are particularly susceptible to high accumulations of snow and ice due to the weight they would bear. Loss of power is also expected, either from falling trees or the weight of the ice on the supply lines during ice storms.

People

Winter storms interrupt daily activities when roads are forced to close, affecting travel within and outside of town. Persons with limited resources or diminished mobility are more likely to be negatively impacted during these events as they face more obstacles to remediate challenges or problems (e.g., snow removal, dealing with power outages).

Structures and lifelines

Community lifelines, again, are out of town, so the expected road closures will decrease access to those supports. Because winter storms are not uncommon and widely advertised, most residents are able to prepare in advance for being cut off from the lifelines for a few days. There is also a chance of minor damage to buildings, particularly Town Hall with its flat roof, under heavy accumulation.

Systems

The town's electric supply is vulnerable to severe winter snow and ice storms. Accumulating snow and ice on supply lines increases their weight, resulting in lines breaking and loss of power.

Natural, cultural, and historic resources

Middlefield is mostly forested. Because winter storms often involve heavy precipitation events and high winds, there is a high risk of trees being lost during the storms. The soil is not usually softened like other severe precipitation events because of the cold temperatures during winter storms, but if the temperature rapidly rises, there is a chance that the melting snow can lead to flooding as the water flows down watersheds and overwhelms culverts or natural drainage.

SEVERE THUNDERSTORM/WIND/TORNADO/ MICROBURST

DESCRIPTION

A storm is produced by a cumulonimbus cloud and accompanied by lightning and thunder. Any thunderstorm that is over 40 mph or produces hail is considered a severe thunderstorm. When a thunderstorm produces winds greater than 55 mph, it is considered a tornado. Traditionally, thunderstorms are associated with warm, humid air in the summer months, usually toward the end of a humid afternoon.

According to The National Weather Service, tornadoes are rotating columns of air that extend from cumulus clouds to ground level. The wind speeds associated with the rotation can reach speeds over 200 miles per hour. Our collectively shared image of a tornado is made of water droplets and other particulates (i.e., dirt and debris) that is caught in the rotating column or funnel. Tornadoes are most common in the summer months, and, in Massachusetts, they are most prevalent in the central part of the state. Tornadoes are violent and destructive, typically destroying everything along their path.

LOCATION

According to NOAA, severe storms are measured by affecting more than 10% of the area. Although a high risk is rare and implies a dangerous situation and the possibility of a major severe weather outbreak. Typically, thunderstorms and windstorms move through an entire region, which indicates a greater impact of the town. Due to the topography of Middlefield, some higher ground areas could be more impacted by severe storm damage, but any severe thunderstorm or wind event would affect the entire town. Therefore, the affected location would be **large**.

A microburst is a more focused event than a severe thunderstorm, so it is expected that it would affect some parts of town while others would remain unaffected. The estimated location impacted would be **medium**, between 20 - 30% of town.

It is difficult to predict the specific location a tornado will form. While anything the tornado contacts is likely to be devastated, the damage is typically limited to the tornado's path and area immediately adjacent. Damage beyond that area tends to be limited because the wind speeds quickly decrease outside the funnel. Therefore, any damage would be the result of materials ejected from the funnel or from precipitation associated with the storm. Therefore, the impacted location is **small**.

Taken together, the estimated location impacted by severe thunderstorms, winds, tornadoes, and/or microburst annually is **medium**.

EXTENT

The TS scale rates thunderstorms from a weak TS1 to a dangerous TS5. Average rate of rainfall, maximum wind speeds, hail size, lightning frequency, tornado potential and capacity for damage are factors in determining the scale rating.

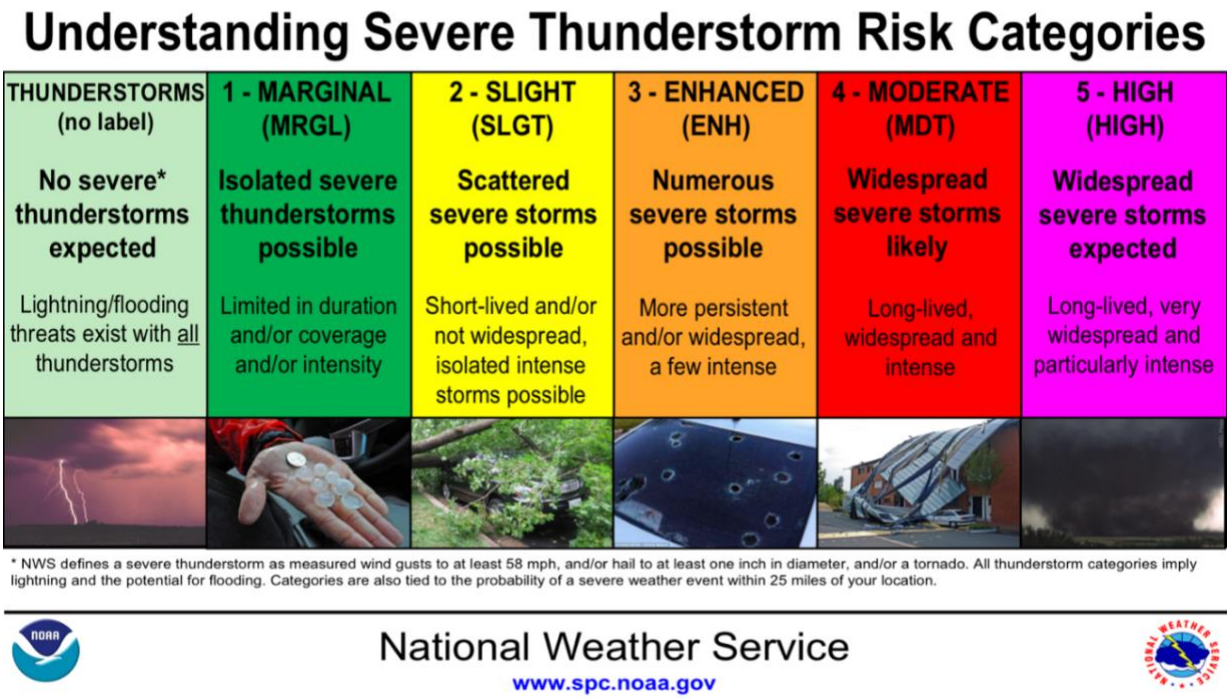


***Figure 24**. Understanding severe thunderstorm risk categories*[58]

Tornadoes have been classified using the Fujita Scale (F Scale) or Enhanced Fujita Scale (EF-Scale). The F Scale rates a tornado based on a damage assessment of the area affected by a tornado. The wind speed ranges associated with an F Scale rating are estimated based on the damage caused by the tornado.

F Scale	*Character*	*Estimated Winds*	*Description*
Zero (F0)	Weak	40-72 mph	**Light damage.** Some damage to chimneys; branches broken off trees; shallow-rooted trees uprooted; sign boards damaged.
One (F1)	Weak	73-112 mph	**Moderate damage.** Roof surfaces peeled off; mobile homes pushed off foundations or overturned; moving autos pushed off road.
Two (F2)	Strong	113-157 mph	**Considerable damage.** Roofs torn from frame houses; mobile homes demolished; boxcars pushed

[58] National Weather Service. (1970). *Storm prediction center: SPC products*. National Oceanic and Atmospheric Administration. Retrieved on October 26, 2022, from https://www.spc.noaa.gov/misc/about.html

			over; large trees snapped or uprooted; light objects become projectiles.
Three (F3)	Strong	158-206 mph	**Severe damage.** Roofs and some walls torn from well-constructed houses; trains overturned; most trees in forested area uprooted; heavy cars lifted and thrown.
Four (F4)	Violent	207-260 mph	**Devastating damage.** Well-constructed houses leveled; structures with weak foundation blown some distance; cars thrown; large missiles generated.
Five (F5)	Violent	260-318 mph	**Incredible damage.** Strong frame houses lifted off foundations, carried considerable distances, and disintegrated; auto-sized missiles airborne for several hundred feet or more; trees debarked.

***Table 18**. Tornado F Scale overview*[59]

Alternatively, the EF Scale is based on the velocity of their winds. The EF Scale rating system still uses damage to estimate the wind speeds, but the calculated wind speed is then used to rate the tornado. Ratings for tornadoes were completed using the F Scale until 2007 when the EF Scale was adopted as the new standard.

[59] National Weather Service. (n.d.). *The Fujita Scale*. National Oceanic and Atmospheric Administration. Retrieved on October 26, 2022, from https://www.weather.gov/oun/efscale

EF Rating	Wind Speeds	Expected Damage		
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.		
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.		
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.		
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.		
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.		
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.		

***Table 19**. Tornado EF Scale overview*[60]

PREVIOUS OCCURRENCES

According to the SHMCAP, there are approximately 10 to 30 days of thunderstorm activity in Massachusetts each year.

A list of severe thunderstorms in Hampshire County impacting Middlefield directly with winds over 50 knots, since 1993, is provided in ***Table 21*** below. On average, since 1993, there has been just under one event per year. If not restricted to only the events that impacted Middlefield, there are 144 days with events over that same period of time, averaging just under 5 events per year.

In public survey responses, one respondent noted that several microbursts affected the respondent's property as well as wind and hail damage from thunderstorms. Additionally, the same respondent noted that hilltop structures are more vulnerable to microbursts and wind than those in lower lying areas.

[60] National Weather Service. (n.d.). *Explanation of EF Scale ratings*. National Oceanic and Atmospheric Administration. Retrieved on October 26, 2022, from https://www.weather.gov/images/hun/stormsurveys/2011-04-27/EF-Ratings_large.jpg

Since NOAA began collecting severe thunderstorms and wind data, the methodology has been modified. Events prior to 1993 were recorded at the county level, but since then they have been reported by either zone (e.g., Eastern or Western Hampshire County) or town. Below are the storm events recorded for Hampshire County, Western Hampshire Zone (Z), or Middlefield, Massachusetts. There were 25 events reported from 1993 to present in "*Thunderstorm wind*" and "*High wind*" categories with winds of 50 knots or greater. A summary of the events is reported in ***Table 20***, below, followed by a complete list of those events in ***Table 21***.

Number of Days with Event:	**25**
Number of Days with Event and Death:	**0**
Number of Days with Event and Death or Injury:	**1**
Number of Days with Event and Property Damage:	**16**
Number of Days with Event and Crop Damage:	**0**

Table 20*. Thunderstorm wind and high wind summary, Hampshire County*[57]

Location	*Date*	*Event Type*	*Magnitude (in knots*)*	*Deaths/ Injuries*	*Property Damage (dollars)*
Hampshire County	7/8/1966	T-storm Wind	56 kts.	0	0
Hampshire County	6/28/1972	T-storm Wind	72 kts.	0	0
Hampshire County	6/22/1988	T-storm Wind	60 kts.	0	0
Hampshire County	7/11/1988	T-storm Wind	50 kts.	0	0
Hampshire County	7/28/1989	T-storm Wind	50 kts.	0	0
Hampshire County	10/18/1990	T-storm Wind	50 kts.	0	0
Hampshire County	8/4/1991	T-storm Wind	50 kts.	0	0
Western Hampshire (Z)	4/8/2000	High Wind	50 kts. E	0	0
Western Hampshire (Z)	11/13/2003	High Wind	50 kts. EG	0	$50,000
Western Hampshire (Z)	12/1/2004	High Wind	58 kts. EG	0	$25,000
Western Hampshire (Z)	10/16/2005	High Wind	58 kts. EG	0	$20,000
Western Hampshire (Z)	1/18/2006	High Wind	58 kts. EG	0	$10,000
Western Hampshire (Z)	2/17/2006	High Wind	58 kts. EG	0	$30,000
Western Hampshire (Z)	3/21/2008	High Wind	54 kts. MG	0	0
Middlefield	9/3/2008	T-storm Wind	50 kts. EG	0	$8,000
Middlefield	5/4/2010	T-storm Wind	50 kts. EG	0	$25,000
Middlefield	8/16/2010	T-storm Wind	50 kts. EG	0	$1,000
Middlefield	8/16/2010	T-storm Wind	50 kts. EG	0	$10,000
Middlefield	7/26/2011	T-storm Wind	50 kts. EG	0	$15,000
Western Hampshire (Z)	9/18/2012	High Wind	56 kts. EG	0	$10,000
Middlefield	6/18/2014	T-storm Wind	50 kts. EG	0	$500
Western Hampshire (Z)	10/23/2016	High Wind	50 kts. EG	1 injury	$5,000

Middlefield	8/17/2018	T-storm Wind	50 kts. EG	0	$2,000
Western Hampshire (Z)	2/25/2019	High Wind	57 kts. EG	0	$33,000
Western Hampshire (Z)	3/2/2021	High Wind	52 kts. EG	0	$4,000
Total		***11 High Wind 14 T-storm Wind***		***1 injury 0 deaths***	***$248,500***

Table 21*. Severe thunderstorm events in Middlefield. *E = Estimated, EG = Estimated gust, MG = Measured gust*[61]

Tornadoes in Hampshire County are not common, averaging just over one tornado every decade since the 1950s. ***Table 22***, below, contains the recorded tornadoes for Hampshire County.

Date	***F Scale***	***Reported Deaths***	***Reported Injuries***	***Damage to Property (dollars)***
8/16/1954	F1	0	0	$2,500
7/5/1957	F1	0	0	$2,500
8/14/1958	F2	0	0	$250,000
7/21/1961	F2	0	0	$25,000
5/27/1965	F1	0	0	$250
9/13/1971	F3	0	0	$25,000
7/5/1984	F1	0	0	$2,500
6/2/2000	F1	0	0	0
2/25/2017	EF1	0	0	$250,000
Total	***9***	***0***	***0***	***$557,750***

Table 22*. Tornadoes in Hampshire County*[62]

PROBABILITY OF FUTURE EVENTS

Per the SHMCAP, there are approximately 10 to 30 days of thunderstorm activity in the state each year. Therefore, the probability of severe thunderstorms or wind in Middlefield each year is 100%, or **very high**. Microbursts are not differentiated from other storms by NOAA, but local officials believe the rate has not changed since the 2019 HMP. Therefore, there is a 10 - 40%, or **moderate**, chance of a microburst annually.

The Tornado Index, calculated by USA.com, indicates the likelihood of a tornado based on historical occurrences. The index for Hampshire County has not changed since the 2019 HMP.

Tornado Index for Hampshire County

[61] National Centers for Environmental Information. (n.d.). *Storm events database*. Retrieved January 23, 2023, from https://www.ncdc.noaa.gov/stormevents

[62] National Centers for Environmental Information. (n.d.). *Storm events database*. Retrieved January 30, 2023, from https://www.ncdc.noaa.gov/stormevents

Hampshire County	125.73
Massachusetts	87.60
United States	136.45

***Table 23**. Tornado Index for Hampshire County*[63]

Increasing temperatures and extreme storm events may increase the likelihood of tornadoes beyond the expected expiration of this plan, but, even allowing for an increase, the probability of a tornado touching down in Middlefield each year is **low**.

Taken together, the probability of severe thunderstorms, winds, tornadoes, and/or microburst is **high** in any given year.

CLIMATE CHANGE IMPACT

The SHMCAP includes additional information about the impact of climate change on future events, summarized in ***Figure 25*** below. Though there is already a high chance of severe thunderstorms/winds/microbursts/tornadoes every year, the intensity and frequency will both likely increase due to climate change.

Since Middlefield is an aging population with a median age of over 59, as time progresses more members of the population will be considered elderly and thus, climate vulnerable. This creates additional concern when it comes to ability to evacuate prior to or during a severe weather event such as a thunderstorm, heavy wind, tornados, or microbursts.

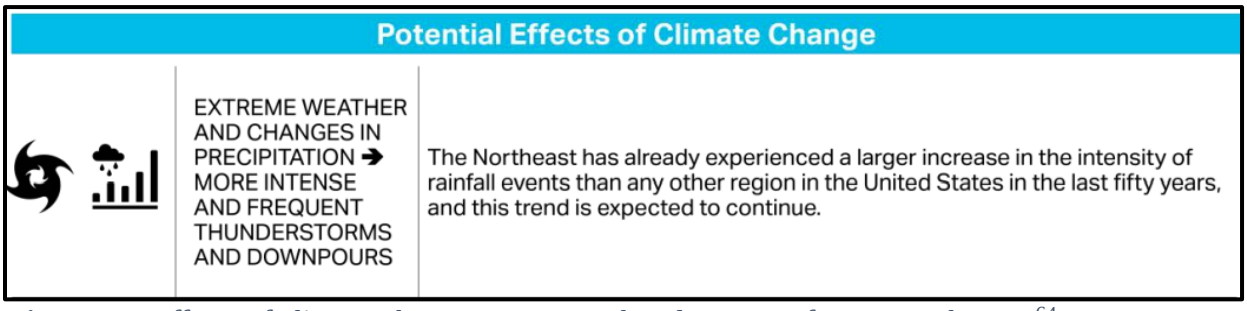


***Figure 25**. Effects of climate change on severe thunderstorms for Massachusetts*[64]

IMPACT

Having been constructed prior to their passage, most buildings in town do not meet the requirements of Design Wind Speed Codes (1975), which would lead to increased damage in a

[63] USA.com. (n.d.). *Hampden County natural disasters and weather extremes*. Retrieved on January 30, 2023, from http://www.usa.com/hampshire-county-ma-natural-disasters-extremes.htm#TornadoIndex

[64] Commonwealth of Massachusetts. (2018). *Massachusetts state hazard mitigation and climate adaptation plan (SHMCAP)*. Retrieved from https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf

severe event. Although the town has a limited travel path of development areas, the risk of downed trees, minor home damage, and power outages is probable during a severe thunderstorm, microburst, or wind event. Due to Middlefield's more remote location and lack of redundant power supply lines, service interruptions could take days to restore as neighboring communities will also be similarly impacted. Communications infrastructure would be similarly impacted.

