TOWN OF NAHANT
HAZARD MITIGATION PLAN
2021 UPDATE

MAPC 50 YEARS
METROPOLITAN AREA PLANNING COUNCIL
SMART GROWTH AND REGIONAL COLLABORATION

FINAL PLAN
Adopted by the Town on February 18, 2022

ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the Town of Nahant by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation (PDM) Grant Program.

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Calvin Hastings	Chairman, Planning Board
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SECTION 1: EXECUTIVE SUMMARY

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. In the communities of the Boston region of Massachusetts, hazard mitigation planning tends to focus most on flooding, the most likely natural hazard to impact these communities. This plan considers how our warming climate will affect natural hazards. Warming temperatures will fuel changing precipitation patterns, sea level rise, and an increasing frequency and intensity of severe storms. The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five-year intervals.

PLANNING PROCESS

The Hazard Mitigation Plan 2021 Update was led by the Nahant Local Hazard Mitigation Planning Team ("Local HMP Team" or "Local Team"), composed of staff from different town departments including Fire, Police, Emergency Management, Conservation Commission, Public Works, and Planning Board. The Local HMP Team convened on June 10, 2021, August 12, 2021, and November 9, 2021, to discuss the impacts of natural hazards on various areas in town, the effects of climate change, goals for addressing these impacts, updates to the Town's existing mitigation measures, and new or revised hazard mitigation measures that would benefit the town.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Town's Local Hazard Mitigation Planning Team hosted two public meetings. The first meeting on October 13, 2021, was held via Zoom. The second meeting was held before the Conservation Commission meeting on December15, 2021. See Public Comments for feedback.

RISK ASSESSMENT

The Nahant Hazard Mitigation Plan assesses the potential impacts to the town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, drought, and invasive species. For each risk, the assessment identifies the projected impacts of a warming climate. These are shown in the map series in Appendix B. The Nahant Local Hazard Mitigation Planning Team identified 32 critical facilities. These are also shown on the map series and listed in Table 28, identifying which facilities are located within the mapped hazard zones.

Hazards U.S. – Multi-hazards (HAZUS-MH) is a standardized methodology developed by FEMA that utilizes Geographic Information Systems (GIS) to estimate physical, economic, and social impacts of disasters. The HAZUS-MH analysis for Nahant estimates property damages from Hurricanes of category 2 and 4 ($4.5 million to $32.6 million), earthquakes of magnitudes 5 and 7 ($67.4 million to $195 million), and the 1% and .2% chance of flooding ($16.5 to $21 million).

HAZARD MITIGATION GOALS

The Nahant Local Hazard Planning Team endorsed the following seven hazard mitigation goals at the August 12, 2021, team meeting. The team added a seventh goal focused on incorporating future climate change projections.

1. Promote cost-effective hazard mitigation actions that protect and promote public health and safety from all hazards with a particular emphasis on reducing damage to repetitive and severe repetitive loss properties.
2. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.
3. Ensure that critical infrastructure sites are protected from natural hazards.
4. Protect the Town's ability to respond to various natural hazard events.
5. Increase awareness of the benefits of hazard mitigation through outreach and education.
6. Increase coordination and cooperation between Town departments in implementing sound hazard mitigation planning and sustainable development.
7. Consider the potential of impacts of future climate change and incorporate sustainability and climate resiliency into hazard mitigation planning.

HAZARD MITIGATION STRATEGY

The Nahant Local Hazard Mitigation Planning Team identified mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. Overall, the hazard mitigation strategy recognizes that mitigating hazards for Nahant will be an ongoing process as our understanding of natural hazards and the actionable steps to mitigate their damages changes over time. Global climate change and a variety of other factors impact the Town's vulnerability in the future, and local officials will need to work together across municipal lines and with state and federal agencies to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into the Town's other related plans and policies.

PLAN REVIEW & UPDATE PROCESS

A summary of the process for developing Nahant's Hazard Mitigation Plan 2021 Update is provided in Table 1 below.

Table 1: Plan Review and Update Process

Section	Reviews and Updates
Section 3: Public Participation	The Local Hazard Mitigation Planning Team placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was discussed at two public meetings hosted by the Hazard Mitigation Team. The plan was also available for public comment; see "Public Comments" section for feedback.

Section 4: Risk Assessment	MAPC gathered the most recently available climate, hazard and land use data and met with town staff to identify changes in local hazard areas and development trends. Town staff reviewed critical infrastructure with MAPC staff to create an up-to-date list. The Risk Assessment integrates projected climate impacts. MAPC also used the most recently available version of HAZUS and assessed the potential impacts of flooding using the latest data.
Section 5: Goals	The Nahant Local Hazard Mitigation Planning Team reviewed and endorsed the Hazard Mitigation Goals.
Section 6: Existing Mitigation Measures	The list of existing mitigation measures has been updated to reflect current mitigation activities in the town.
Sections 7 and 8: Hazard Mitigation Strategy	Mitigation measures from the 2014 Plan were reviewed and assessed as to whether they were completed, in progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into the 2021 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2014 plan. The Local Hazard Mitigation Team prioritized these mitigation measures based on current conditions.
Section 9: Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan implementation review and five-year update process that will assist the Town in incorporating hazard mitigation issues into other Town planning and regulatory review processes and better prepare the Town for the next comprehensive plan update.