To approximate the potential impact to property and people that could be affected by severe thunderstorms, winds, or microbursts, the total value of all property in town, $56,752,200 is used. For a severe thunderstorm or wind event, an estimated 70% of town would be impacted. The expected damage would be minimal (estimated at 5% of value), resulting in a total of $1,986,327 in potential damage. The impact ranking would, therefore, be **limited**.

Tornadoes are most likely to occur on hill tops or along river corridors, and Middlefield contains both. The Middle Branch Westfield River runs along Middlefield's eastern border with Worthington. There are also a few high elevation spots, including the area with Town Hall. These areas are populated, but the likelihood of a tornado impacting dwellings is less than 1% each year.

Given the prior rankings of tornadoes in Hampshire County, an EF1 strength tornado is most likely in the event of a tornado. Homes and other structures in the area are not built to withstand wind speeds associated with tornadoes. Therefore, an EF1 tornado would cause minor damage to any structures it encounters, destroying roofs, blowing out windows, and moving homes off their foundations.

Given the small location ranking of (estimated at 5%) but expected high damage (100% of their value) to those structures, the calculated impact on the town in the event of a tornado is $2,837,610. This estimate does not take into account the cost of roads, bridges, or other infrastructure damage, which potentially includes Town Hall given its elevation. Because of the focused nature and destructive power of a tornado, expected injuries or deaths, and the interruption to services, the impact of a tornado is ranked as **critical**.

Taken together, the predicted impact of severe thunderstorms, winds, tornadoes, and microbursts in Middlefield is **critical**.

VULNERABILITY

Middlefield can expect property damage and emergency management needs related to severe thunderstorms and winds annually. The town may be affected by downed power lines, wind damage or destruction, and/or road closures. In the case of tornadoes or microbursts, there is also an increased chance of injuries or even deaths. These events will affect the entire region in terms of resources.

Given the location impacted, probability of future events, and expected impact, the risk assessment of Middlefield's vulnerability to severe thunderstorms, winds, tornadoes, and microbursts is rated as **high**.

People

Extreme precipitation often results in localized flooding events. These events interrupt daily activities when roads are forced to close, affecting travel within and outside of town. Persons with limited resources or diminished mobility are more likely to be negatively impacted during these events as they face more obstacles to remediate challenges or problems. Additionally, prolonged periods of precipitation can lead to increased mold growth in homes, resulting in health issues for those residents. Heavy precipitation can also cause contamination in private wells or cause septic system failures. Because these systems are all private in Middlefield, residents would be immediately impacted and responsible for repairs costs.

Structures and lifelines

The same roads, bridges, and culverts referenced in previous sections would be impacted by heavy precipitation during severe storms. Community lifelines are, again, located in neighboring towns, so any road closures due to localized flooding will decrease access to those supports or services.

Systems

The town's electric supply is likely to fail during heavy precipitation and wind events.

Natural, cultural, and historic resources

Heavy precipitation and wind events cause erosion and washout in affected areas. The loosened soil will travel "downstream" where it can back-up culverts that are undersized or already partially blocked. Those blocked culverts, in turn, increase the risk for more localized flooding. Wildlife in the flooded areas will also be affected through loss of their habitat.

As previously noted, Middlefield is mostly forested. Because flooding is related to heavy or repeated precipitation events, there is a high risk of trees being lost during floods. The extreme precipitation events soften the soil making trees more likely to fall, especially when there are heavy winds.

WILDFIRE/BRUSHFIRE

DESCRIPTION

FEMA defines a wildfire as an unplanned fire that burns in a natural area such as a forest, grassland, or prairie. Wildfires are larger fires than brushfires, distinguished by their quick movement and impact on forested or grassland areas. Brushfires tend to be smaller and impact scrubland, but they can also impact large areas. The risk of a wildfire or brushfire is increased during periods of drought, when there is excess deadwood, and/or under high wind conditions, as the first two create conditions for easy ignition and the latter aid in their advance.

Wildfires and brushfires are not easily controlled once started. They typically advance through available fuel sources leaving very little surviving vegetation, if any, in their wake. Wildfires and brushfires are hazards to humans for several reasons. First, if the fire moves to developed areas, there is an immediate risk to the safety of the inhabitants as well as to the structures in the fire's path. Losses of life and property result. The loss of vegetation and tree canopies has negative impacts for people by decreasing the area's natural defense against extreme temperatures and precipitation. Additionally, the smoke from wildfires can travel hundreds of miles, increasing the risk of respiratory problems for people in and well beyond the area of the fire. The young, elderly, and those with existing respiratory issues are most at risk.

There are three categories of wildfires, each based on where the fire is spreading. *Ground fires* begin underground, burning the roots of plants or other organic materials. Ground fires become *surface fires* as the fire spreads to the grasses, shrubs, and deadwood at ground level. The final category is a *crown fire*, distinguished by the burning of the tree canopy.

LOCATION

Approximately 93% of Middlefield is forested, covering almost the entire town. The location at risk of a wildfire or brushfire, therefore, is **large**. If the Emerald Ash Borer continues to advance, the deadwood supply in the forest areas will continue to increase. Since deadwood is more easily ignited than living trees, any wildfire that reaches the forests in Middlefield will spread rapidly. Areas near train tracks along Middlefield's southern border have previously been noted to be of greater threat due to trains and track cleaning operations throwing sparks that could have ignited fires in the past, but, regardless of the point of ignition, the entire town would quickly become engulfed.

EXTENT

Climate change has resulted in more high temperature records and an increased average temperature in Middlefield, as well as increased the number of consecutive days without precipitation, resulting in more periods of drought. Additionally, the Emerald Ash Borer is making its way to this area, increasing the deadwood along the forest floor as the species moves from tree to tree. Finally, many areas in Middlefield are remote and not easily accessed by firefighting personnel. Without improving access via fire road maintenance or improved forest

management activities, containing any wildfire or brushfire before it has burned through most of the community will be extremely challenging. All these factors increase the extent of the damage expected to the town in the event of a wildfire or brushfire.

PREVIOUS OCCURRENCES

Because of the annual rainfall in the region, wildfires are less likely in Massachusetts than other regions of the country. There are no recorded wildfires in all of Hampshire County, including Middlefield, based on NOAA's Storm Event Database. A few communities of note have experienced wildfires. For example, Montgomery, in Hampden County, experienced a wildfire in 1999 and again in 2016 with neighboring Russell. Both wildfires began on Tekoa Mountain and eventually burned 500 and 90 acres of forest, respectively. Russell experienced two other wildfires, the first in 1995 and the other in 2010, each consuming hundreds of acres. Another wildfire developed from a brushfire in Brimfield that grew out of control and resulted in 50 acres burning.

PROBABILITY OF FUTURE EVENTS

Given the factors mentioned above, including extensive forest, climate change, and the Emerald Ash Borer/increase in the deadwood along the forest floor, as well as the recent history of wildfires in the area, the probability of a wildfire or brushfire in Middlefield is **moderate**. The United States Department of Agriculture (USDA) Forest Service categorizes the risk of a wildfire to private homes in Hampshire Country as being greater than 85% of Massachusetts counties. As can be seen in ***Figure 26***, the risk increases from west to east across the county, meaning Middlefield is situated within the lowest risk area of the county. Balancing this with historical data, the probability of a wildfire annually is between 10 - 40%.

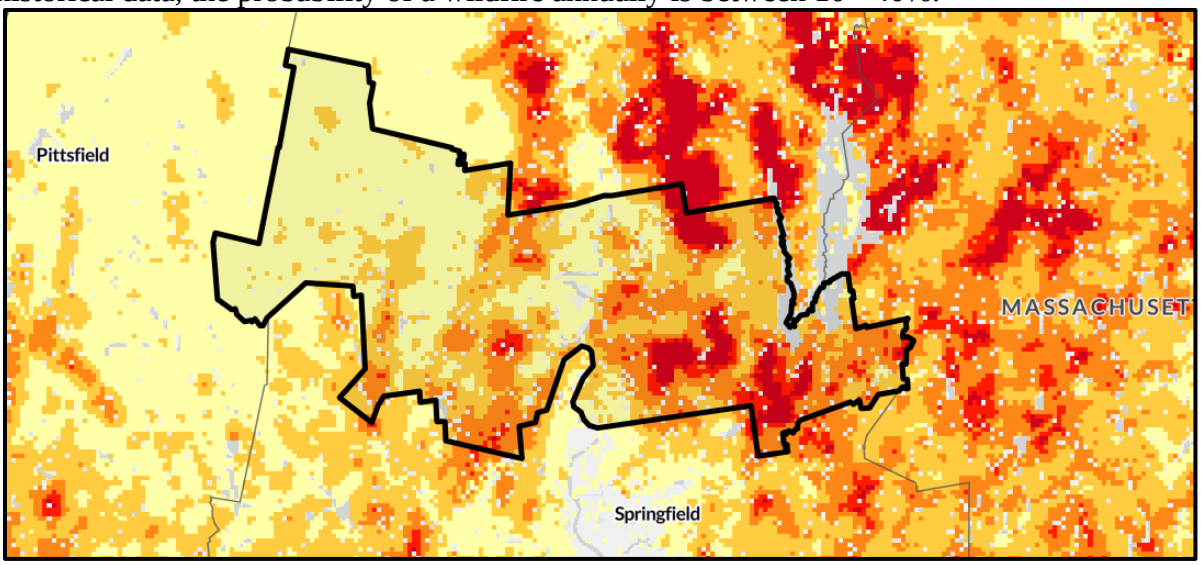


Figure 26*. Wildfire risk to private homes in Hampshire County, MA. Risk increases from yellow to red*[65]

[65] United States Department of Agriculture Forest Service. (2022). *Wildfire risk to communities*. Retrieved on January 30, 2023, from https://wildfirerisk.org/explore/0/25/25015/

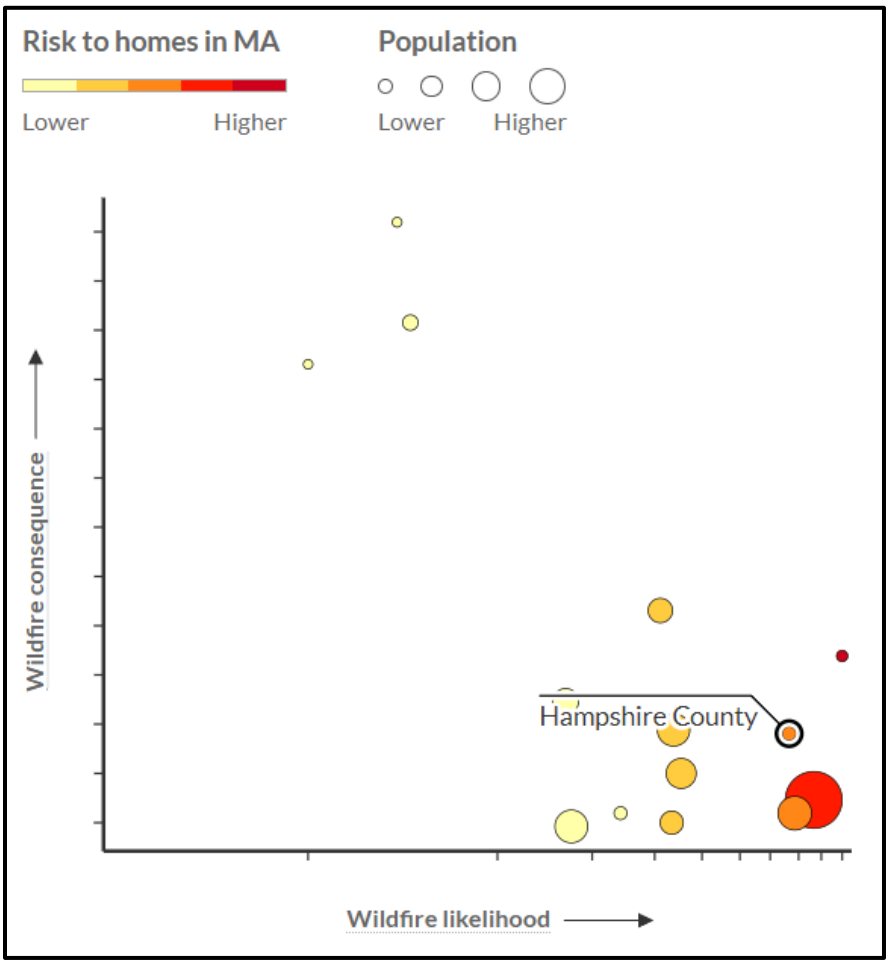


***Figure 27**. Wildfire risk in Hampshire County*[66]

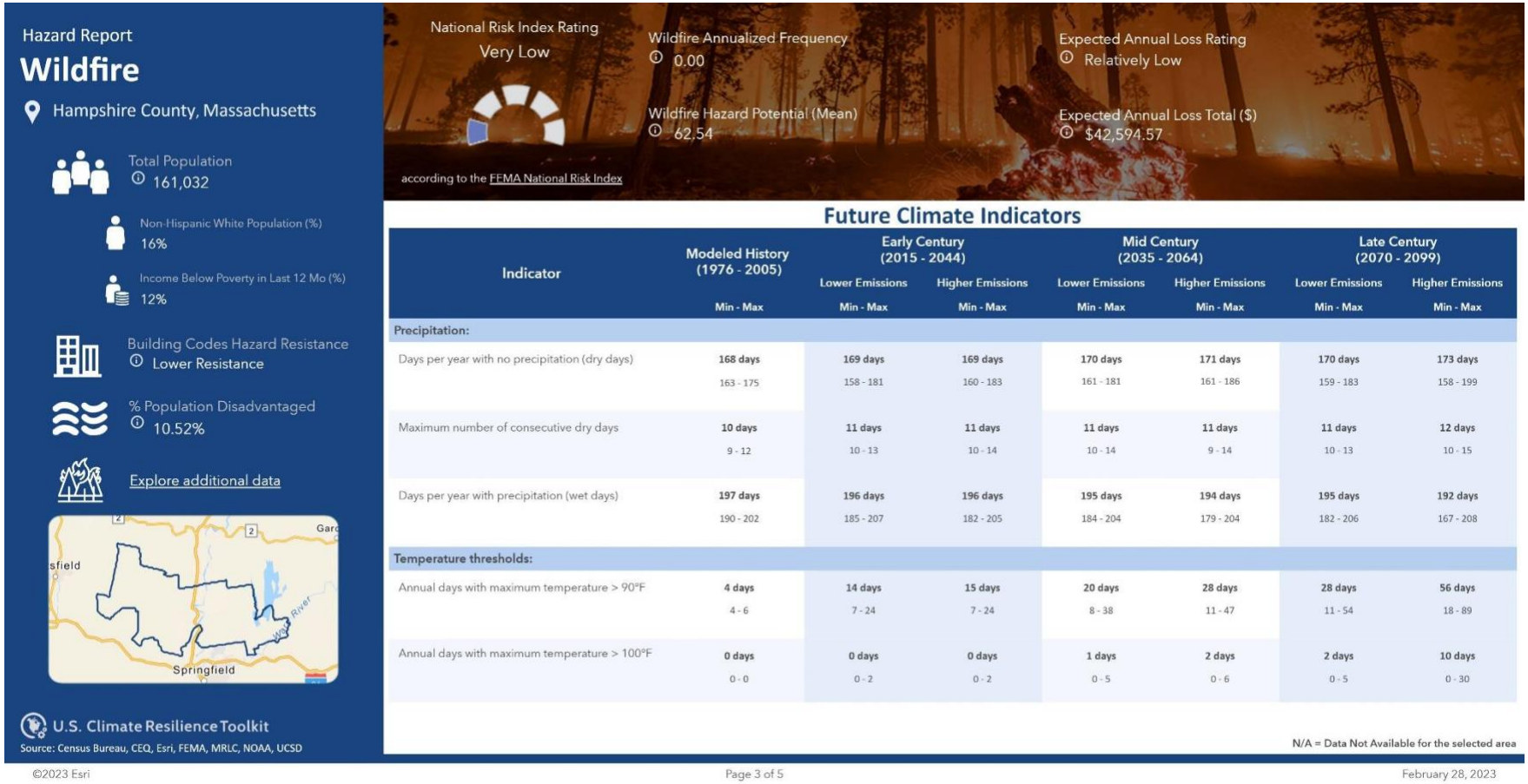
Wildfire Risk

This graph, from the USDA Forest Service, shows the wildfire risk for Hampshire County. The color represents the risk to private homes and the size of the circle the population affected. The likelihood is shown as high, but the expected consequences are low.

CLIMATE CHANGE IMPACT

The impact of climate change on the risk of wildfires for Hampshire County is limited. Even under high emission conditions, the expected change in the annual number of dry days, consecutive dry days, and days above 100°F each only increase by a few days per year through the mid-century. The largest predicted increase is in the number of days above 90°F, which could increase by over 20 days in the same timeframe. Given these factors, climate change is not likely to significantly change the likelihood of wildfires in the coming decade. Please see ***Table 24*** for more detail.

[66] United States Department of Agriculture Forest Service. (2022). *Wildfire risk to communities*. Retrieved on January 30, 2023, from https://wildfirerisk.org/explore/0/25/25015/



Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Days per year with no precipitation (dry days)	168 days 163 - 175	169 days 158 - 181	169 days 160 - 183	170 days 161 - 181	171 days 161 - 186	170 days 159 - 183	173 days 158 - 199
Maximum number of consecutive dry days	10 days 9 - 12	11 days 10 - 13	11 days 10 - 14	11 days 10 - 14	11 days 9 - 14	11 days 10 - 13	12 days 10 - 15
Days per year with precipitation (wet days)	197 days 190 - 202	196 days 185 - 207	196 days 182 - 205	195 days 184 - 204	194 days 179 - 204	195 days 182 - 206	192 days 167 - 208
Temperature thresholds:							
Annual days with maximum temperature > 90°F	4 days 4 - 6	14 days 7 - 24	15 days 7 - 24	20 days 8 - 38	28 days 11 - 47	28 days 11 - 54	56 days 18 - 89
Annual days with maximum temperature > 100°F	0 days 0 - 0	0 days 0 - 2	0 days 0 - 2	1 days 0 - 5	2 days 0 - 6	2 days 0 - 5	10 days 0 - 30

***Table 24**. Hazard Report, Wildfire*[67]

This table shows the future climate indicators that affect the potential for wildfires in Hampshire County across the century given either low or high emission scenarios. There are minor changes expected in the number of wet and dry days, consecutive dry days, and days above 100F. The largest change is for the number of days above 90F. Given the expected changes, the risk assessment continues to be low when compared to the rest of the U.S.

[67] National Oceanic and Atmospheric Administration. (n.d.). *Climate Mapping for Resilience and Adaptation: Hampshire County*. Retrieved on February 28, 2023, from https://cmra-reports.s3.amazonaws.com/county/25015.html

IMPACT

The limited consequences anticipated indicated in ***Figure 27*** above are reflective of the limited development and small population in Middlefield relative to other counties in Massachusetts. This is not an indication of a small impact to the community in the event of a wildfire. Given the distribution of forested area across town and its proximity to developed areas, there is a substantial risk to people, homes, and to critical infrastructure. The lack of forest management has increased the expected impact since the 2019 HMP. Using the combined property value in town as a starting point and estimating 25% of structures would be affected, damages from a wildfire in Middlefield would total $14,188,050.

While residential property damage would be substantial, the greater impact to the town would be pronounced. Including the immediate risk of injury or death from direct contact with the fire, there are other health and welfare concerns associated with a large wildfire. Wildfires in remote forested areas in the mountains are not easily contained. The smoke produced is a concern for the health of residents in Middlefield and neighboring communities. Advisories would limit outdoor activities, resulting in loss of production for local agriculture and other outdoor-based businesses. The potential for harm would be greater for those with underlying medical conditions, disabilities, the very young, and the elderly. These climate vulnerable populations are less able to evacuate when necessary as well as being generally more susceptible to environmental irritants (i.e., smoke).

Because of these factors, the impact of a wildfire on the community would be **critical**.

VULNERABILITY

Based on the risk assessment of location, probability of future events, and impact, the vulnerability to Middlefield from wildfires and brushfires is rated as **high**.

People

Because 93% of Middlefield is forested, a wildfire or brushfire puts the people in town at risk. Increased drought, extreme temperatures, and invasive species each increase the risk of wildfires as a secondary event. These conditions put all residents at risk, but the elderly population would be at an even greater risk since it would be more difficult to afford and obtain supplies, seek shelter, or evacuate if necessary.

Structures and lifelines

As stated above, 93% of Middlefield is forested, so any wildfire or brushfire puts the built structures in town at risk. All outdoor activities, save firefighting efforts, would have to cease in the event of a wildfire for the health and safety of residents. Wildfires would impact community lifelines if travel were restricted, and local agriculture would be heavily affected. Farmers would incur additional expenses due to loss of crops and/or animals leading to a decreased yield.

Systems

The electrical network would be strained with the increased load across town as wildfires are most likely when it is hot. The increased load can lead to brownouts while the supply lines themselves would simultaneously be at greater risk as telephone poles could be caught up in the wildfires like trees.

Natural, cultural, and historic resources

When the trees are generally healthy and sufficiently watered, wildfire can still be devastating due to the extreme heat they generate. The impact on compromised trees due to invasive species or extended drought compounds the impact.

MITIGATION STRATEGIES

GOAL STATEMENT

The HMP Committee reviewed the 2019 HMP and re-affirmed that the goal statement continues to express Middlefield's goal regarding natural hazards. It has been amended to add three hazards identified as relevant to the community during the update process as follows:

> *To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to the following hazards: dam failure, drought, earthquake, extreme temperature, flooding, hurricane/tropical storm, invasive species, severe snowstorm/ice storm, severe thunderstorm/wind/tornado/microburst, and wildfires/brushfires.*

EXISTING MITIGATION CAPABILITIES AND STRATEGIES

Although a rural community, Middlefield uses its resources to accomplish mitigation actions such as Town plans, policies, staff, funding, and other resources to mitigate vulnerabilities.

TOWN STAFF AND COMMISSIONS

The Town of Middlefield has a small staff and many of the departments and volunteers in the community wear several hats. There is no Town Administrator or Manager to run day-to-day operations, but the existing structure has been manageable given the town's small population. Middlefield has been working with the Town of Washington to trial a shared Town Administrator, but it is unclear when or if that will happen at this time. Middlefield uses zoning regulations and policies to assist with hazard mitigation and climate policy on a local level and has dedicated staff and volunteers to implement these practices and make improvements as needed.

The Town is managed by a three-member Selectboard and several supporting committees and commissions. There is no Town Administrator, but additional municipal staff includes an Emergency Management Director, a Department of Public Works, Building Inspector, and a Tree Warden.

Middlefield has consistently updated recommended plans in place including an Emergency Management Plan and an Open Space and Recreation Plan. The Town has recently completed a Capital Improvement Plan that will assist in guiding capital expenditures. Middlefield has actively pursued state programs including becoming a designated Green Community through

DOER and participating in the Community Compact Program. Lastly, Middlefield continues to rely on Mutual Aid agreements with neighboring communities through contractual agreements.

TOWN PLANS AND POLICIES

Due to the limited number of staff and competing priorities, the Town limits its planning activities. The previous HMP was adopted in 2019. Middlefield does not have a Master Plan, Vision Plan, Land Use Plan, or Economic Development Plan. Overall, development in Town has been very limited, so these have not been priority tasks for the Town. Middlefield Zoning and Subdivision Regulations are local policies to establish necessary regulations.

Middlefield has additional planning documents that have addressed natural hazards and were taken into consideration when updating this plan. The Middlefield Comprehensive Emergency Management Plan was used to identify infrastructure and reviewed at a Core Team Meeting and additionally used to identify climate vulnerable populations. The Town recently updated its Open Space and Recreation Plan that provided environmental context and assisted in driving discussion around potential vulnerabilities, and the Massachusetts SHMCAP was utilized as a resource and reference in the development of this plan.

PROGRAMS

Middlefield participates in the National Flood Insurance Program (NFIP). The NFIP is a program managed by the Federal Emergency Management Agency (FEMA) that offers flood insurance to private entities in participating communities. "The NFIP provides flood insurance to property owners, renters, and businesses, and having this coverage helps them recover faster when floodwaters recede. The NFIP works with communities required to adopt and enforce floodplain management regulations that help mitigate flooding effects"[68]. At the time of this report, there are no insured buildings in town.

Middlefield should consider participating in the Community Rating System (CRS)[69]. CRS is a FEMA program that awards points to participating municipalities for their floodplain management efforts that exceed the NFIP requirements. The points can be used to obtain discounts on insurance premiums for private owners in Special Flood Hazard Areas (SFHA). Town officials are seeking participation in this program to encourage more participation in the NFIP from local homeowners.

FINANCIAL CAPABILITIES

Financial capabilities are the resources that a Town can use to fund mitigation actions. The costs to implement mitigation activities vary from relatively low-cost to relatively high-cost activities. Low-cost actions include building assessments or outreach efforts, which require little to no costs

[68] Federal Emergency Management Agency. (n.d.). *Flood insurance*. Retrieved October 11, 2022, from https://www.fema.gov/flood-insurance

[69] National Flood Insurance Program. (2018). *Community rating system*. Federal Emergency Management Agency. Indianapolis, IN. Retrieved from https://www.fema.gov/floodplain-management/community-rating-system

other than staff time and existing operating budgets. Alternatively, high-cost actions, such as the acquisition of flood-prone properties or major infrastructure redesigns, could require a substantial monetary commitment from local, state, and federal funding sources. The Town is capable of undertaking these actions, evidenced by recent purchases of two new emergency vehicles.

The Town of Middlefield has the following potential sources of funding to implement hazard mitigation activities:

1. General fund/free cash
2. Chapter 90 for Infrastructure
3. Fees from building sewer services; hauler services
4. Incurring debt through general obligation debt exclusion

The Town's annual revenue from taxes can be used to fund some mitigation actions, but larger actions require external funding sources, such as from state and federal grant programs. The Selectboard has been successful in pursuing grant funding, including an annual Emergency Management Planning grant, Massachusetts Small Town Assessment grants, and a Thermal Imaging Camera grant.

RESOURCES

Without question, the primary resource in the Town of Middlefield is its citizens. The first responder to an emergency is likely to be a neighbor. Residents look out for each other, and do not hesitate to lend a hand. A core group of volunteers holds many public positions within the town, and long-time residents have a wealth of historical knowledge about the town. These people ensure day-to-day functioning of public services as well as lead the community through emergencies or disasters. When resources within the community are insufficient to resolve an issue, they seek available resources from neighboring communities or the Commonwealth.

Table 25 includes existing mitigation strategies that were identified in the 2019 HMP that remain in effect as well as an assessment of their current effectiveness. Effectiveness was ranked as from very effective to ineffective, based on the strategy's success in mitigating the Town's vulnerability to the targeted hazard(s) as summarized below.

Effectiveness rating	*Description*
Very effective	Strategy has decreased the vulnerability substantially, no improvements needed
Effective	Strategy has decreased vulnerability as intended
Somewhat effective	Strategy resulted in some mitigation, but improvements needed
Ineffective	Strategy not decreasing vulnerability to hazard(s)

Strategy	*Action Type*	*Description/Prior Status*	*Hazards Mitigated*	*Effectiveness/ Update*

Flood Control Structure	Capital	There are five dams in Middlefield* *There are only 2 dams remaining in Middlefield	Flooding	Somewhat effective – Private LLC owns one of the remaining dams, but it has not been inspected
Culvert Replacement	Capital	Have worked to maintain culverts in town	Flooding	Very effective – Continue to seek funding opportunities for culvert replacement
Floodplain Protection District	Regulation	Areas delineated as part of the 100-year floodplain are protected by strict use regulations	Flooding	Very effective – No changes
Earth Removal	Regulation	Requires special permit approval for earth removal	Flooding	Effective – No changes
Site Plan Approval	Regulation	Specific requirements for new construction to be integrated into the existing environment	Flooding/ Drought	Effective – No changes
Subdivision Rules and Regulations	Regulation	Definitive Plan – Proposed septic or sewer water supply must be shown. Additionally – Hydrology Study and Drainage Calculation; Sanitary Sewer Study; Water Study; Environmental Impact Statement; Development Impact Statement	Flooding	Effective – No changes, not often used
Open Space and Recreation Plan	Planning Document	Inventories natural features and promotes natural resource preservation in the town, including areas in the floodplain; such as wetlands, groundwater recharge areas, farms and open space, rivers, streams, and brooks	Flooding/ Drought	Effective – Open Space Plan recently updated
National Flood Insurance program Participation	Program	There are 4 homeowners with flood insurance policies* * In 2023 there are no homeowners participating in the program	Flooding	Ineffective – No existing policies, so Town should consider joining CRS

Driveway Review During Permitting	Regulation	The Highway Superintendent reviews plans for all new driveways built in town to ensure that run-off and erosion is properly managed.	Flooding	Effective – No changes
State Building Code	Regulation	The Town of Middlefield has adopted the Massachusetts State Building Code.	Severe Snow/ Ice Storm, Hurricane, Severe Wind, Tornado, Microburst, Earthquake	Effective – No changes
Backup Electric Power	Operational	Shelter has backup power. Soon all critical facilities will have generators	Severe Snow/ Ice Storm	Effective – No changes
Tree Management	Operational	Eversource is on a 5-year trimming schedule. Highway Superintendent will contact Eversource if any immediate problems	Severe Snow/ Ice storm	Very effective – No changes
Use Regulations – Prohibited Uses	Regulation	Mobile homes/trailers are prohibited in all zone districts in town	Hurricane, Severe Wind, Tornado, Microburst	Effective – No changes
Site Plan Approval	Regulation	Special granting authority can request Fire Department inspection/review of any plan.	Wildfire/ Brushfire	Effective – No changes
Burn Permits	Regulation	Residents must obtain burn permits, and personnel provide information on safe burn practices	Wildfire/ Brushfire	Somewhat effective – No changes
Public Education/ Outreach	Operational	Emergency Management Director has preparedness handouts at Senior Center and at voting locations	Wildfire/ Brushfire	Somewhat effective – Emergency Kit FAQ at COA
New Dam Construction Permits	Regulation	State law requires a permit for the construction of any dam	Dam Failure	Effective – No changes
Dam Inspections	Regulation	DCR has an inspection schedule that is based on the hazard rating of the dam (Low, medium, high hazard)	Dam Failure	Ineffective – Private owner is not inspecting dam on prescribed schedule

Table 25*. Existing strategies to mitigate hazards and their effectiveness*

PRIOR MITIGATION ACTIONS STATUS

Table 26 provides a summary of the mitigation actions from the 2019 HMP, the progress the Town has made on completing them, and their current priority. Uninitiated and ongoing actions that remain priorities are also included as mitigation actions in ***Table 27***. There are items that were not completed due to lack of funding and lack of staff time. However, the Core Team have confirmed that these measures are priority actions and should be carried over to the current HMP. Items 1, 5 and 6 have not been carried over to Table 27 because the Town is now working on a regional MVP plan that will include these items to be completed through this capacity.

Item	*Action Type*	*Action Description*	*Hazards Addressed*	*Priority (2109)*	*Progress and Notes*
1	Structure and Infrastructure Projects	Seek funding to replace Clark Wright Road culvert (design work has already been completed).	Flooding, Hurricanes, Severe Storms	High 1a	Ongoing - seeking funding for project
2	Local Plans And Regulations	Set up a system to document the impacts (damage and costs) of undersized culverts throughout town.	Flooding, Hurricanes, Severe Storms	High 1b	Not initiated - Town has not initiated due to limited resources (funding and personnel)
3	Local Plans And Regulations	Hire a firm to conduct a comprehensive culvert assessment and erosion study, so that the Town can better prioritize limited resources.	Flooding, Hurricanes, Severe Storms	High 1c	Completed - Town participating in regional MVP action grant project for dirt road improvements, and this assessment is included
4	Structure and Infrastructure Projects	Seek funding to replace problem culverts as identified through the documented impacts system and comprehensive culvert assessment.	Flooding, Hurricanes, Severe Storms	High 1d	Ongoing – Root Rd culvert @ Glendale Brook design and engineering completed with DER grant. Cone Road culvert @ Bear Mt. Brook has engineering completed and Town applied for DER grant. These are the only remaining severe barriers in town

					(see Table 27, action 10)
5	Structure and Infrastructure Projects	Seek funding to replace/upgrade bridge on Town Hill Road that is currently posted as light.	All	High 2a	Ongoing- applied for Civil Infrastructure Grant, but not awarded
6	Structure and Infrastructure Projects	Seek funding to replace/upgrades bridges throughout town as necessary.	All	High 2b	Ongoing- Chester Road bridge was replaced in 2020, but limited resources prevented further activity
7	Local Plans And Regulations	Finalize Capital Improvement Plan to ensure Town has a plan to maintain and replace critical equipment and facilities in order to respond to hazards.	All	High 3	Ongoing - Town seeking assistance from PVPC to use DLTA grant funds for Capital Improvement Plan
8	Structure and Infrastructure Projects	Consider installing cell phone signal booster at some of the Town Buildings to ameliorate communication issues.	All	High 4	Completed - booster installed at COA building, but gaps remain
9	Local Plans And Regulations	Pursue funding to participate in state's new Municipal Vulnerability Preparedness Program.	All	High 5	Completed - completion of this plan will grant access to MVP Action grants
10	Structure and Infrastructure Projects/ Preparedness	Install generator in the Council on Aging. This is the last Town facility without back up power. Additionally, if power goes out in winter, staff constantly needs to go in to ensure that pipes don't burst.	Severe Winter Weather, Hurricanes, Severe Wind	Med 1	Not initiated - Town has not initiated due to limited resources (funding and personnel)
11	Education And Awareness Programs/ Preparedness	Finalize list of vulnerable populations in town and formalize a plan for providing access to water, information, shelter, and food stores to these people	All	Med 2	Not initiated - Town has not initiated due to limited resources (personnel)

		in the events of a severe storm.			
12	Education And Awareness Programs/ Preparedness	Collect, periodically update, and disseminate information on natural hazard preparation.	All	Med 3	Ongoing - limited activity due to constrained resources, but some information is available at COA
13	Structure and Infrastructure Projects/ Preparedness	Install air conditioning in Council on Aging building and Town Hall so that they can function as cooling stations. (Many residents don't have air conditioning in homes because Middlefield has never had to contend with high heat days that are becoming more common.) Explore moving AC unit from Old Store to COA and purchasing portables for Town Hall.	Extreme Temper-atures	Med 4	Ongoing - some window AC units have been installed, but the store air conditioner did not function and is not an option.
14	Structure and Infrastructure Projects	Explore roadway designs that will cause fewer washouts on Clark Wright Road, Cone Road, and other dirt roads in town.	Flooding, Hurricanes, Severe Storms	Med 5	Completed - Town participating in regional MVP action grant project for dirt road improvements, and this assessment is included
15	Local Plans And Regulations/ Preparedness	Conduct a feasibility study to determine the best location for a shower in Town Hall. (The installation of a shower would help with facilitating long-term sheltering if needed).	All	Med 6	Not initiated - Town has not initiated due to limited resources (funding and personnel)
16	Structure and Infrastructure Project/ Preparedness	Seek funding to install shower in Town Hall.	All	Med 7	Not initiated - Town has not initiated due to limited resources (funding and personnel), but shower was installed in

					Highway Department building
17	Local Plans And Regulations	Pursue funding to complete Master Plan and Update Open Space and Recreation Plan.	All	Low	Ongoing - Open Space Plan updated 2022; Town currently seeking assistance from PVPC's DLTA grant to create Master Plan

***Table 26**. Prior mitigation action steps and their current status*

EXISTING MITIGATION MEASURES

The following are existing and ongoing mitigation measure performed by the Town of Middlefield:

1. Emergency Response Plans: The state plan addresses mitigation, preparedness, response, and recovery from a variety of natural and man-made emergencies. This plan provides vendors who offer immediate resources in a disaster or emergency scenario.
2. Generators for public buildings: The Town has the capability of holding a shelter with heat in case of emergency.
3. Public Information and Outreach: The Town provides information to residents and business owners relating to a range of potential natural hazards. To widely disseminate information, the Town website posts emergency notices. The extent of public outreach capacity could, however, be improved.
4. Municipal Maintenance Operations and Activities: The Municipal Maintenance Department maintains the Town's storm drain system. Specific activities include street sweeping, catch basin cleaning, and roadway treatments.
5. Tree Trimming Program: The electric and telephone utilities trim branches near the electric lines while the Town staff maintains trees in other areas.