As indicated in Table 33, Nahant has accomplished great progress implementing mitigation measures identified in the 2014 Hazard Mitigation Plan. High priority projects that were completed including the repairs of Tudor Beach/Town Wharf Seawall; reconstruction of the Nahant Causeway drainage system; dredging of Bear Pond tributaries; and purchase of new pumps for emergency water removal. Nahant also secured funding from FEMA to repair the seawall at Forty Steps Beach, which is anticipating completion in the next two years. Several mitigation projects are also in progress, including floodplain mapping, maintaining the ditches of Bear Pond tributaries, as well as continuing outreach to enhance coastal emergency preparedness during extreme storm events. Many of the identified actions in previous plans are converted into the Town's ongoing maintenance and/or public outreach programs.

Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision-making processes. As in the past, the Town will document any actions taken within this iteration of the Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Nahant Hazard Mitigation Implementation Team, as described in Section 9, Plan Adoption and Maintenance of this Plan.

SECTION 2: INTRODUCTION

PLANNING REQUIREMENTS UNDER THE FEDERAL DISASTER MITIGATION ACT

The Federal Disaster Mitigation Act, passed in 2000, requires that after November 1, 2004, all municipalities that wish to continue to be eligible to receive FEMA funding for hazard mitigation grants, must adopt a local multi-hazard mitigation plan and update this plan in five-year intervals. This planning requirement does not affect disaster assistance funding.

The Federal Emergency Management Agency (FEMA) administers federal hazard mitigation planning and grant programs in collaboration with the states. These programs are administered in Massachusetts by the Massachusetts Emergency Management Agency (MEMA) in partnership with the Department of Conservation and Recreation (DCR).

The Town of Nahant contracted with the Metropolitan Area Planning Council (MAPC), to assist the Town in updating its third local Hazard Mitigation Plan, which was first adopted in 2005 as a multi-jurisdictional plan and updated as a single municipality plan in 2014.

WHAT IS A HAZARD MITIGATION PLAN?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities. This plan incorporates consideration of future risks due to projections for the increased frequency and severity of extreme weather fueled by a warming planet.

PREVIOUS FEDERAL/STATE DISASTERS

As noted in the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), Essex County, in which the Town of Nahant is located, experienced the most FEMA flood disaster declarations from 1954–2017.

Since 1991, Essex County, in which the Town of Nahant is located, has experienced approximately 27 natural hazard events that triggered federal or state disaster declarations. These are listed in Table 2 below. The majority of these events involved flooding, while others were due to hurricanes or nor'easters, and severe winter weather.

Table 2: Federal/State Disaster Declarations, 1991-2018

Disaster Name	Date of Event	Declared Areas
Hurricane Bob	August 1991	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Severe Coastal Storm No Name Storm	October 1991	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Blizzard	December 1992	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk
Blizzard	March 1993	Statewide
Blizzard	January 1996	Statewide
Windstorm	May 1996	Counties of Essex, Plymouth, Norfolk, Bristol
Severe Storms, Flood	October 1996	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
Heavy Rain, Flood	June 1998	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Severe Storms, Flood	March 2001	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Snowstorm	March 2001	Counties of Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, Worcester
Snowstorm	February 2003	Statewide
Snowstorm	December 2003	Counties of Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester
Flooding	April 2004	Counties of Essex, Middlesex, Norfolk, Suffolk, Worcester
Blizzard	January 2005	Statewide
Hurricane Katrina	August 2005	Statewide
Severe Storms, Flooding	October 2005	Statewide
Severe Storms, Flooding	May 2006	Statewide
Nor'easter	April 2007	Statewide
Severe Storms, Flooding	December 2008	Counties of Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Suffolk, and Worcester
Severe Storms, Flooding	December 2008	Statewide
Severe Storms, Flooding	March/April 2010	Counties of Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester

Disaster Name	Date of Event	Declared Areas
Severe Winter Storm, Snowstorm	January 2011	Counties of Berkshire, Essex, Hampden, Hampshire, Middlesex, Norfolk, Suffolk
Severe Winter Storm, Snowstorm and Flooding	February, 2013	Statewide
Severe Winter Storm, Snowstorm, and Flooding	April 2013	Statewide
Severe Winter Storm, Snowstorm, and Flooding	April 2015	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe winter storm and flooding	March 2018	Counties of Barnstable, Bristol, Essex, Nantucket, Norfolk, Plymouth
Severe winter storm and Snowstorm	March 2018	Counties of Essex, Middlesex, Norfolk, Suffolk, Worcester

Source: SHMCAP, 2018

FEMA FUNDED MITIGATION PROJECTS

Over the last 20 years the Town of Nahant has received funding from FEMA for three (3) mitigation projects under the Hazard Mitigation Grant Program (HMGP). These projects totaled $457,500, with $343,125 covered by FEMA grants and $87,625 by local funding. The projects are summarized in Table 3 below.