PARTICIPATION IN NFIP AND CONTINUED COMPLIANCE

The Town of Middlefield currently participates in the National Flood Insurance Program. The general boundaries of the Floodplain Overlay District are shown on the Town of Middlefield FIA Flood Hazard Boundary Map, dated June 2,1993, as the Special Flood Hazard Area that indicates the 100-year water surface elevations shown on the FIRM. The Town maintains their participation in this program by meeting zoning/permitting requirements as well as active floodplain management. These tasks are accomplished through Bylaws Chapters III, Article XXI (Superintendent of Roads) and Chapter IV (Zoning) as well as Zoning Bylaws Section V (Overlay District Regulations) and associated enforcement outlined in Section VI. There are two watersheds under the protection of the municipality. The Skyline Trail and the Coles and Factory

Brook systems flow to the West Branch of the Westfield River. Finally, the Conservation Committee Act (M.G.L. c.40 §8C) for open space protection, the Wetlands Protection Act (M.G.L. c.131, §40) for protecting wetlands and waterways, and the home rule provisions of the state constitution for non-zoning wetland bylaws are enforced by the Conservation Committee.

As of the date of this plan, there are currently no structures in town insured through the NFIP, and there are no repetitive loss properties or severe repetitive loss properties. Middlefield will maintain compliance with the NFIP throughout the next five-year Hazard Mitigation Planning cycle by monitoring its Floodplain Overlay District and ensuring that the district accurately reflects the 100-year flood plain and FEMA Flood Insurance Rate Map (FIRM). As stated above, it is recommended that Middlefield join the CRS to increase participation in NFIP by residents in the floodplain.

NATURE-BASED SOLUTIONS

According to FEMA, nature-based solutions are sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience. These solutions are designed to combat climate change, reduce flood risk, improve water quality, restore and protect wetlands, and/or add recreational space. These solutions typically come at a lower cost than traditional infrastructure, so they should be prioritized by the Town[70].

Of the action items recommended, the following should be considered as nature-based solutions.

1. Creation of a forestry management program
2. Forest protection measures (e.g., ordinances) to support air quality
3. Maintaining current Overlay Districts in town (Floodplain, Westfield River Protection)
4. Creation of a public water supply
5. Root Road culvert replacement to allow trout to move through culvert

MITIGATION STRATEGIES

MITIGATION STRATEGY PRIORITIZATION PROCESS

To prioritize the recommended mitigation strategies, a two-step process was used. The first step ranked or assessed the mitigation strategy among the factors described below. Those results were then integrated in the second step to determine the priority ranking for each strategy.

Hazard(s) mitigated

This section documents which hazards would be mitigated by the action. Actions that mitigate all hazards are noted as “all.”

[70] Federal Emergency Management Agency. (n.d.). *Nature-based solutions*. Retrieved on January 4, 2023, from https://www.fema.gov/emergency-managers/risk-management/nature-based-solutions

Responsible entity(ies)

This section identifies the public party(ies) responsible for ensuring, overseeing, and completing the strategy. These parties may consist of local boards and committees, Town staff, State Agencies, or other public entities that play a vital role in the implementation of a strategy. Not included are private businesses who may ultimately enter into agreements with the Town to complete some portions of the strategy.

Cost

The cost is estimated and ranked as low, medium, or high according to the scale below. Estimates are based on existing feasibility studies, professional estimates, or comparable historical projects as available. When the action only relies on the activity of the municipality (e.g., passing a new Bylaw), an estimate of the hours required by Town officials at a rate of $30 per hour is used.

Rank	*Estimated Cost Range*
Low	Less than $10,000
Medium	$10,001 - $49,999
High	$50,000 or greater

Benefit

The estimated benefit is a ranking that assesses the change in vulnerability upon completion of the action. This measure considers the change in location of impact and/or the change in estimated impact cost as possible with the information available at the time of the report production.

Rank	*Estimated Benefit*
Low	Limited change in vulnerability. Only a few residents or small location affected. No notable change in potential for damage, injury, or death in the event of hazard event.
Medium	Notable change in vulnerability. Half the population affected. Some decrease in risk of damage, injury, or death in the event of hazard.
High	Significant change in vulnerability. Most of the Middlefield and potentially neighboring communities affected. Notable decrease in risk of damage, injury, or death in the event of hazard.

Cost benefit analysis (CBA) or Cost-effectiveness analysis (CEA)

This section calculates the ratio of cost of the project against the anticipated benefit. The distinction between CBA and CEA is dependent on how the benefit is measured. If the benefit is measured in dollars, CBA is used. Otherwise, CEA is a more accurate description of the analysis.

Without the benefit of specific action plans created by engineers, including actual costs, this assessment instead compares the estimated cost of each action with the resulting change in vulnerability to the Town.

In calculating a CBA/CEA, the lower the ratio the greater the benefit of an action. For example, a project costing $1M with an expected benefit of $10M would be described by the formula:

$$\frac{Cost}{Benefit} = \frac{\$1M}{\$10M} = \frac{1}{10}, or\ 0.1$$

This equation demonstrates a return of $10 for every dollar spent. In fact, the lower the ratio the better the Town's return on investment. Describing the benefit as being better when the ratio is lower may seem counterintuitive, though, as a lower CBA or CEA can be perceived as a less advantageous action. Therefore, the ranking system will use the inverse ratio. In the example above, the result would be 10 instead of 0.1, thereby aligning a "high" value with an action that is of benefit for the community.

Value	*Inverse Estimated CBA or CEA*
Low	< 0.9
Neutral	0.9 - 1.1
High	> 1.1

Potential funding source

This section identifies the primary source of funding for the action to be completed. Town officials' time is assumed in all actions and is not noted in this section unless that is the only cost associated with an action.

Timeline

This is an estimation for how long the action would take to complete. This calculation may include the time estimated to obtain funding if necessary but not already completed.

Priority (includes historical priority if applicable)

Given all the factors described above, a final priority was assigned to each action. Specifically, the assessment involved weighing the costs, benefits, funding sources/access to funding, historical priority, and willingness of the municipality to complete the action. In some cases, priority may be given to smaller actions that are easy to achieve, even if there is a low benefit, over a higher benefit action that has little backing or would be difficult to fund.

Though qualitative, the assessment can be conceptualized by the equation:

$$Priority\ (P) = H(CBA\ or\ CEA) \times funding\ source \times public\ support.$$

H represents the number of hazards mitigated by the action. For *funding source* and *public support*, there is no numeric value assumed. Instead, they represent the assumed effort involved to complete the action in terms of accessing the funding or garnering support to pass warrants, secure volunteers, etc., as necessary to complete the action. The actions are, therefore, weighted by these variables. For example, an action with multiple state or federal funding sources would increase the priority while an action requiring substantial funding from the Town's budget would decrease priority. When actions were included in the 2019 HMP, their historical priority was used as a starting point and only changed if a significant change to one or more of the variables changed since the last HMP. In summary, the priority rankings are described below.

Rank	***Priority Description***
Low	Strategies with limited benefit to property or people, limited mitigation of only one or two hazards, or requires funding and time resources that are impractical for the community
Medium	Strategies that have some benefit to people and property, and somewhat cost effective, and requires funding and time resources that the community can manage if prioritized
High	Extremely beneficial strategies that will contribute to the mitigation of multiple hazards, significantly benefits people and property, and requires funding and time resources that the community can readily identify

Potential mitigation actions for each identified hazard and problem identified in the Risk Assessment are shown in Table below. Hazards are listed in order of risk. Some of these mitigation actions are included in the Action Plan; some were not included because of cost-benefit-analysis outcomes or inconsistency with Town priorities.

Hazard	*Possible Mitigation Strategy*
Snow and Ice Storms	● Increase capacity to seek grant funding. ● Prioritize vulnerable areas most at risk for evacuation plan and shelter options
Flooding	● Replace culverts as priority action ● Distribute FEMA NFIP information to homes and businesses within the floodplain
Thunderstorms, Tornadoes, Microbursts	● Use additional community education and outreach methods to alert residents to safety ● Install reverse 911 system in place to alert residents of shelter
Dam failure	● Collaborate with state to support private owned dam maintenance
Drought	● Develop local water conservancy policy
Earthquake	● Add educational information on masonry structures to builders for new development. ● Education and outreach to residents regarding earthquake plan using emergency management plan
Extreme Temperature	● Conduct outreach to vulnerable populations that may need assistance in sheltering or evacuating.
Wild and Brushfire	● Remove dead trees and brush from areas near roadways. ● Develop plan with DCR for forest maintenance
Invasive Species	● Conduct mechanical harvesting of invasive species

Item	Action	Priority	Hazard(s) Mitigated	Responsible Entity	Cost	Benefit	CBA/ CEA	Funding Source	Time-line	Notes
1	Set up a system to document the impacts (damage and costs) of undersized culverts throughout town	High	Flooding; Severe thunderstorm/ wind/tornado/ microburst; Severe snow/ice storms; Hurricanes/tropical storms	Highway Dept, Emergency Management Director (EMD)	Low	High	High	General Fund, Town	6-12 months 2023-2024	Carried over from 2019 HMP
2	Finalize list of vulnerable populations in town and formalize a plan for providing access to water, information, shelter, and food stores to these people in the events of a severe storm.	Med	All	Council on Aging (COA), EMD, Selectboard	Low	Med	High	Staff and volunteer time	1-2 years 2023-2025	Carried over from 2019 HMP
3	Collect, periodically update, and disseminate information on natural hazard preparation	Med	All	COA, EMD	Low	Low	Neutral	Staff and volunteer time	6 months 2024	Carried over from 2019 HMP
4	Finalize Capital Improvement Plan to ensure Town has a plan to	High	All	Selectboard, Finance Committee	Med	Med	Neutral	Staff time, PVPC (DTLA)	6-12 months 2025	Carried over from 2019 HMP

	maintain and replace critical equipment and facilities in order to respond to hazards									
5	Install generator in the Council on Aging. This is the last Town facility without back up power. Additionally, if power goes out in winter, staff constantly needs to go in to ensure that pipes don't burst	Med	Severe thunderstorm/ wind/tornado/ microburst; Severe snow/ice storms; Hurricanes/tropical storms	Selectboard, EMD, COA	Med	Low	Low	FEMA (HMPG), HUD (ESG), DOER (Green Commun-ities)	3 years 2024-2027	Carried over from 2019 HMP. Town can also consider a solar array and battery back-up as a more sustainable solution.
6	Seek town consensus on one site within Middlefield as the emergency shelter for the town	High	All	Selectboard, EMD, residents	Low	High	High	Staff time	6 months 2023-2024	
7	Create plan to secure/improve consensus emergency shelter site for that purpose (e.g., back-up power, heating/colling station ability,	High	All	Selectboard, EMD, Police Chief, Fire Chief, Finance Committee, Town Council	Low-High	High	Neutral - High	Capital Funding, Town FEMA (EMPG), Sheltering grants, DOER (Green	5 years 2024-2029	Cost and CEA will be vary based on which site is selected

	supplies, accommoda-tions, usage agreements, etc.)							Commun-ities)		
8	Conduct a feasibility study to determine the best location for a shower in Town Hall. (The installation of a shower would help with facilitating long-term sheltering if needed.)	Med	All	EMD, Selectboard	Low	Med	High	General Fund, HUD (Emer-gency Solutions Grant, ESG)	2-4 years 2025-2029	Carried over from 2019 HMP; only necessary if Town Hall is consensus emergency shelter location
8	Seek funding to install shower in Town Hall.	Med	All	EMD, Selectboard	Low	High	High	General Fund, HUD (ESG)	2-4 years 2028-2029	Carried over from 2019 HMP; only necessary if Town Hall is consensus emergency shelter location
10	Improve road infrastructure which will include an assessment and upgrade of all culverts and bridges as warranted	High	Flooding; Severe thunderstorm/ wind/tornado/ microburst; Severe snow/ice storms; Hurricanes/tropical storms	MassDOT, Highway Dept	High	High	High	EEA (MVP), DER (Culvert Replace-ment Municipal Assistance Grant), FEMA (BRIC)	3-5 years 2023-2028	This action "rolls up" the remaining parts of actions 1, 4, 5, & 6 from the 2019 HMP.

11	Improve communication system for emergency response and residents	High	All	EMD, Fire Dept, Selectboard	Low	High	High	FEMA (HSGP)	2 years 2023-2025	Town uses CodeRED, but gaps in cellular coverage and low sign on limit effective-ness.
12	Cell tower installation to eliminate gaps in cellular service	Med	All	Selectboard, EMD	Med	Med	Neutral	Capital Fund from Town	3-5 years 2024-2029	Town improved cell service with booster installation, but cover-age gaps remain.
13	Install air conditioning in COA building and Town Hall so that they can function as cooling stations	Med	Severe thunderstorm/ wind/tornado/ microburst; Hurricanes/tropical storms; Extreme temperatures	Selectboard, EMD	Med	Low	Low	General Fund, FEMA (EMPG), HUD (ESG), DOER (Green Commun-ities)	3 years 2023-2026	Carried over from 2019 HMP, intent is to use COA and Town Hall as heating and cooling stations.
14	Work with Regional Planning Commission on creating a public transportation plan. This may be a regional effort.	Low	Severe thunderstorm/ wind/tornado/ microburst; Severe snow/ice storms; Hurricanes/tropical storms	Selectboard, Planning Board	Med	Med	Neutral	General Fund, MassDOT (Commun-ity Transit Grant,	5 years 2024-2029	

							Complete Streets)		
15	Recruit and retain more Emergency Management volunteers	Low	Flooding; Severe thunderstorm/ wind/tornado/ microburst; Severe snow/ice storms; Hurricanes/tropical storms; Wildfire/brushfire	Fire Dept, Selectboard, EMD	Low	High	High	Staff time	1-2 years 2024-2026	
16	Identify location for public water supply accessible to residents reliant on well water and Fire Department (e.g., cisterns, reservoir access)	High	Drought; Wildfire/brushfire	Selectboard, EMD, Conservation Commission	Low	High	High	EEA (MVP), DCS (Drinking Water Supply Protection Grant)	2-3 years 2025-2028	First step to create a back-up supply for residents, farms, and Fire Dept. as drought dries out wells or other water supplies.
17	Restore/create a public water supply for public access to clean and provisioned water, farm back-up, and Fire Department use	Med	Drought; Wildfire/brushfire	EMD, Highway Dept, Fire Dept, Conservation Commission, Planning Board	High	High	High	EEA (MVP), DCS (Drinking Water Supply Protection Grant)	3-5 years 2025-2028	Second step to create a back-up supply for residents, farms, and Fire Dept. as drought dries out wells or other water supplies.

18	Support local farms through education and technical support on grant opportunities to expand private water supplies	High	Drought	Selectboard, Conservation Commission	Low	Med	High	General Fund; MDAR (ACRE and AEEP grants)	1 year 2024-2025	The Town wants to keep farms in Town, but re-petitive droughts are elimin-ating their existing water supplies.
19	Create communication plan with CSX, mainly to discuss derailment and fire prevention, including clearing of debris near tracks	Med	Wildfire/ brushfire; Drought; Flooding	EMD, Fire Dept, Selectboard, MassDOT	Low	Med	High	Staff time	2-3 years 2024-2027	
20	Monitor transformers for leaks	Low	Wildfire/brushfire	EMD	Low	Low	Low	Staff time	1 year 2024	
21	Create a communication plan with DCR regarding forestry regulation and fire risk	Med	Invasive species; Wildfire/brushfire	Conservation Commission, Fire Dept, EMD, DCR	Low	Low	Neutral	DCR (VFA)	5 years 2025-2030	
22	Create a beaver management plan to identify and mitigate town's vulnerability	Low	Flooding	MassWildlife, Conservation Commission	Low	Med	High	General Fund, US Fish and Wildlife (Land	5 years 2025-2030	

	related to the beaver dams						Manage-ment and Conseva-tion Assistance Grant)		
23	Build garage for Emergency Vehicles to alleviate winter storm wear and tear and improve longevity	High	Flooding; Severe thunderstorm/ wind/tornado/ microburst; Severe snow/ice storms; Hurricanes/tropical storms; Wildfire/brushfire	Selectboard, EMD	High	High	Neutral	FEMA (HMPG)	2-3 years 2024-2027	
24	Participate in CRS to increase NFIP participation	Low	Flooding; Severe thunderstorm/ wind/tornado/ microburst	Selectboard	Low	Med	High	Staff time	1-2 years 2023-2025	NFIP participa-tion has decreased since 2019 HMP.
25	Repair foundation of Senior Center to support use as a heating/cooling and hazard information distribution center	Low	Extreme temperatures; Flooding	Selectboard, EMD	High	Med	Low	Capital Funding through Town, US Army Corps of Engineers (CWIFP)	3-5 years 2025-2030	
26	Regularly update Comprehensive Emergency Management (CEM) Plan	High	Flooding; Severe thunderstorm/ wind/tornado/ microburst; Severe snow/ice storms;	EMD, Fire Dept, Highway Dept, Selectboard	Low	Low	Neutral	FEMA (EMPG)	3 years 2024-2027	

			Hurricanes/tropical storms; Wildfire/brushfire							
27	Update Hazard Mitigation Plan every 5 years, using procedures identified in the plan	Med	All	EMD, Selectboard	Med	High	High	EEA (MVP), FEMA (HMPG)	5 years 2028-2029	
28	Pursue funding to complete Master Plan	Low	All	Planning Board, Selectboard	Med	Low	Low	PVPC (DTLA)	2-4 years 2025-2029	Carried over from 2019 HMP, but removed Open Space and Rec Plan as it has been updated.
29	Enforce state's dam safety inspection requirements by reporting non-compliers to ODS	Low	Dam Failure	Selectboard	Low	Low	Neutral	Staff time	1 year 2023-2024	Existing strategy ineffective as ODS is not holding non-compliers with state statute to account.
30	Preserve floodplains as open space and protect natural resources located within flood-plains	Low	Flooding	Highway Dept, Planning Board, Conservation Commission	Low	Low	Neutral	General Fund	3 years 2025-2028	

***Table 27**. Recommended action steps to mitigate hazard*

PLAN ADOPTION AND MAINTENANCE

ADOPTION

The draft of this plan was completed in March 2023 and publicly posted to allow residents to review the contents. A (second) public comment opportunity was held on April 5, 2023 (see ***Appendix K***) to allow for feedback from the public. Subsequently, the plan was submitted to MEMA and FEMA for approval. Upon receiving conditional approval from FEMA, the plan was presented to the Selectboard, and it was voted into adoption on September 6, 2023 (see ***Appendix Q***).

IMPLEMENTATION AND MAINTENANCE PROCESSES

PLAN MAINTENANCE

Commonwealth Municipal Consulting, LLC has worked in partnership with the Middlefield Hazard Core Team to prepare this plan. After approval of the plan by FEMA, the Town representatives from this project will meet on a regular basis. The Emergency Management Director will be designated as the lead coordinator of these efforts. Additional members could be added to the local implementation team from other Town departments.

The plan will be evaluated by the Selectboard and Emergency Management Director on an annual basis. The Core Team, now referred to as the HMP Committee, will continue to meet quarterly to review the plan and update the action item progress. The implementation of this plan will be the responsibility of the HMP Committee, under the leadership of the Selectboard and Emergency Management Director. The committee will track the implementation plan over the course of the five-year period until the next update. The Selectboard will evaluate on an annual basis and create a plan of which mitigation measures should be prioritized for the following year. The HMP committee will execute and give updates quarterly. This will include identifying grant applications to be completed to assist funding in these mitigation measures. Following this evaluation, the Committee and Emergency Management Director will be responsible for the implementation of the plan upon approval from the Selectboard.

PREPARING FOR THE NEXT PLAN

The Committee will include members of the Core Team, who were responsible for completing the MVP process with the Town. The Committee will meet at least quarterly to evaluate the plan's progress to date, in accordance with state and federal agencies and the agreements of this plan. The Committee will set criteria for the progress plan and will ensure the plan remains transparent and the updates will commence in advance of this plan's expiration date.

The Town will continue to encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Middlefield Hazard Core Team, these will be placed on the Town's website, and any meetings will be publicly noticed in accordance with town and state open meeting laws. The charge of the Committee will be as follows:

> ***Prepare for the next Plan Update*** - FEMA's approval of this plan is valid for five years, by which time an updated plan must be approved by FEMA to maintain the Town's approved plan status and its eligibility for FEMA mitigation grants. Given the lead time needed to secure funding and conduct the planning process, the Core Team under the direction of the Emergency Management Director will begin to prepare for an update of the plan in year three and four. This will help the Town avoid a lapse in its approved plan status and grant eligibility when the current plan expires. Middlefield will update its plan's content by doing annual reports as an addendum this current report with any advisory documentation, updates in action plans, and goals for the following year. This will set a timeline by year four to prepare for the full update of the plan and applying for funding for an updated HMP.
>
> ***Plan Implementation*** - The Committee will give an annual update to the Selectboard regarding the implementation of the plan. The Committee and the Emergency Management Director shall be responsible for tracking the implementation of the plan over the 5-year period until the next HMP update. The plan will be monitored by the Emergency Management Director and the Selectboard with this annual review of the plan. At the beginning of each year, Core Team will create an action plan for which mitigation measures will be accomplished that year by identifying which grants application will be completed for which mitigation measures. This process that will be used to evaluate the plan will be vetted through Town Meeting in which the Town will approve funding for the following fiscal year to execute these measures. Additionally, the Core Team will discuss the actions that are due in the timeline chronologically suggested, apply for grants to assist in the funding, and bring before the Selectboard for approval. The actions will follow a fiscal year cycle of July 1-June 30 for goals of completion. Any multi-year plan will be broken down into phases for approval and funding annually.

To maintain designation as an MVP Community by EEA, the Town is also required to submit an annual progress report detailing the efforts made by the Town toward completing their top recommendations. These efforts can include applying for grant funding, passing Bylaws or zoning regulations, updating other plans based on this report, or completing other activities. EEA provides a template that the Town is encouraged to use.

INCORPORATION WITH OTHER PLANS

The Town of Middlefield has taken steps to implement findings from the 2019 HMP into the following policies and plans: The Open Space and Recreation Plan (2022) and the Emergency Management Plan (2021). The Town has been seeking assistance for an update of their Capital Improvement Plan (2023) and working in collaboration on a Regional Road MVP plan (2023). The Core Team utilized knowledge from the Conservation Commission representative that sat on the Core Team Committee as well as the Open Space and Recreation Committee to integrate

vital information about the Open Space and Recreation Plan in this HMP. The same applied for the Emergency Improvement Plan and the Emergency Management Director's role in this project.

Water sources and wetlands were a topic that we wanted to make sure was consistent throughout the plans and had discussions during the core team meeting. One of the Emergency Management priorities has been the communication goals of the Town and we have added them in as action priorities as they pertain to hazard mitigation.

The creation of this combined plan included reviews of the SHMCAP, Middlefield's 2019 HMP, Zoning Bylaws, General Bylaws, and its Emergency Response Plan. Updates to the General and Zoning Bylaws should be considered based on the recommendations in this report and, when deemed appropriate, changes or additions should be made according to the respective processes required. The Town's Emergency Response Plan should also be revisited after the review of this plan and updated if warranted.

System to integrate this plan with other planning documents

For the Town of Middlefield to succeed in reducing hazard risks over the long term, the information and recommendations of this HMP should be integrated throughout government operations. Any local plans and processes that present opportunities to address hazard mitigation that will support the community objectives will be identified and leveraged. These should include, but not be limited to, any risk reduction. The Town will demonstrate the integration of the importance of climate resiliency across all elements of this planning document.

All new or updated local planning documents will be informed and consistent with the goals and actions of this hazard mitigation plan. This will include any of the local plans identified:

- Comprehensive Emergency Management Plan
- Open Space and Recreation Plan
- Comprehensive Master Plan
- Capital Improvement Plan
- MVP Plan

Additional opportunities to integrate the requirements should continue to be identified through the Town and their regional planning commission during the five-year review process. Other planning mechanisms include local regulations and any special projects or initiatives and any capital planning decisions during the Town's budget process. It will be the responsibility of each assigned lead department to determine any additional measures that can support the actions of this document. These measures include any documents, processes, or mechanisms that are deemed most effective.

Although there are many benefits to integrating this plan, this plan is considered by the Town to be the most effective and appropriate method to prioritize and implement its

local hazard mitigation actions. The Town of Middlefield will consider incorporating any other planning documents or related climate adaptation efforts.

APPENDICES

APPENDIX A: INDEX OF TABLES

(Please note that the page listed is the beginning page)

APPENDIX B: INDEX OF FIGURES

APPENDIX C: LIST OF ACRONYMS

ACRE	Agricultural Climate Resiliency & Efficiencies
AEEP	Agricultural Environmental Enhancement Program
BRIC	Building Resilient Infrastructures and Communities Grant
C	Celsius
CBA	Cost-benefit analysis
CBO	Community based organization
CEA	Cost-effectiveness analysis
CMR	Code of Massachusetts Regulations
COA	Council on Aging
CRB	Community Resilience Building
CVP	Climate Vulnerable Population
CWIFP	Core Water Infrastructure Financing Program
DCR	Massachusetts Department of Conservation and Recreation
DCS	Massachusetts Division of Conservation Services
DER	Massachusetts Department of Ecological Restoration
DFW	Massachusetts Division of Fisheries and Wildlife (or MassWildlife)
DLTA	District Local Technical Assistance
DOT	Massachusetts Department of Transportation (or MassDOT)
EAB	Emerald Ash Borer
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EF-Scale	Enhanced Fujita Scale
EG	Estimated gust (wind)
EJ	Environmental Justice (population)
EMD	Emergency Management Director
EMPG	Emergency Management Performance Grant
EMT	Emergency medical technician
EOC	Emergency Operation Center
ESG	Emergency Solutions Grant
F	Fahrenheit
F-Scale	Fujita Scale
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FPL	Federal Poverty Level
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HUD	U.S. Department of Housing and Urban Development
kmh	Kilometers per hour
kt	Knots
MDAR	Massachusetts department of Agricultural Resources
MEMA	Massachusetts Emergency Management Agency
MG	Measured gust (wind)
M.G.L.	Massachusetts General Law
mph	Miles per hour
MVP	Municipal Vulnerability Preparedness

n.d.	No date
NESIS	Northeast Snowfall Impact Scale
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
ODS	Massachusetts Office of Dam Safety
PVPC	Pioneer Valley Planning Commission
SFHA	Special Flood Hazard Areas
SHMCAP	Massachusetts State Hazard Mitigation and Climate Adaptation Plan
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VOIP	Voice over internet protocol
Z	Zone

APPENDIX D: CORE TEAM AGENDAS

Date: November 2, 2022

Time: 6:00 PM EST

Subject: HMP/MVP Core Team Meeting, Town of Middlefield

Location: Selectboard Meeting room or Via Zoom, link provided below

Committee Members: *Doreen DeFazio (CMC), Rob Polsinelli (CMC), Sophie Protano (CMC) , Ann Marie Visconti (Chair Middlefield Select Board/ Emergency Management Director) Tonya Santaniello (Select Board Member/ Middlefield Police Officer), Curt Robie (Select Board Member), Joseph Kearns (Chair Middlefield Finance Committee), Adair Cafarella (Middlefield Finance Committee Member/Local Business Owner), Ronald Radwich (Middlefield Fire Chief), Jenny Dion (Middlefield Police Chief), Skip Savery (Middlefield Highway Superintendent), Crystal Kruszyna (Middlefield Emergency Medical Services Director), Carol Waag (Chair Middlefield Conservation Committee/ Member Open Space Committee)*

1. **Introductions/Roles**
2. **Overview of HMP/MVP Process**
    1. Project timeline
    2. Scheduling biweekly meetings and expectations
    3. Workshop target
3. **Developing a comprehensive outreach strategy**
    1. Requirements
    2. Tools
4. **Reviewing prior HMP report**
    1. Methodologies used in determining hazards
    2. Identify changes/updates since last report – homework
5. **Questions/Concerns**
6. **Adjourn**

Join Zoom Meeting
https://us02web.zoom.us/j/84225208076?pwd=NFE5a2tCSGR5bUNEYjgwMWRtb0JUQT09
Meeting ID: 842 2520 8076
Passcode: 195857
One tap mobile
+16469313860,,84225208076#,,,,*195857# US
+13017158592,,84225208076#,,,,*195857# US (Washington DC)
Dial by your location
+1 646 931 3860 US
+1 301 715 8592 US (Washington DC)
+1 309 205

Date: November 16, 2022

Time: 6:00 PM EST

Subject: HMP/MVP Core Team Meeting, Town of Middlefield

Location: Selectboard Meeting room or Via Zoom, link provided below

Committee Members: *Doreen DeFazio (CMC), Rob Polsinelli (CMC), Sophie Protano (CMC) , Ann Marie Visconti (Chair Middlefield Select Board/ Emergency Management Director) Tonya Santaniello (Select Board Member/ Middlefield Police Officer), Curt Robie (Select Board Member), Joseph Kearns (Chair Middlefield Finance Committee), Adair Cafarella (Middlefield Finance Committee Member/Local Business Owner), Ronald Radwich (Middlefield Fire Chief), Jenny Dion (Middlefield Police Chief), Skip Savery (Middlefield Highway Superintendent), Crystal Kruszyna (Middlefield Emergency Medical Services Director), Carol Waag (Chair Middlefield Conservation Committee/ Member Open Space Committee)*

1. **Call meeting to order**
2. **Review outreach strategy ideas**
    1. Feedback from core team
    2. Timeline/methodologies
    3. Additional contacts outside of core team for potential sub committee
    4. Finalize outreach plan for next meeting
3. **CRB workshop**
    1. date
    2. invitations – inviting stakeholders – meeting our local and regional requirements
    3. stakeholder\contact list – prepare for next meeting
    4. location
4. **Reviewing prior HMP report**
    1. Review methodologies used in determining hazards
    2. Review any changes/updates since last report
5. **Questions/Comments**
6. **Adjourn**

Join Zoom Meeting
https://us02web.zoom.us/j/89209826535?pwd=ZkplU3VXeWIrbGFpYi9hV3c3a25IQT09
Meeting ID: 892 0982 6535
Passcode: 017476
One tap mobile
+13017158592,,89209826535#,,,,*017476# US (Washington DC)
+13092053325,,89209826535#,,,,*017476# US

Date: November 30, 2022

Time: 6:00 PM EST

Subject: HMP/MVP Core Team Meeting, Town of Middlefield

Location: Selectboard Meeting Room

Committee Members: *Doreen DeFazio (CMC), Rob Polsinelli (CMC), Sophie Protano (CMC) , Ann Marie Visconti (Chair Middlefield Select Board/ Emergency Management Director) Tonya Santaniello (Select Board Member/ Middlefield Police Officer), Curt Robie (Select Board Member), Joseph Kearns (Chair Middlefield Finance Committee), Adair Cafarella (Middlefield Finance Committee Member/Local Business Owner), Ronald Radwich (Middlefield Fire Chief), Jenny Dion (Middlefield Police Chief), Skip Savery (Middlefield Highway Superintendent), Crystal Kruszyna (Middlefield Emergency Medical Services Director), Carol Waag (Chair Middlefield Conservation Committee/ Member Open Space Committee)*

1. **Call meeting to order * Sophie will be attending via conference call**
2. **Outreach Strategy Plan**
    1. Feedback from core team
    2. Accept plan for implementation
    3. Public Comment options – virtual turnout vs. in person
    4. Updating the Public
3. **CRB workshop**
    1. invitations list review
    2. discuss implementation plan
4. **Reviewing HMP**
    1. Review hazard rankings
    2. Review critical facilities
    3. Review action strategies
5. **Questions/Comments**
6. **Adjourn**

Date: January 11, 2023
Time: 6:00 PM EST
Subject: HMP/MVP Core Team Meeting, Town of Middlefield
Location: Selectboard Meeting Room
Zoom link:
https://us02web.zoom.us/j/87148832384?pwd=RG40Rk5qb2EyQnc1Q2FrOW5jVWcwdz09
Meeting ID: 871 4883 2384
Passcode: 032248
One tap mobile
+16465588656,,87148832384#,,,,*032248# US (New York)
+16469313860,,87148832384#,,,,*032248# US

Committee Members: *Doreen DeFazio (CMC), Rob Polsinelli (CMC), Sophie Protano (CMC) , Ann Marie Visconti (Chair Middlefield Select Board/ Emergency Management Director) Tonya Santaniello (Select Board Member/ Middlefield Police Officer), Curt Robie (Select Board Member), Joseph Kearns (Chair Middlefield Finance Committee), Adair Cafarella (Middlefield Finance Committee Member/Local Business Owner), Ronald Radwich (Middlefield Fire Chief), Jenny Dion (Middlefield Police Chief), Skip Savery (Middlefield Highway Superintendent), Crystal Kruszyna (Middlefield Emergency Medical Services Director), Carol Waag (Chair Middlefield Conservation Committee/ Member Open Space Committee)*

1. **Call meeting to order**
2. **Outreach Activities (surveys)**
3. **Workshop RSVPs**
4. **Reviewing HMP**
    1. Update on hazard rankings
    2. Review action strategies
        1. Existing mitigation capabilities: confirm/update previous effectiveness
        2. New and continuing mitigation strategies
5. **Community Capability Assessment Worksheet (time permitting)**
6. **Questions/Comments**
7. **Adjourn**

Date: March 22, 2023
Time: 6:30 PM EST
Subject: HMP/MVP Core Team Meeting, Town of Middlefield
Location: Selectboard Meeting Room

Committee Members: *Doreen DeFazio (CMC), Rob Polsinelli (CMC), Sophie Protano (CMC) , Ann Marie Visconti (Chair Middlefield Select Board/ Emergency Management Director) Tonya Santaniello (Select Board Member/ Middlefield Police Officer), Curt Robie (Select Board Member), Joseph Kearns (Chair Middlefield Finance Committee), Adair Cafarella (Middlefield Finance Committee Member/Local Business Owner), Ronald Radwich (Middlefield Fire Chief), Jenny Dion (Middlefield Police Chief), Skip Savery (Middlefield Highway Superintendent), Crystal Kruszyna (Middlefield Emergency Medical Services Director), Carol Waag (Chair Middlefield Conservation Committee/ Member Open Space Committee)*

1. **Call meeting to order**
2. **Update on draft plan**
3. **Review topics for clarification**
    a. Action steps - confirm reasons actions not taken
    b. Development - discuss available lots/plans
    c. Nature-based solutions
    d. Miscellaneous questions
4. **Final steps**
    a. Second public input opportunity
    b. Dates for draft posting
    c. Submitting for approval
5. **Questions/Comments**
6. **Adjourn**

Zoom link:

https://us02web.zoom.us/j/85386197164?pwd=Qm8zRmNBNHdDekpBSkQ0UmN2Z1prUT09
Meeting ID: 853 8619 7164
Passcode: 905253
One tap mobile
+13092053325,,85386197164#,,,,*905253# US
+13126266799,,85386197164#,,,,*905253# US (Chicago)

APPENDIX E: WORKSHOP INVITATION

December 22, 2022

Dear Community Stakeholder,

Given previous and ongoing events we now find ourselves in a new era of more unpredictable and severe weather that can potentially cause more damage to our Town of Middlefield.