Table 3: FEMA-Funded Mitigation Projects

Project Title	Scope of Work	Total Cost	Federal Funding	Local Funding
Bear Pond Drainage Improvements (2005)	Upgraded headwall, replaced metal drainpipe, upgraded reinforced concrete vault and tide gate, installed drain manhole, and slip line.	$132,000	$99,000	$6,250
Improvements to Bear Pond Outlet (2008)	Project consisted of pouring 6" concrete easement, replacing duckbill valves, and replacing riprap.	$90,500	$67,875	$22,625
Forty Steps Beach Stabilization	Repairs to seawall.	$235,000	$176,250	$58,750

(Source: database provided by MEMA)

COMMUNITY PROFILE

Located in the southernmost part of Essex County, the Town of Nahant is a peninsula jutting south of the City of Lynn and surrounded on three sides by the Atlantic Ocean. Nahant is approximately 1.04 square miles, and the smallest community in MA. Nahant is known for its rocky coastline, sandy beaches, and scenic views. Table 4 summarizes additional demographic features of the town.

Table 4: Nahant Demographics and Characteristics

- Population: 3,502 residents
  - 14% are under age 18
  - 62% are between age 18-64
  - 24% are over age 65
  - 95% of the population is White
- About 2.4% of residents are living below poverty level. Median household income in Nahant is $97,778 (approx. 20% higher than in MA).
- Number of housing units: 1,724
  - 30% are renter-occupied

Source: 2019 American Community Survey.

In early colonial days, Nahant served as a grazing area for cattle, sheep, and goat flocks owned by Lynn residents. Nahant very soon became a maritime community with a small population devoted to fishing. Settlers were granted land for home sites but only if they also spent time fishing and small boat fishing developed before 1640. By1657, Nahant was laid out in planting lots of equal shares for all residents of Lynn with the requirement that all lots were to be cleared of wood in 6 years. This mandate effectively stripped Nahant of all its first growth woodlands. Incorporated in 1853, Nahant became known for its rocky coasts. As a resort town, it was also site of the most massive hotel complex on the Atlantic Coast and the location of an annual regatta. By the end of the 19th century, the town experienced a visible shift away from hotels and toward residences. Starting around 1870, and for over the next four decades, Nahant grew significantly with hundreds of summer homes developed. Today, Nahant remains a predominantly residential town, made up of family groups and diverse individuals who share common ground and strong commitment to protecting this small island community.[1]

Nahant has several unique characteristics to keep in mind while planning for natural hazards:

- Nahant is accessible by land via a single road known as the Causeway. MA DCR maintains this road. This Causeway connects Nahant to Lynn and Route 129 and 1A. DCR also manages a 3,202,000-square-foot reservation along the causeway connecting Nahant and Lynn, which includes Nahant Beach, a bike path, bathroom facilities, and public parking.
- The two main sections of Nahant, known as Big Nahant and Little Nahant, are connected by another causeway.
- Open space and limited recreational resources in Nahant include Lodge Park, Tudor Wharf, Tudor Beach, Marjoram Park, Bailey's Hill, and Short Beach. Nahant has three State-designated barrier beaches - Nahant Beach, Short Beach and Pond Beach.
- Nahant's water source is the Quabbin Reservoir. The Massachusetts Water Resources Authority (MWRA) administers the town's water supply.

1 The History of Nahant. https://nahant.org/history/.

- Today, Nahant's sewage is directed a regional sewage treatment facility in Lynn, where it receives primary and secondary treatment. A sewer outfall, approximately 0.6 miles off Bass Point, discharges treated waste into Lynn Harbor.
- Also affecting the quality of the Nahant coastal waters is the Greater Boston Sewage Treatment Plant at Deer Island administered by the MWRA. This plant, which began operations in the spring of 2000, is discharging secondary treated sewage from forty-two cities and towns through an outfall about 5.5 miles from Nahant.
- There are no forests or woodlands of significant size in Nahant, except perhaps for the overgrown tree-covered area atop and around the gun emplacements at the Bailey's Hill complex.

The Town of Nahant's official website is https://nahant.org/.

SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

MAPC employs a six-step planning process based on FEMA's hazard mitigation planning guidance focusing on local needs and priorities but maintaining a regional perspective matched to the scale and nature of natural hazard events and regional climate change. Public participation is a central component of this process, providing critical information about the local occurrence of hazards while also serving as a means to build a base of support for hazard mitigation activities. MAPC supports participation by the general public and other plan stakeholders through two public meetings, posting of the plan to the Town's website, and invitations sent to neighboring communities, town boards and commissions, and other local or regional entities to review the plan and provide comment.

PLANNING PROCESS SUMMARY

The six-step planning process outlined below is based on the guidance provided by FEMA's Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. In plan updates, the process described below allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to a municipality's existing mitigation measures, and progress made on actions identified in previous plans.

Figure 1: Six-Step Planning Process

1. **Map the Hazards** – MAPC relies on data from a number of different federal, state, and local sources in order to map the areas with the potential to experience natural hazards. This mapping represents a multi-hazard assessment of the municipality and is used as a set of base maps for the remainder of the planning process. A particularly important source of

information is the knowledge drawn from local municipal staff on where natural hazard impacts have occurred. These maps can be found in Appendix B.