In order to be as proactive as we can in preparing and protecting our Town, I would like to personally invite you to join me at one free, full-day, Community Resilience Building Workshop on January 21, 2022. The CRB Workshop will take place from 9:00 am to 5:00 pm at Town Hall. Refreshments and food will be provided. In the event of a weather cancellation, the Workshop will be held on January 28th from 9:00 am to 5:00 pm. Advanced notice will be provided.

The Town of Middlefield is partnering with Commonwealth Municipal Consulting, LLC to offer this timely single Workshop which will bring together community members like you to comprehensively identify and prioritize steps to reduce risk and improve resilience across Middlefield. This single Workshop will help clarify and advance comprehensive community resilience planning and hazard mitigation efforts.

The Workshops Objectives are as follows:

- Understand connections between natural hazards and local planning/mitigation efforts.
- Evaluate strengths and vulnerabilities of residents, infrastructure, and natural resources.
- Develop and prioritize resilient actions for the municipality, local organizations, institutions, businesses, private citizens, neighborhoods, and community groups.

- Identify immediate opportunities to advance actions that reduce the impact of hazards and increase resilience in Middlefield.

Please RSVP for this Workshop by January 14th to Sophie Protano at sophie.commonwealth@gmail.com.

I hope you or a designee can join me at this critical workshop. Thank you for your consideration! Sincerely,

Sophie Protano, Sustainability Specialist
Commonwealth Municipal Consulting, LLC

APPENDIX F: WORKSHOP INVITATION LIST

Name	*Position*	*Municipality/Agency*	*Email*	*Attend*
Curt Robie	Selectboard Member	Town of Middlefield	notes4321@yahoo.com	Yes
Ann Visconti	Selectboard Chair	Town of Middlefield	viscoa@verizon.net	Yes
Tonya Santaniello	Selectboard Member	Town of Middlefield	tsantaniello@yahoo.com	Yes
Crystal Kruzyna	Emergency Medical Services Director	Town of Middlefield	crystalj9@verizon.net	Yes
Skip Savery	Highway Superintendent	Town of Middlefield	skipsavery@gmail.com	Yes
Jenny Dion	Police Chief	Town of Middlefield	chiefj.dion@gmail.com	Yes
Ronald Radwich	Fire Chief and Forest Warden	Town of Middlefield	firechief@middlefieldma.net	Yes
Susan Lemieux	Town Clerk	Town of Middlefield	townclerk@middlefieldma.net	Yes
Carol Waag	Conservation Commission, Chair	Town of Middlefield	carolewaag@gmail.com	Yes
Adair Cafarella	Financial Committee Member, Business Owner	Town of Middlefield	adair@abyssdistribution.com	Yes
Joseph Kearns	Financial Committee, Chair	Town of Middlefield	mlkearns2@verizon.net	Yes
Lois Leonardo	Council on Aging, Director	Town of Middlefield	coa@middlefieldma.net	No
Judith Hoag	Council on Aging, Chair	Town of Middlefield	coa@middlefieldma.net	Yes
Chris McDonough	Police Chief	Town of Becket	chief@townofbecket.org	No
Kathy Warden	Town Administrator	Town of Becket	administrator@townofbecket.org	No
Richard Small	Fire Chief	Town of Chester	chiefrichsmall@msn .com	No
Susan Rathbun	Police Chief	Town of Hinsdale	Police.Chief@hinsdalema.gov	No
Bob Graves	Town Administrator	Town of Hinsdale	town.administrator@hinsdalema.gov	No
Westfield Wild & Scenic	Member	Wild and Scenic Westfield River Committee	westfieldriver@gmail.com	Yes
Kristen Smidey	Superintendent of Schools	Gateway Regional School District	ksmidy@grsd.org	No
Chirs Goshea	Emergency Preparedness Planner	Pioneer Valley Planning Commission	cgoshea@pvpc.org	No

Dr. Brian Conz	Geography, Planning, and Sustainability Department Chair	Westfield State University	bconz@westfield.ma .edu	No
Tamarin Laurel	Owner/Manager	Blossom Center	tamarin.laurel@gmail .com	Yes
Susan Purser	Resiliency Hub Liaison	Town of Becket	susanbythesea6696@ hotmail.com	Yes
Mark Lipton	Resident, Alderman Road	Town of Middlefield	mark@marklipton.com	No
Cathy Roth	Resident, Arthur Pease Road	Town of Middlefield	croth@umass.edu	Yes

APPENDIX G: WORKSHOP SIGN IN SHEETS

COMMONWEALTH

Date: January 21, 2023
Time: 9:30 am
Subject: Middlefield CRB Workshop

Attendance Sheet

Name (please print)	Position/Role(s)
Crystal Kruszyna.	EMS - Director
ADAIR LAUREL-CAFARELLA	Business owner Finance Committee
Tonya Santanielo	
Ann Marie Visconti	Selectboard Chair/EMD
Tamarin Laurel	Middlefield Assessors Blossom Center
Susan Purser	Becket resident (lived in Middlefield for 5yrs)
Carol Wagg	Middlefield Conservation
Jenny Dion	Police Chief
Cathy Roth	Citizen
Joe Kearns	Chair Fin Com
Ronald Radwich	Fire Chief
CURT ROBIE	SELECT BOARD
Skip Sweet	Highway Supt
Suzanne Lebrecq	Town Clerk

COMMONWEALTH

Date: January 21, 2023
Time: 9:30 am
Subject: Middlefield CRB Workshop

Attendance Sheet

Name (please print)	Position/Role(s)
Michael Wolski	Becket Resident
Navedyth Babcock	Wild & Scenic

APPENDIX H: CLIMATE PROJECTIONS FOR MIDDLEFIELD, MA

Middlefield Climate Projections (Westfield Basin)

From Resilient MA Map and Data Center: *Massachusetts Climate and Hydrologic Risk Project (Phase 1) – Stochastic Weather Generator Climate Projections XLSX*
Available at: https://resilientma-mapcenter-mass-eoeea.hub.arcgis.com/documents/massachusetts-climate-and-hydrologic-risk-project-phase-1-stochastic-weather-generator-climate-projections-xlsx/about

Precipitation:

Total Precipitation
Projected change in inches of total precipitation

- Annual baseline (inches): 49.27
    - High emissions scenario (RCP 8.5[1,3]):
        - 2030s: +6.08
        - 2050s: +8.06
        - 2070s: +9.67
        - 2090s: +11.96
    - Medium emissions scenario (RCP 4.5[2,3]):
        - 2030s: +5.55
        - 2050s: +6.68
        - 2070s: +7.37
        - 2090s: +8.82

Consecutive Dry Days:
Projected change in # of consecutive dry days

- Annual baseline (# of consecutive days): 29.43
    - High emissions scenario (RCP 8.5)
        - 2030s: +0.50
        - 2050s: +0.95
        - 2070s: +1.55
        - 2090s: +2.48
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +0.28
        - 2050s: +0.45
        - 2070s: +0.67
        - 2090s: +0.67

Extreme Precipitation > 1”
Projected change in # Days with precipitation > 1 inch

- Annual baseline (days): 5.61
    - High emissions scenario (RCP 8.5):
        - 2030s: +0.84
        - 2050s: +1.47
        - 2070s: +1.94
        - 2090s: +2.63
    - Medium emissions scenario (RCP 4.5):

        - 2030s: +0.84
        - 2050s: +1.06
        - 2070s: +1.30
        - 2090s: +1.30

Extreme Precipitations > 2"
Projected change in # Days with precipitation > 2 inches

- Annual baseline (days): 0.62
    - High emissions scenario (RCP 8.5):
        - 2030s: +0.23
        - 2050s: +0.43
        - 2070s: +0.56
        - 2090s: +0.77
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +0.23
        - 2050s: +0.30
        - 2070s: +0.37
        - 2090s: +0.37

Extreme Precipitation > 4"
Projected change in # Days with precipitation > 4 inches

- Annual baseline (days): 0.06
    - High emissions scenario (RCP 8.5)
        - 2030s: +0.00
        - 2050s: +0.03
        - 2070s: +0.05
        - 2090s: +0.09
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +0.00
        - 2050s: +0.02
        - 2070s: -0.02
        - 2090s: -0.02

Temperature

Average Temperatures:
Projected change in average temperature (°F), rounded to nearest tenth

- Annual baseline (°F): 45.06
    - High emissions scenario (RCP 8.5):
        - 2030s: +3.6
        - 2050s: +6.3
        - 2070s: +8.1
        - 2090s: +10.8
    - Medium emissions scenario (RCP 4.5):
        - 2030s: +3.6
        - 2050s: +4.5
        - 2070s: +5.4
        - 2090s: +5.4

Minimum Temperatures
Projected change in minimum temperature °F, rounded to the nearest tenth

- Annual baseline (°F): -8.80
    - High emissions scenario (RCP 8.5)
        - 2030s: +3.6
        - 2050s: +6.3
        - 2070s: +8.1
        - 2090s: +10.8
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +3.6
        - 2050s: +4.5
        - 2070s: +5.4
        - 2090s: +5.4

Maximum Temperatures

Projected change in minimum temperature °F, rounded to the nearest tenth

- Annual baseline (°F): 80.91
    - High emissions scenario (RCP 8.5)
        - 2030s: +3.6
        - 2050s: +6.3
        - 2070s: +8.1
        - 2090s: +10.8
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +3.6
        - 2050s: +4.5
        - 2070s: +5.4
        - 2090s: +5.4

Days < 0 °F

Projected change in # days below 0 °F

- Annual baseline (days): 13.39
    - High emissions scenario (RCP 8.5):
        - 2030s: -5.80
        - 2050s: -8.40
        - 2070s: -9.52
        - 2090s: -11.02
    - Medium emissions scenario (RCP 4.5)
        - 2030s: -5.80
        - 2050s: -6.62
        - 2070s: -7.52
        - 2090s: -7.52

Days < 32 °F

Projected change in # days below 32 °F

- Annual baseline (days): 167.14
    - High emissions scenario (RCP 8.5):
        - 2030s: -26.81
        - 2050s: -48.63
        - 2070s: -61.07
        - 2090s: -79.25
    - Medium emissions scenario (RCP 4.5)
        - 2030s: -26.81
        - 2050s: -34.49

        - 2070s: -41.38
        - 2090s: -41.38

Days > 90 °F
Projected change in # days above 90 °F
- Annual baseline (days): 1.63
    - High emissions scenario (RCP 8.5)
        - 2030s: +6.59
        - 2050s: +17.13
        - 2070s: +27.67
        - 2090s: +46.59
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +6.59
        - 2050s: +9.70
        - 2070s: +13.02
        - 2090s: +13.02

Days > 95 °F
Projected change in # days above 95 °F
- Annual baseline (days): 0.00
    - High emissions scenario (RCP 8.5)
        - 2030s: +0.55
        - 2050s: +3.48
        - 2070s: +7.05
        - 2090s: +16.30
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +0.55
        - 2050s: +1.18
        - 2070s: +2.22
        - 2090s: +2.22

Days > 100 °F
Projected change in # days above 100 °F
- Annual baseline (days): 0.00
    - High emissions scenario (RCP 8.5)
        - 2030s: +0.00
        - 2050s: +0.14
        - 2070s: +0.41
        - 2090s: +2.70
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +0.00
        - 2050s: +0.01
        - 2070s: +0.08
        - 2090s: +0.08

Cooling Degree Days[4]
Projected change in cooling degree days
- Annual baseline (degree days): 288.92
    - High emissions scenario (RCP 8.5):
        - 2030s: +273.75

        - 2050s: +543.00
        - 2070s: +751.21
        - 2090s: +1099.36
    - Medium emissions scenario (RCP 4.5):
        - 2030s: +273.75
        - 2050s: +357.81
        - 2070s: +447.69
        - 2090s: +447.69

Growing Degree Days[5]

Projected change in growing degree days

- Annual baseline (degree-days): 2459.40
    - High emissions scenario (RCP 8.5)
        - 2030s: +557.25
        - 2050s: +1001.77
        - 2070s: 1304.54
        - 2090s: +1771.24
    - Medium emissions scenario (RCP 4.5)
        - 2030s: +557.25
        - 2050s: +703.97
        - 2070s: +852.53
        - 2090s: +852.53

Heating Degree Days[6]

Projected change in heating degree days

- Annual baseline (degree-days): 7577.37
    - High emissions scenario (RCP 8.5)
        - 2030s: -1042.14
        - 2050s: -1759.52
        - 2070s: -2210.35
        - 2090s: -2848.93
    - Medium emissions scenario (RCP 4.5)
        - 2030s: -1042.14
        - 2050s: -1286.94
        - 2070s: -1526.03
        - 2090s: -1526.03

Comparisons to other towns

- Amongst towns that will experience the largest decrease in days below 0°F
- Amongst towns that will experience smallest increase in days > 100°F
- Maximum temperatures change consistent with the rest of the state
- Minimum temperatures change consistent with the rest of the state
- Coastal vulnerabilities N/A

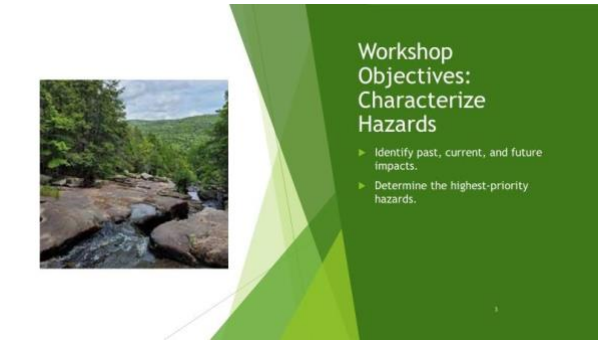
Category	*Annual Baseline*	*High Emissions Scenario*

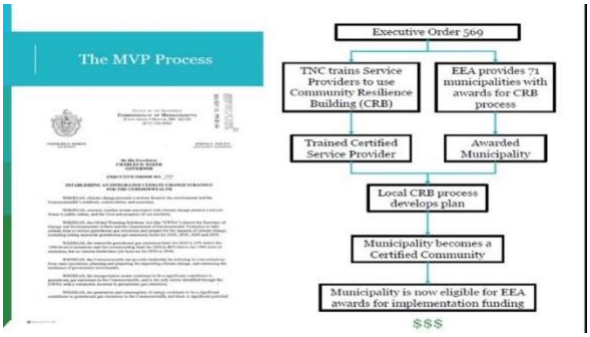
		(RCP 8.5) Projection by 2050's
Consecutive dry days	29.93 days	+0.95 days
Extreme precipitation > 1"	5.61 days	+1.47 days
Extreme precipitations > 2"	0.62 days	+0.43 days
Extreme precipitation > 4"	0.06	+0.03 days
Total precipitation	49.27 inches	+8.06 inches
Average temperatures	45.06 °F	+6.3 °F
Cooling degree days	288.92 degree days	+543.00 degree days
Days < 0 °F	13.39 days	-8.40 days
Days < 32 °F	167.14 days	-48.63 days
Days > 100 °F	0.00 days	+0.14 days
Days > 90 °F	1.63 days	+17.13 days
Days > 95 °F	0.00 days	+3.48 days
Growing green days	2459.40 degree days	+1001.77 degree days
Heating degree days	7577.37 degree days	-1759.52 degree days
Maximum temperatures	80.91 °F	+6.3 °F
Minimum Temperatures	-8.80 °F	+6.3 °F

Notes:

1. Representative Concentration Pathway (RCP) 8.5 refers to the concentration of carbon that delivers global warming at an average of 8.5 watts per square meter across the planet.
2. RCP 4.5 is a scenario of long-term, global emissions of greenhouse gasses, short-lived species, and land-use-land-cover which stabilizes radiative forcing at 4.5 watts per meter squared
3. RCP 4.5 future climate projection produces decreases of air temperature and increases of precipitation while RCP 8.5 tends to reduce the precipitation and to increase the temperature.
4. "Cooling Degree Days" measures the degrees that a day's average temperature is above 65° Fahrenheit to quantify the demand for energy
5. "Growing Degree Days" is used to estimate the growth and development of plants and insects during the growing season. The basic concept is that development will only occur if the temperature exceeds some minimum development threshold, or base temperature
6. "Heating Degree Days" measures the degrees that a day's average temperature is below 65° Fahrenheit (18° Celsius), used to quantify the demand for energy

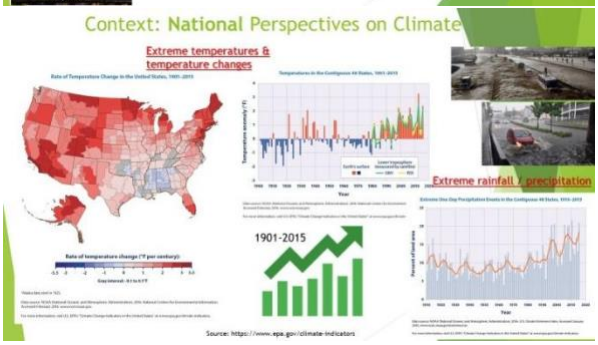
APPENDIX I: CRB WORKSHOP PRESENTATION

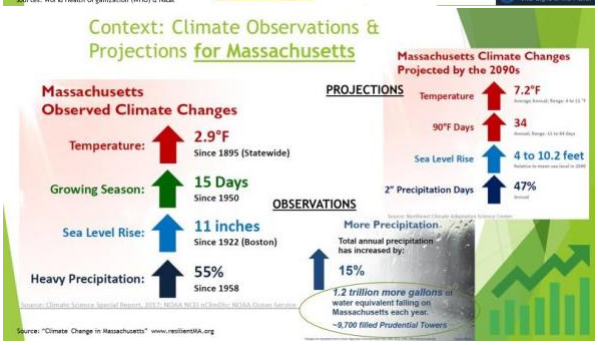





Context: Why care about climate change?
Impact of Climate Change on Human Health
Threats to human health
Threats to national security
Climate Security is National Security
Many other threats


Context: Global Perspectives on Climate
WHO IS AT RISK OF CLIMATE CHANGE?
EVERYONE
EVERYWHERE
WHETHER YOU LIVE IN A...
For example:
CLIMATE CHANGE THREATENS YOUR HEALTH
Basic necessities will be disrupted...
250 000 ADDITIONAL DEATHS PER YEAR
2018 fourth warmest year in continued warming trend, according to NASA, NOAA


Context: National Perspectives on Climate
Extreme temperatures & temperature changes
Extreme rainfall / precipitation
1901-2015


Context: Climate Observations & Projections for Massachusetts
Massachusetts Observed Climate Changes
Temperature: 2.9°F Since 1895 (Statewide)
Growing Season: 15 Days Since 1950
Sea Level Rise: 11 inches Since 1922 (Boston)
Heavy Precipitation: 55% Since 1958
PROJECTIONS
OBSERVATIONS
Massachusetts Climate Changes Projected by the 2090s
Temperature 7.2°F
90°F Days 34
Sea Level Rise 4 to 10.2 feet
2" Precipitation Days 47%
More Precipitation
Total annual precipitation has increased by:
15%


Climate Projections: Middlefield
median value
3.6
-1
0
-6
3.6
-4
-22
-1042
-27
3.6
1
0
274
7
0
0
557


Climate Projections: Middlefield (precipitation)
median value
6.1
8.2
0
0
0.3
6.9
1
0
0


MIDDLEFIELD'S TOP FOUR HAZARDS
1. Flooding
2. Thunderstorms (heavy rainfall / precipitation)
3. Severe Snowstorms, Ice Storms, Nor'easters
4. Drought
5. Wildfires
6. Wind, Tornadoes
7. Hurricanes
These TOP 4 HAZARDS will serve as an important input to Workshop Actions.


Identifying Top Hazards
What hazards have impacted your community in the past?
Where, how often, and in what ways?
What hazards are impacting your community currently?
Where, how often, and in what ways?
What effects will these hazards/changes have on your community in the future (5, 10, 25 years)?
What is exposed to hazards and climate threats within your community?
What have been the impacts to operations and budgets, planning and mitigation efforts?
Others concerns or considerations related to impacts?

Small Group Activity

Determine top-priority hazards (small teams)

Identify the Top 3 to 4 Hazards that pose the greatest threat to the community currently and over the next decade or longer and against which the community should take action

Workshop Actions

Small Group Activity "C1, C2, & C3" - Identify Community Vulnerabilities and Strengths

Small Group Activity

- Purpose and description of Step C:

C Identify Community Vulnerabilities and Strengths

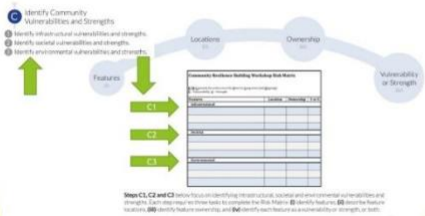
Section C Objectives (small teams): Develop a comprehensive understanding or profile of the community's (1) infrastructural, (2) societal, and (3) environmental components that are impacted by the **Top 4 Hazards** (B-2), as well as those features that help to make the community stronger and more resilient against these top hazards. The **Risk Matrix** captures the community's **Top 4 Hazards**, vulnerabilities, strengths, and actions. The **Risk Matrix** provides information necessary to develop strategies, inform community plans and advance actions to lessen hazard impacts and build resilience.

In light of TOP 4 HAZARDS

1. Identify infrastructural vulnerabilities and strengths.
2. Identify societal vulnerabilities and strengths.
3. Identify environmental vulnerabilities and strengths.

Small Group Activity

- Infrastructural (C1), Societal (C2), and Environmental (C3):



Once small team agreement is reached, fill out the applicable sections of the risk matrix

15 MINUTE BREAK

Workshop Actions

2nd Small Group Activity

"D1, D2, & D3" - Identify and Prioritize Community Actions

Workshop: 2nd Small Group Activity

- Purpose and description of Step D:

D Identify and Prioritize Community Actions

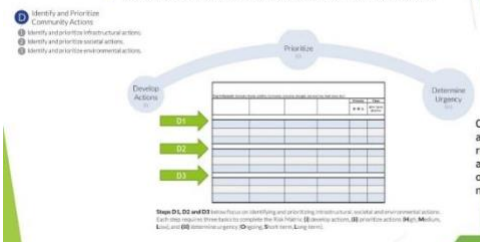
Section D Objective: For each profile – Infrastructural, Societal, Environmental – carefully identify and then prioritize actions to help reduce vulnerability or reinforce strengths for each or all of the **Top 4 Hazards**. Continue to work as small teams through the following three steps for each profile and capture dialogue, in detail, on the respective Risk Matrix. The **Risk Matrix** captures the community's **Top 4 Hazards**, vulnerabilities, strengths, and actions. The **Risk Matrix** provides information necessary to develop strategies, inform community plans and advance actions to lessen hazard impacts and build resilience.

In light of TOP 4 HAZARDS, VULNERABILITIES, & STRENGTHS

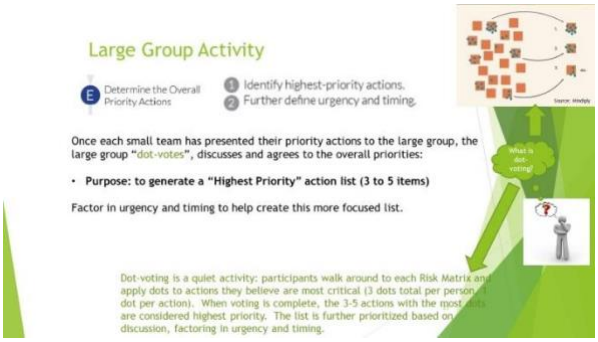
1. Identify and prioritize infrastructural actions.
2. Identify and prioritize societal actions.
3. Identify and prioritize environmental actions.

2nd Small Group Activity

- Infrastructural (D1), Societal (D2), and Environmental (D3):



Once small team agreement is reached, fill out the applicable sections of the risk matrix near your table.


Large Group Activity
E Determine the Overall Priority Actions
1 Identify highest-priority actions.
2 Further define urgency and timing.
Once each small team has presented their priority actions to the large group, the large group "dot-votes", discusses and agrees to the overall priorities:
• Purpose: to generate a "Highest Priority" action list (3 to 5 items)
Factor in urgency and timing to help create this more focused list.
What is dot-voting?
Dot-voting is a quiet activity: participants walk around to each Risk Matrix and apply dots to actions they believe are most critical (3 dots total per person, 1 dot per action). When voting is complete, the 3-5 actions with the most dots are considered highest priority. The list is further prioritized based on discussion, factoring in urgency and timing.


WRAP-UP / NEXT STEPS


What Happens Next?
F Put It All Together
1 Generate final workshop products.
G Move Forward
1 Continue community outreach and engagement.
2 Secure additional data and information.
3 Inform existing planning and project activities.
From: Community Resilience Building WORKSHOP GUIDE


Thank you all for your participation!

APPENDIX J: PUBLIC COMMENT OPPORTUNITY ONE NOTICE

Public Notice

This notice informs you that the Town is holding a **Public Meeting** on **Saturday, January 21, 2023, from 9:00 AM - 9:30 AM.** This public meeting is to discuss the proposed Municipal Vulnerability Plan (MVP), which the Town has been working on with Commonwealth Municipal Consulting, LLC, since last spring.

The Municipal Vulnerability Preparedness grant program (MVP) provides support for cities and towns in Massachusetts to begin the process of planning for climate change resiliency and implementing priority projects. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans. Communities that complete the MVP program become certified as an MVP community and are eligible for MVP Action Grant funding and other opportunities. The report includes an update to our Hazard Mitigation Plan.

If you cannot attend the meeting but have questions regarding the MVP/HMP plan, please submit your questions in writing to Doreen.commonwealth@gmail.com **before 3:00 PM, January 19, 2023**, and we will answer them during the public meeting.

The Meeting will be held at Town Hall, 188 Skyline Trl, Middlefield, Massachusetts, 01243

Additional questions can be directed to the Municipal Office at (413)-623-8966.

APPENDIX K: PUBLIC COMMENT OPPORTUNITY TWO NOTICE

Public Notice

This is a notice to the public that the Town is holding a **Public Comment Meeting** on **Wednesday, April 5, 2023, at 6:00 pm.**

This public meeting is to ask questions regarding the proposed Municipal Vulnerability Plan (MVP), which the Town has been working on with Commonwealth Municipal Consulting, LLC, since last spring.

The Municipal Vulnerability Preparedness grant program (MVP) provides support for cities and towns in Massachusetts to begin the process of planning for climate change resiliency and implementing priority projects. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans. Communities that complete the MVP program become certified as an MVP community and are eligible for MVP Action Grant funding and other opportunities. The report includes an update to our Hazard Mitigation Plan.

If you cannot attend the meeting but have questions regarding the MVP/HMP plan, please submit your questions in writing to Doreen.commonwealth@gmail.com **before 3:00 PM, April 4, 2023**.

The Meeting will be held at Town Hall, 188 Skyline Drive, Middlefield, Massachusetts, 01243

Additional questions can be directed to the Municipal Office at (413)-623-8966. Information about the project can be found on the Town of Middlefield website.

APPENDIX L: ANNOUNCEMENT OF PUBLIC COMMENT OPPORTUNITY TWO IN LOCAL PAPER

from Huntington, got right to the point. "I think that rural school aid and transportation reimbursement are critical now."

Pupil Services Director Kurt Garivaltis seconded that position. "We have a tenaciously dedicated staff at Gateway and we do the best we can with what we have. But we hope you'll tenaciously advocate for us." Garivaltis added that before

before."

Mark gave an overview on the status of Rural School Aid, saying that it did not even exist in 2017. For the first time, the Governor's budget has proposed $7.5 million in that line item, although Mark admitted it still falls far short of the $60 million called for in the 2022 Rural Schools Commission Report to

SCHOOL, page 13

State Representative Nicholas Boldyga, from left, Superin Kristen Smidy and State Senator Paul Mark met with ad for rural school funding from Gateway Regional.

Photos by We

MIDDLEFIELD

Middlefield to host public comment session

On Wednesday April 5 at 6 p.m.. consultants from Commonwealth Municipal Consulting LLC and members of the Town Core MVP/HMP Committee will host a public comment session at the Town Hall to answer any questions residents may have on the draft Mass Vulnerability/ Hazardous Mitigation Plan.

The town has been working on for the past year on this plan. It will also be a chance to gather any comments or input from town residents before the report is sent to Boston for approval.

The Municipal Vulnerability Preparedness grant program provides support for cities and towns in Massachusetts to begin the process of planning for climate change resiliency and implementing priority projects. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans.

Communities, which complete the MVP program become certified as an MVP community and are eligible for MVP Action Grant funding and other opportunities. The report includes an update to our Hazard Mitigation Plan.

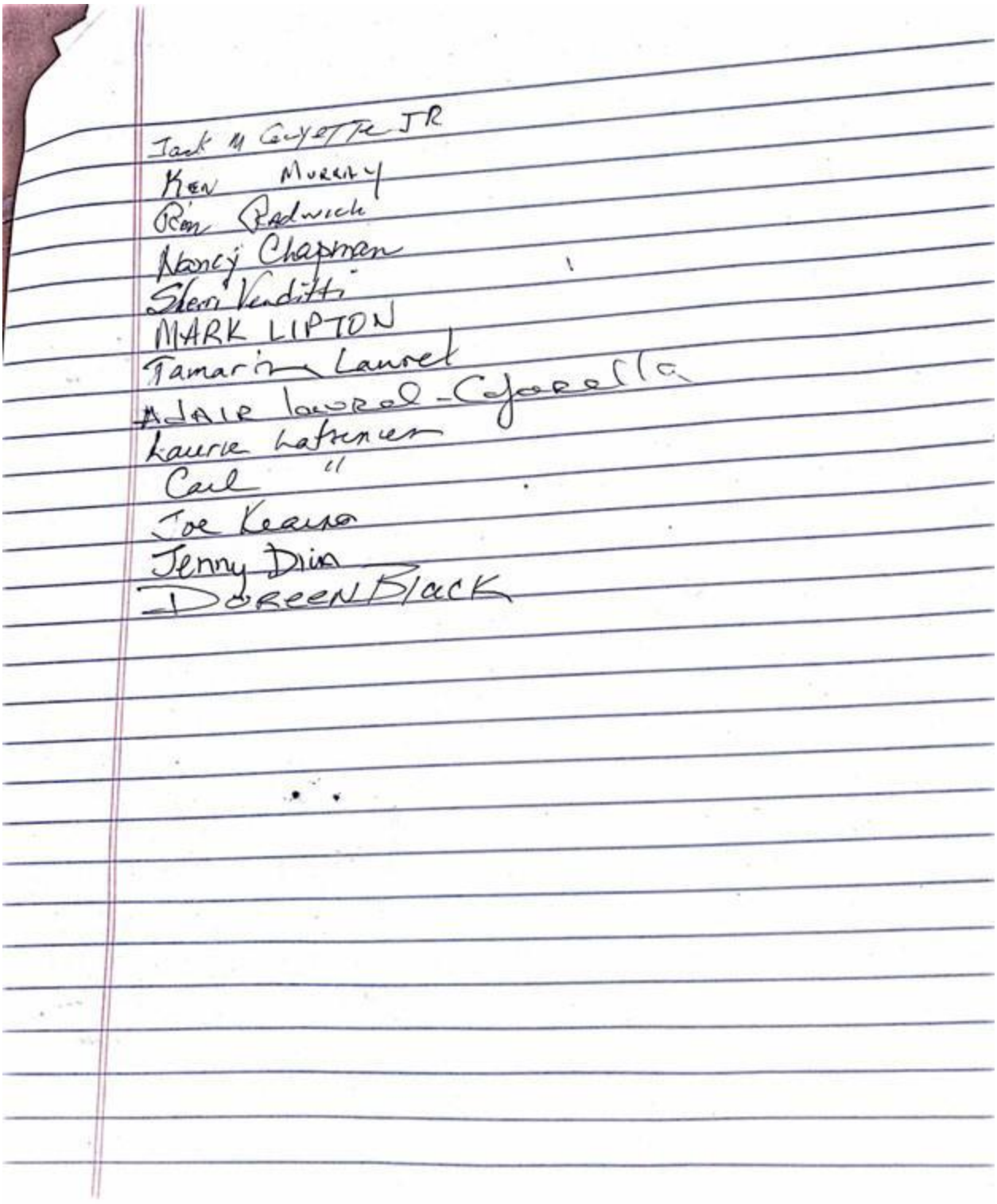
If residents cannot attend the comment session, but have questions regarding the MVP/HMP plan, they may submit their questions in writing via email to Doreen atcommonwealth@gmail.com on Tuesday, April 4 at 3 p.m.

Additional questions can be directed to the Select Board Office by calling 413-623-8966 or emailing selectboard@middlefield-ma.net. Information about the project can be found on the Town of Middlefield website. Several copies are also available for viewing at the Town Hall.

WAL

Hikers and their C Road.

APPENDIX M: PUBLIC COMMENT TWO SIGN IN SHEET



APPENDIX N: PUBLIC SURVEY AND NOTICE

Public Notice: Seeking Your Input

The Town of Middlefield is participating in a combined Hazard Mitigation and Municipal Vulnerability Preparedness Planning Project. The goals of this project are to ensure Middlefield is mitigating its risk to natural hazards and to improve the Town's climate resilience. The Town is partnering with Commonwealth Municipal Consulting, LLC, for this project. The project is funded by a grant from the MA Executive Office of Energy and Environmental Affairs (EEA).

The main activities of this project include:

- Core Team/Committee meetings updating information in the Town's 2019 HMP
- Community Resilience Building Workshop focused on climate resilience
- Public outreach activities including surveys and public listening sessions
- Drafting, approval, and submission of the final report to EEA, MEMA, and FEMA

Federal and State approval of the final plan grants Middlefield access to funding for mitigation and climate resilience projects in Town.

As a resident of Middlefield, we are seeking your input as part of this process. There is a survey attached to this notice that we hope you will take a few minutes to complete. By participating, you will be adding your thoughts and concerns to the project, helping ensure the final plan is reflective of our entire community.

There is a supplemental survey available for some people who belong to *Climate Vulnerable Populations*. Information about inclusion in those populations and how to access that survey, if applicable to you, is included at the end of the main survey.

Surveys are due by **January 31, 2023**. You may complete the included paper survey, or, if you prefer, a link to an online version is posted on the Town's website. If you complete the paper version, please return it by:

- Dropping it in the black "Drop box" located to the left of the entrance to Town Hall
- Placing it in the marked envelope in the Town's Post Office
- Mailing your completed survey to the Selectboard's attention at Town Hall.

There will be two public comment meetings. One will be held in January 2023 and the second is planned for Spring 2023. Information about those meetings will be posted on the Town's website at a later date.

For more information, contact the Rob Polsinelli at Commonwealth Municipal Consulting at robp.commonwealth@gmail.com or call the Town's Administrative Assistant at 623-2079.