2. **Assess the Risks & Potential Damages** – Working with local staff, critical facilities, infrastructure, vulnerable populations, and other features are mapped and contrasted with the hazard data from the first step to identify those that might represent particular vulnerabilities to these hazards. Land use data and development trends are also incorporated into this analysis. In addition, MAPC develops estimates of the potential impacts of certain hazard events on the community. MAPC drew on the following resources to complete the plan:

    - Nahant Zoning Bylaws
    - Town of Nahant Community Resilience Building Workshop Summary of Findings 2019
    - Town of Nahant Open Space Plans, 2016
    - Nahant Wetlands Protection By-law, 2019
    - Blue Hill Observatory
    - Boston HIRA
    - FEMA, Flood Insurance Rate Maps for Essex County, MA, 2013
    - FEMA, Hazards U.S. Multi-Hazard
    - FEMA, Local Mitigation Plan Review Guide, October 2011
    - Fourth National Climate Assessment, 2018
    - Massachusetts Flood Hazard Management Program
    - Massachusetts Office of Coastal Zone Management Shoreline Change Data
    - Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams 2018
    - Massachusetts State Hazard Mitigation Plan, 2013
    - Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data
    - National Weather Service
    - Nevada Seismological Library
    - New England Seismic Network, Boston College Weston Observatory, http://aki.bc.edu/index.htm
    - NOAA National Climatic Data Center, http://www.ncdc.noaa.gov/
    - Northeast Climate Adaptation Science Center
    - Northeast States Emergency Consortium, http://www.nesec.org/
    - Tornado History Project
    - US Census, 2010 and American Community Survey 2019 5-Year Estimates
    - USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis
    - USDA Forest Service, Wildfire Risk to Communities, www.wildfirerisk.org

3. **Review Existing Mitigation** – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted flood plain zoning districts, wetlands protection programs, and other measures as well as enforcing the State building code, which has strong provisions related to hazard resistant building requirements. Many communities have started adopting regulations designed to promote climate resilience. All current municipal mitigation measures must be documented.

4. **Develop Mitigation Strategies** – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Section 7.

5. **Plan Approval & Adoption** – Once a final draft of the plan is complete, it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Section 9 and documentation of plan adoption can be found in Appendix D.

6. **Implement & Update the Plan** – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a five-year basis making preparation for the next plan update an important on-going activity. Section 9 includes more detailed information on plan implementation.

2014 PLAN IMPLEMENTATION & MAINTENANCE

Nahant's 2014 Hazard Mitigation Plan Update contained a risk assessment of identified hazards for the town and mitigation measures to address the risk and vulnerability from these hazards. Since approval of the 2014 Plan by FEMA and local adoption, progress has been made on implementation of the measures. High priority projects that were completed including the repairs of Tudor Beach/Town Wharf Seawall; reconstruction of the Nahant Causeway drainage system; dredging of the Bear Pond tributaries; and purchase of new pumps for emergency water removal.

Nahant also secured funding from FEMA to repair the seawall at Forty Steps Beach, which is anticipating completion in the next two years. Several mitigation projects are also in progress, including floodplain mapping, dredging of Bear Pond tributaries, as well as continuing outreach to enhance coastal emergency preparedness during extreme storm events.

THE LOCAL MULTIPLE HAZARD COMMUNITY PLANNING TEAM

MAPC worked with the local community representatives to organize a Local HMP Team for Nahant. MAPC briefed the local representatives as to the desired composition of that team as well as the need for public participation in the local planning process. This team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The Local HMP Team was tasked to set plan goals, provide information on the hazards that impact the town, existing mitigation measures, and helping to develop new mitigation measures for this plan update. The team membership is listed below.

Antonio Barletta	Town Administrator
Dennis Ball	Director, Emergency Management
Austin Antrim	Chief, Fire Department

Timothy Furlong	Chief, Police Department
Zachary Taylor	Superintendent, DPW
Kristen Kent	Conservation Agent, Conservation Commission
Calvin Hastings	Chairman, Planning Board
Mary Lowe	Administrative Assistant, DPW

Led by the Emergency Management Division, the Director of Emergency Management coordinated and solicited feedback with all entities responsible for regulating and maintaining operations in town. The Nahant's Planning Board and Conservation Commission are the primary entities responsible for regulating development in town. Feedback from the Planning Board and Conservation Commission was assured through the participation of the Planning Board Chairman and Conservation Agent on the Local HMP Team. In addition, MAPC, the state-designated regional planning authority for Nahant, works with all agencies that that regulate development in the region, including the listed municipal entities and state agencies, such as the Department of Transportation and the Department of Conservation and Recreation.

The Local HMP Team met on the following dates: June 10, August 12, and November 9, 2021. The purpose of the meetings was to introduce the Hazard Mitigation planning program, consider climate impacts, review, and update hazard mitigation goals, and to gather information on local hazard mitigation issues and sites or areas related to these. Later meetings focused on verifying information gathered by MAPC staff and discussion of existing mitigation practices, the status of mitigation measures identified in the 2014 HMP Update, and potential new or revised mitigation measures. The agendas for these meetings are included in Appendix A.

PUBLIC MEETINGS & LOCAL STAKEHOLDER INVOLVEMENT

Public participation in the hazard mitigation planning process is important, both for plan development and for later implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding of the concept of hazard mitigation and climate impacts, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the Town hosted two public meetings, one during the planning process and one after a complete draft plan was available for review.

The public had an opportunity to provide input to the Nahant's hazard mitigation planning process during a public meeting held on October 13, 2021, on Zoom. The final draft plan update was presented at a Conservation Commission meeting on December 15, 2021, also on Zoom. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law.. In addition, the draft plan was made available to members of the public for review and feedback submission after the second public meeting presentation.