Town of Middlefield, MA, Public Survey

This survey aims to learn about public opinions of natural hazards and vulnerabilities in the Town of Middlefield, Massachusetts. Responses to this survey serve as essential public input regarding the contents and direction of the Hazard Mitigation Planning and Municipal Vulnerability Preparedness process being conducted by the Town. The survey will take approximately 5 - 10 minutes and consists of 10 questions. If you are not able to answer specific questions, please feel free to skip them. Answers to this survey are anonymous. This survey is intended only for residents of Middlefield, Massachusetts, and may only be completed once per resident. If you are assisting a resident in completing this survey, please indicate so below.

If you prefer to complete this survey online, please go to the **Middlefield Town Website** to find a link to be directed to the online version.

Part 1: Confirmation

Please check the appropriate boxes to attest that you have read the above information, that you would like to proceed with taking this survey, that you will only complete the survey one time, and that you are a current resident of the Town of Middlefield.

- € I have read the above information and would like to proceed with taking this survey.
- € I pledge to only complete the survey one time.
- € I am a resident of the town of Middlefield.

  or
- € I am assisting a resident of Middlefield in completing this survey because they are unable to complete it on their own.

Part 2: Survey

1: Rank the hazards faced by the Town of Middlefield from 1 - 9, with **1** being the **MOST** concerning and **8 (or 9 if writing in "Other")** being the **LEAST** concerning.

Hazard *(listed in alphabetical order)*	**Rank 1- 9 (most - least concerning)**
Dam Failure	*(e.g., 5)*
Drought	
Extreme Temperatures	
Flooding	
Hurricanes/Tropical Storms	
Severe Snowstorms/Ice storms	
Severe Thunderstorms/Winds/Tornadoes/Microbursts	
Wildfires/Brushfires	
Other *(optional)*: _____	

2: Please provide a brief explanation as to why you ranked your top hazard as the most concerning. _____

_____

3: Are there one or more areas of Town that come to mind as particularly vulnerable to hazards? Please list them in the space provided. _____

_____

4: What project(s) could be done to limit the vulnerability of the area(s) you listed above?

_____

_____

5: Fill in the blank: If Middlefield were to experience a hazard event, I would feel _____ in the Town's ability to be resilient and manage emergency services.

- € very confident
- € confident
- € neutral
- € apprehensive
- € very apprehensive

6: If you answered "very confident" or "confident," what do you think the Town is doing well to prepare/plan for hazardous events? _____

_____

7: If you answered "apprehensive" or "very apprehensive," what could the Town do differently to be better equipped to handle hazards? _____

_____

8: How would you rank your concern for climate change? (**1** being "**not at all concerned**" and **5** being "**very concerned**")

1 2 3 4 5

9: If you answered "4" or "5" to the previous question, what is your biggest climate change concern as it relates to the hazards faced by the Town of Middlefield? _____

_____

10: How would you vote to prioritize improving the Town's ability to respond to hazards and/or climate change versus other needs in Town?

- € Top priority
- € High priority
- € Low priority
- € Not a priority

Part 3: Climate Vulnerable Population Invitation

To gauge the opinions of Climate Vulnerable Populations in Middlefield, the Town has prepared a subsequent survey seeking respondents who belong in one or more of the following categories:

- Non-white or Latino
- Low income
- 65 or older
- Individuals with a chronic physical disability (some examples include a visual impairment, hearing impairment, motor impairment including the need for physical assistance or use of a wheelchair, walker, or cane)
- Individuals with a mental health disorder or intellectual disability (some examples include PTSD, Depression, cognitive impairment, or developmental disability.)

If any of the above categories pertain to you, we invite you to complete the **Climate Vulnerable Population Survey**. Copies can be obtained at Town Hall, the Post Office, or the Senior Center. If you would like a paper copy mailed to you, please email **robp.commonwealth@gmail.com** or call the Town's Administrative Assistant at 623-2079.

Part 4: Debrief

Thank you for taking the time to participate in this survey. To ensure your responses are anonymous, **please do not mail your completed survey with your property tax payment**. Instead, you can deposit it at the drop box outside Town Hall, leave it at the Post Office (there is an envelope labeled for survey collection), or mail it to:
Middlefield Town Hall
Attn: Selectboard
188 Skyline Trail
Middlefield, MA 01243

If you have any questions or concerns please feel free to reach out to Rob Polsinelli, CMC's Director of Policy, at **robp.commonwealth@gmail.com** or call the Town's Administrative Assistant at 623-2079. Your participation is appreciated!

EDITORIAL NOTE: *This survey was available for residents online per the decision of the Core Team. Minor differences in format exist, notably that open ended questions could be answered in a text box rather than on a line as shown below*.

APPENDIX O: CLIMATE VULNERABLE POPULATION SURVEY

Climate Vulnerable Population Survey - Town of Middlefield, MA

Consent: This survey aims to collect information from Climate Vulnerable Populations in Middlefield, Massachusetts. Responses to this survey will assist in filling gaps in data surrounding environmental justice in Massachusetts and provide a valuable starting point for work that Commonwealth Municipal Consulting can do to best report these stressors. This survey will take approximately 5 – 10 minutes and consists of 14 questions requiring you to choose from multiple-choices or rank items. If you are not comfortable answering specific questions please feel free to skip them. Answers to this survey are anonymous, and there is no risk of a respondent's identity being revealed. This survey is intended only for residents of Middlefield, Massachusetts, and may only be completed once per resident. If you are assisting a resident in completing this survey, please indicate so below.

If you prefer to complete this survey online, please go to the **Middlefield Town Website** and click the link on the homepage to be directed to the online version.

Part 1: Confirmation (*required*)

Please check the appropriate boxes to attest that you have read the above information, that you would like to proceed with taking this survey, that you will only complete the survey one time, and that you are a current resident of the Town of Middlefield.

- € I have read the above information and would like to proceed with taking this survey.
- € I pledge to only complete the survey one time.
- € I am a resident of the Town of Middlefield.

or

- € I am assisting a resident of Middlefield in completing this survey because they are unable to complete it on their own.

Part 2: Demographic information

1: How old are you?

- € Under 18
- € 18-24 years old
- € 25-34 years old
- € 35-44 years old
- € 45-54 years old
- € 55-64 years old
- € 65-74 years old
- € 75 years or older

2: Approximately how long have you been a resident of Middlefield?

- € Less than 1 year
- € 1-4 years
- € 5-9 years
- € 10-14 years
- € 15-19 years
- € 20-29 years
- € 30-39 years
- € 40-49 years
- € 50+ years

3: Do you currently own or rent your home?

- € Own (*includes if you are paying a mortgage*)
- € Rent

4: Are you of Hispanic/Latinx/Spanish origin or descent?

- € Yes
- € No

5: How would you best describe yourself? (*Select **only one***)

- € Two or more races
- € American Indian or Alaskan Native
- € Asian
- € Black/African American
- € Native Hawaiian or other Pacific Islander
- € White
- € Other

6: What is your annual household income?

- € Less than $20,000
- € Between $20,000 and $34,999
- € Between $35,000 and $49,999
- € Between $50,000 and $74,999
- € Between $75,000 and $99,999
- € Between $100,000 and $150,000
- € Over $150,000

7: Do you have a chronic physical disability? (*Examples include but are not limited to a visual impairment, hearing impairment, motor impairment including the need for physical assistance or use of a wheelchair, walker, or cane*)

- € Yes
- € No

8: Do you have an intellectual disability? (*Examples include but are not limited to PTSD, Depression, cognitive impairment, or developmental disability*)

- € Yes
- € No

Part 3: Hazard experience

9: While living in Middlefield, have you experienced a hazardous event within the Town? (*Examples may include flood, dam failure, hurricane, winter storm, severe storm, extreme temperature & drought, wild/brushfire, earthquake, tornado, and/or landslide*)

- € Yes
- € No (*if, no, please skip to #12*)

10: If you answered yes to the previous question, how would you best categorize the hazardous event(s) you have experienced in Middlefield. (*Select as many as applicable*)

- € Dam failure
- € Drought
- € Extreme Temperatures
- € Flooding
- € Hurricanes/Tropical Storms
- € Severe snowstorms/ice storms
- € Severe Thunderstorms/Winds/Tornadoes/Microbursts
- € Wildfires/Brushfires
- € Other (*please list*) _____
- € Not applicable

11: If you answered yes to question 9, choose your level of agreement with this statement: During a time of hazardous event within the Town of Middlefield, I was able to receive the necessary resources and/or assistance to mitigate harm.

- € Strongly agree
- € Agree
- € Disagree
- € Strongly disagree

12: Choose your level of agreement with this statement: If the Town of Middlefield were to experience a hazardous event tomorrow, I would be able to receive the necessary resources and/or assistance to mitigate harm.

- € Strongly agree
- € Agree
- € Disagree
- € Strongly disagree

13: If the Town of Middlefield were to experience a hazardous event, do you expect to have more difficulties accessing or receiving necessary resources and/or assistance to mitigate harm than others based on one of the following factors? (*You may select multiple answers*)

- € Yes, because of my income
- € Yes, because of my race or ethnicity
- € Yes, because of my age
- € Yes, because of a disability
- € No, my experience would not be affected by any of the factors listed above

Part 4: Hazard ranking

14: Rank these hazard categories from most (**1**) to least (**8**) dangerous in terms of your personal vulnerability.

____ Dam failure
____ Drought
____ Extreme Temperatures
____ Flooding
____ Hurricanes/Tropical Storms
____ Severe snowstorms/ice storms
____ Severe Thunderstorms/Winds/Tornadoes/Microbursts
____ Wildfires/Brushfires
____ Other (*please list*) _____

Part 5: Debrief

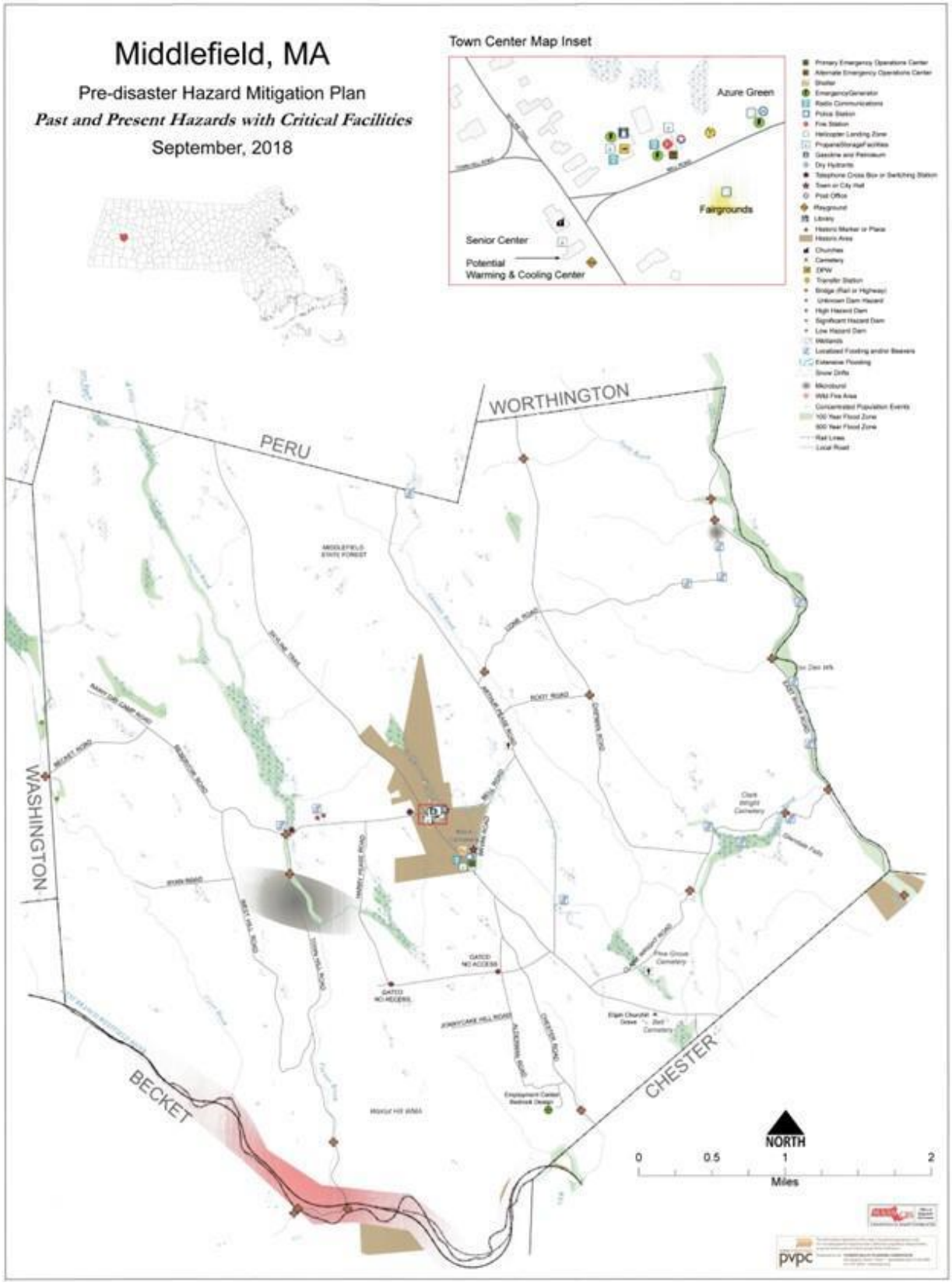
Thank you for taking the time to participate in this survey. Completed surveys can be deposited at the drop box outside Town Hall, left at the Post Office or Senior Center (each has an envelope labeled for survey collection), or mailed to Town Hall at:
Middlefield Town Hall
Attn: Selectboard
188 Skyline Trail
Middlefield, MA 01243

If you have any questions or concerns please feel free to reach out to Rob Polsinelli, CMC's Director of Policy, at **robp.commonwealth@gmail.com** or call the Town's Administrative Assistant at 623-2079.

Your participation is appreciated!

EDITORIAL NOTE: *This survey was available for residents online per the decision of the Core Team. Minor differences in format exist, notably that open ended questions could be answered in a text box rather than on a line as shown below.*

APPENDIX P: SITE MAP OF MIDDLEFIELD, MA



APPENDIX Q: PLAN ADOPTION CERTIFICATE

APPENDIX Q: PLAN ADOPTION CERTIFICATE

TOWN OF MIDDLEFIELD · MASSACHUSETTS · INCORPORATED MARCH 12 1783

CERTIFICATE OF ADOPTION MIDDLEFIELD SELECTBOARD
TOWN OF MIDDLEFIELD, MASSACHUSETTS

A RESOLUTION ADOPTING THE TOWN OF MIDDLEFIELD HAZARD MITIGATION PLAN AND MUNICIPAL VULNERABILITY PREPAREDNESS REPORT

WHEREAS, the Town of Middlefield established a Committee to prepare the Town of Middlefield Hazard Mitigation Plan and Municipal Vulnerability Preparedness Report; and

WHEREAS, the Town of Middlefield Hazard Mitigation Plan and Municipal Vulnerability Preparedness Report contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Middlefield, and

WHEREAS, duly-noticed public meetings were held by the Selectboard and Commonwealth Municipal Consulting LLC on January 14, 2023, and April 5, 2023; and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Middlefield Selectboard adopts the Town of Middlefield Hazard Mitigation Plan and Municipal Vulnerability Preparedness Report, in accordance with M.G.L. c.40 §4 or the charter and bylaws of the Town of Middlefield.
ADOPTED AND SIGNED

Ann Marie Visconti, Chair — Date 9/6/23

Curt Robie, Member — Date 9/6/23

Tamarin Laurel-Paine, Member — Date 9/6/23

APPENDIX R: RISK MATRIX

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	flood	winterstorm	drought	thunderstorms	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Roads(includes culverts and bridges)	clark wright road		v						
Roads(includes culverts and bridges)	resevior road		v						
Roads(includes culverts and bridges)	town hill road		v						
communications					cell tower installation				
housing				imrove drainage- river road					
senior center and. Muni center				foundation repair	garage vehicles				
Societal									
elderly				generator/cooling system					
supply chains									
emergency services				caoital or housing plan					
migration/ relocators									
Environmental									
disease									
animal habitat									
beaver dam				beaver management plan					
forrest				forrest management plan					
rivers				us army corps of engineers feasibility study					

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	flood	drought	winter storms	thunderstorms	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Roads	town	town	V	need of imroved capacity of all roads - major storm impact across all hazards, some roads need paving				H	O
Bridges/Culverts	town	town	V	replacemeat of five culverts and seven bridges throughout town to decrease flood risk				M	o
Communication	town	town/regional	V	improve communication system for emergency management, regional dispatch back to town is unreliable.				H	short
Water Supply	town	personal	V		residents need access to a public water supply			M	L
Trains	csx	csx	V		debris can cause potential fires, csx does not pick up along tracks. Fear of derailment and fire, particularly during dry season with no water supply				
Electricity	town	eversource	V			Line vunerability when trees fall on them, should be underground wires		M	L
Societal									
Elderly Impact	town	town	V			Better transportation options especially during winter		M	O
Access to schools/ jobs/stores	town	town	V			Better transportation options		M	O
water insecurity	town	town	V	town has private wells and needs backup system for water supply				M	L
isolation	town	town	V			Winter storms cause isolation and lack of access		L	O
the pressure of emergency responders	town	town	V	Small team with tough responsibility can hurt morale				M	O
Environmental									
Train accident/fire	town	CSX	v		Need better comm with CSX, should form regional committee to hold accountability			H	O
forrestry - trees falling/diseased	state/town	state	v		Need better comm with DCR, tree damage on fallen roads an issue from storms			H	O
Transformer leaks	town	town	v	leaking oil can get into the groundwater, especially during floods, needs monitoring					
invasive beaver dams	town/state	town	v	Town and state need to mitigage beaver dams				M	O
vunerable farms	town	personal/town	v	Town should support farms particularly during droughts by acess bylaws.				M	S