The following organizations and neighboring municipalities were also invited to review the draft Hazard Mitigation Plan and submit comments to the town:

- Nahant Board of Selectmen
- Nahant Conservation Commission
- Housing Authority
- Health Board
- Council on Aging Board
- Open Space and Recreation Plan Committee
- Watershed Association
- Neighborhood Association
- Nahant Board of Selectmen
- City of Lynn
- Town of Swampscott
- City of Revere
- Town of Winthrop
- Town of Marblehead

See public meeting notices in Appendix C.

PUBLIC COMMENT

At the first public meeting, the Local HMP Team encouraged the public to share their experiences and concerns related to the natural hazards identified. Questions to prompt discussion include:

- What have you experienced at home/in your neighborhood? (Regarding flooding, extreme heat/heatwaves, or extreme storm events, etc.)
- What are your concerns?
- What are your suggestions?

While the Local HMP Team did not receive comments during this public meeting, they received a comment letter from representatives in the Lowlands neighborhood, requesting assurance that identified drainage and flooding issues in the Lowland areas (from previous planning efforts) remain a high priority for the Town to address. These concerned aligned with the Local HMP Team's ongoing discussions during this HMP planning process to date. As such the Local HMP Team spent a significant amount of time at one of its meetings, strategizing mitigation measures to address various vulnerabilities facing the Lowlands neighborhood. No further comments were received at the second public meeting.

CONTINUING PUBLIC PARTICIPATION

Following the adoption of the plan update, the planning team will continue to provide residents, businesses, and other stakeholders the opportunity to learn about the hazard mitigation planning

process and to contribute information that will update the town's understanding of local hazards. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with town and state open meeting laws.

PLANNING TIMELINE

June 10, 2021	Meeting of the Nahant Local Hazard Mitigation team
August 12, 2021	Meeting of the Nahant Local Hazard Mitigation team
October 13, 2021	First Public Meeting held virtually
November 9, 2021	Meeting of the Nahant Local Hazard Mitigation Team
December 15, 2021	Second Public Meeting with the Nahant Conservation Commission
December 27, 2021	Draft Plan Update submitted to MEMA
January 7, 2022	Draft Plan Update submitted to FEMA
February 4, 2022	Notice of Approvable Pending Adoption sent by FEMA
February 18, 2022	Plan Adopted by the Town of Nahant
February 28, 2022	FEMA final approval of the plan for 5 years

POST-APPROVAL IMPLEMANTATION AND PLAN UPDATE TIMELINE

Mid-2023	Conduct Mid-Term Plan Survey on Progress
2024	Seek FEMA grant to prepare next plant update
2025	Begin process to update the plan
2026	Submit Draft 2026 Plan Update to MEMA and FEMA
2026	FEMA approval of 2026 Plan Update

SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Nahant as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. This section also includes a vulnerability assessment that estimates the potential damages that could result from certain large-scale natural hazard events. In order to update Nahant's risk assessment, MAPC gathered the most recently available hazard and land use data and met with Town staff to identify changes in local hazard areas and development trends. MAPC also used FEMA's damage estimation software, HAZUS.

With the adoption of the Hazard Mitigation and Climate Adaptation Plan 2018 (SHMCAP), Massachusetts became the first state to integrate climate projections in a state hazard mitigation plan. Following the state model, the projected impacts of our warming climate on natural hazards are integrated throughout the risk assessment. Key impacts include rising temperatures, which in turn affect precipitation patterns, sea level, and extreme weather.

> *"Global climate is changing rapidly compared to the pace of natural variations in climate that have occurred throughout Earth's history. Global average temperature has increased by about 1.8°F from 1901 to 2016, and observational evidence does not support any credible natural explanations for this amount of warming; instead, the evidence consistently points to human activities, especially emissions of greenhouse or heat-trapping gases, as the dominant cause."*
>
> Fourth National Climate Assessment, 2018 (Chapter 2-1)

CLIMATE CHANGE OBSERVATIONS AND PROJECTIONS

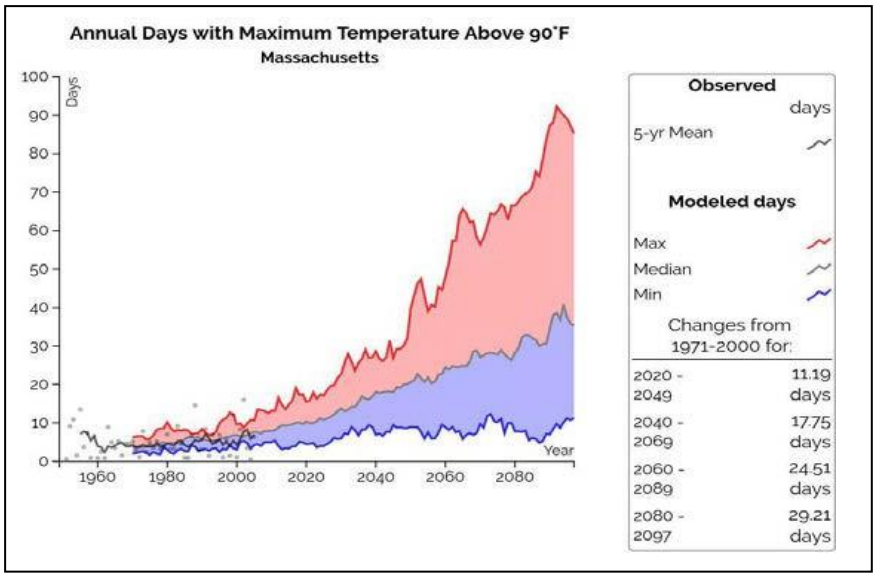
Climate change observations come from a variety of data sources that have measured and recorded changes in recent decades and centuries. Climate change projections, however, predict future climate impacts and, by their nature, cannot be observed or measured. As a result of the inherent uncertainty in predicting future conditions, climate projections are generally expressed as a range of possible impacts.

Temperature

Our climate has always been regulated by gases, including carbon dioxide, methane, and nitrous oxide, that blanket the earth. These gases trap heat that would otherwise be reflected out to space; without them our planet would be too cold to support life. We refer to these gases as "greenhouse gases" (GHGs) for their heat trapping capacity. The combustion of fossil fuels, our primary energy source in the age of industrialization, releases GHGs into the atmosphere. In the past century, human activity associated with industrialization has contributed to a growing concentration of GHGs in our atmosphere.

Records from the Blue Hill Observatory in Milton, MA show that average temperatures (30-year mean) have risen approximately 3 degrees F in the almost 200 years since record keeping began in 1831.

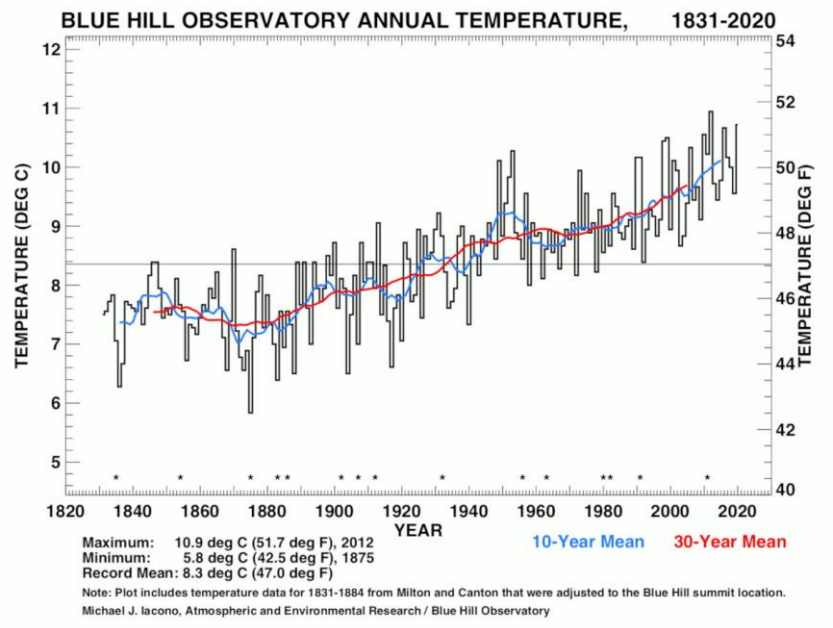
Figure 2: Observed Increase in Temperature



Source: ResilientMA.org

Climate projections include an increase in average temperature and in the number of extreme heat days. Extreme cold day are projected to decrease in number. The Northeast Climate Adaptation Science Center (NECASC) projects average temperatures in Massachusetts will increase by 5 degrees F by mid-century and nearly 7 degrees F by the end of the century. Figure 3 shows the NECASC range of projections for increases in the number of days over 90 degrees annually.

Figure 3: Projected Increase in Annual Days Over 90 Degrees F



Source: Northeast Climate Adaptation Science Center

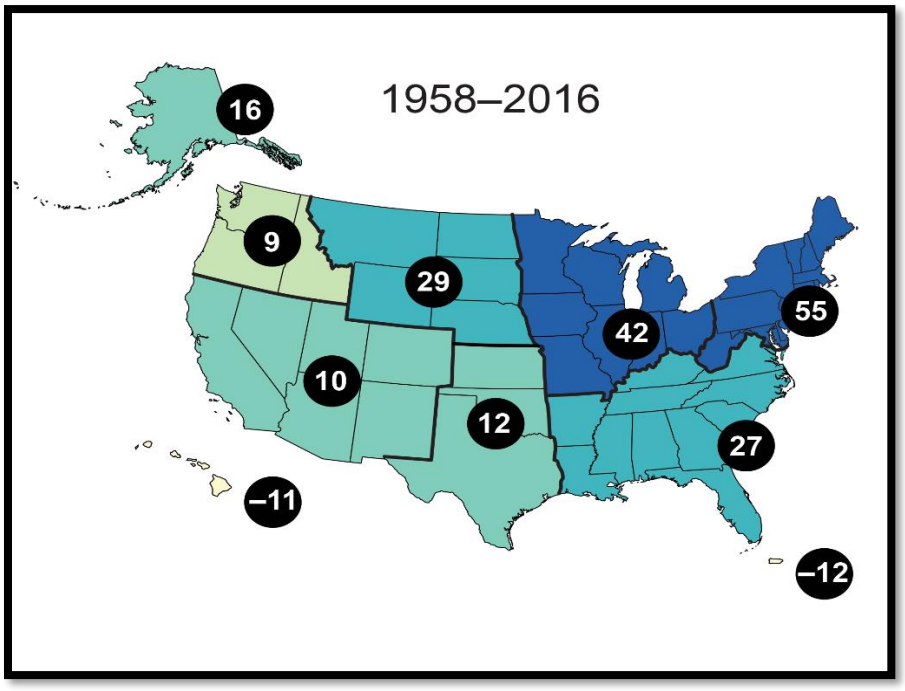
Precipitation Patterns

Annual precipitation in Massachusetts has increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA Climate Adaptation Report, 2011). Moreover, there has been a significant increase in the frequency and intensity of large rain events. For the Northeast US, according to the Fourth National Climate Assessment 2018, in the past sixty years there has been a 55% increase in the amount of annual precipitation that falls in the top 1% of storm events (Figure 4). Changes in precipitation are fueled by warming temperatures which increase evaporation and, therefore, the amount of water vapor in the air.

Total annual precipitation in Massachusetts is projected to increase by 1 to 6 inches by mid-century, and by 1.2 to 7.3 inches by the end of this century (SHMCAP p. 2-22). The Fourth National Climate Assessment predicts that the pattern of increasing frequency and intensity of extreme rain events will continue. By 2070 to 2099, (relative to 1986 to 2015) they project a 30-40% increase in total annual precipitation falling in the heaviest 1% of rain events (Figure 5).

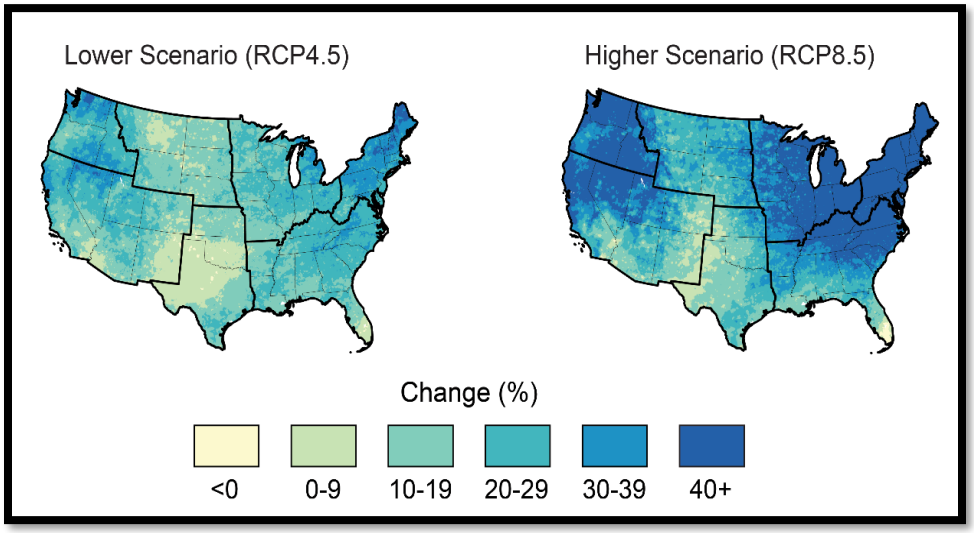
Despite overall increasing precipitation, more frequent and significant summer droughts are also a projected consequence of climate change. This is due to projections that precipitation will increase in winter and spring and decrease slightly in the summer and, a result of earlier snow melt, and higher temperatures that will reduce soil moisture.

Figure 4: Observed Change in Total Annual Precipitation Falling in the Heaviest 1% of Events



Numbers circled in black indicate % change.
Source: Fourth National Climate Assessment, 2018

Figure 5: Projected Change in Total Annual Precipitation Falling in the Heaviest of 1% of Events for 2070-2099

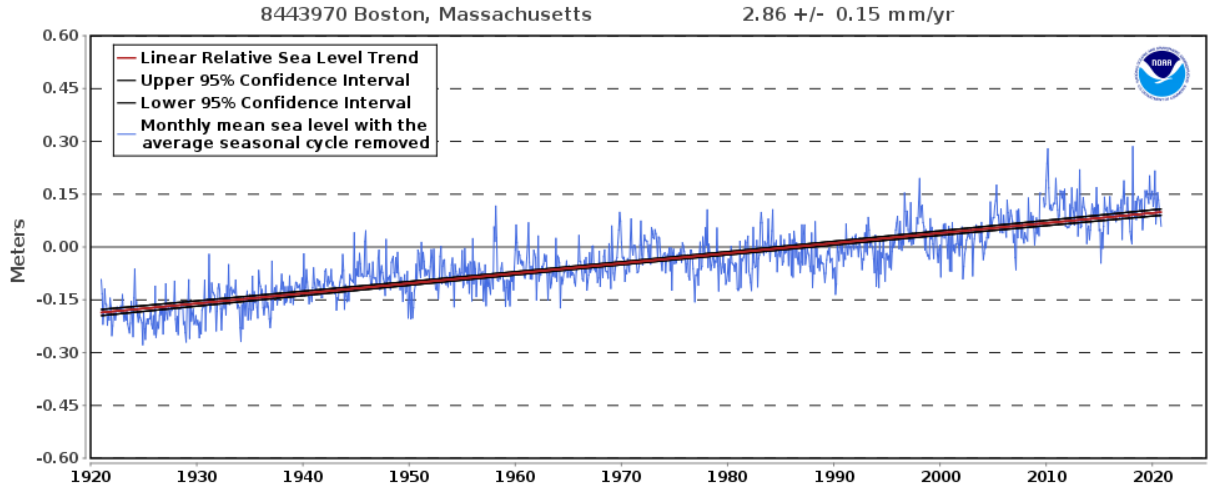


Source: Fourth National Climate Assessment, 2018

Sea Level Rise

Records from the Boston Tide Station show nearly one foot of sea level rise in the past century (Figure 6). Warming temperatures contribute to sea level rise in two ways. First, warm water expands to take up more space. Second, rising temperatures are melting land-based ice which enters the oceans as melt water. A third, quite minor, contributor to sea level rise in New England is not related to climate change. New England is still experiencing a small amount of land subsidence (drop in elevation) in response to the last glacial period.

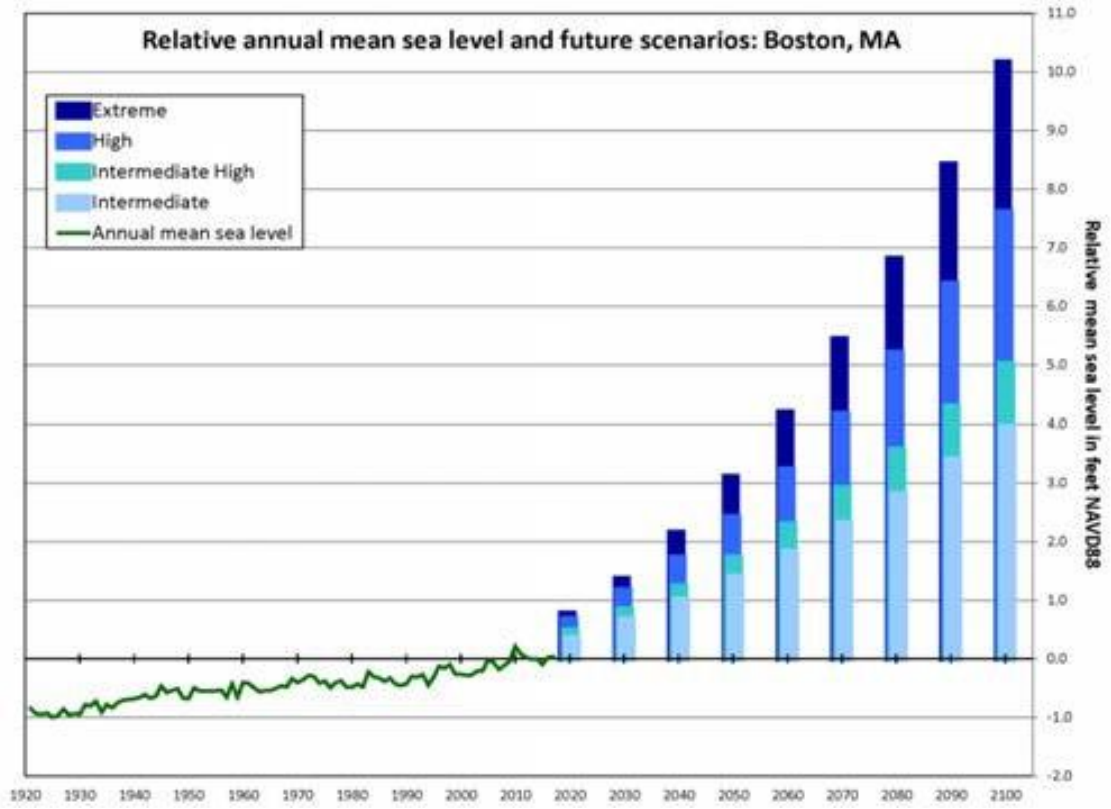
Figure 6: Observed Increase in Sea Level Rise



Source: NOAA

Projections of sea level rise through 2100 vary significantly depending on future greenhouse gas emissions and melting of land-based glaciers. Currently sea level is rising at an increasing rate. Figure 7 shows the recent rate of sea level rise, and a range of sea level rise scenarios. Projections for 2100 range from 4 feet to 10 feet. With ten feet representing the most extreme scenario. For 2050, the projections range approximately 1.5 to 3 feet.

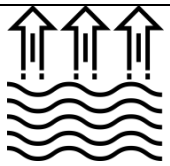
Figure 7: Recent and Projected Increase in Sea Level Rise



Source: SHMCAP, 2018

Following the outline of 2018 SHMCAP, this local hazard mitigation plan organizes consideration of natural hazards based on their relationship to projected climate changes. Table 5 below, from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

Table 5: Climate Change and Natural Hazards

Primary Climate Change Interaction	Natural Hazard	Other Climate Change Interactions	Representative Climate Change Impacts
 **Changes in Precipitation**	Inland Flooding	Extreme Weather	Flash flooding, urban flooding, drainage system impacts (natural and human-made), lack of groundwater recharge, impacts to drinking water supply, public health impacts from mold and worsened indoor air quality, vector-borne diseases from stagnant water, episodic drought, changes in snow-rain ratios, changes in extent and duration of snow cover, degradation of stream channels and wetland
	Drought	Rising Temperatures, Extreme Weather	
	Landslide	Rising Temperatures, Extreme Weather	
 **Sea Level Rise**	Coastal Flooding	Extreme Weather	Increase in tidal and coastal floods, storm surge, coastal erosion, marsh migration, inundation of coastal and marine ecosystems, loss, and subsidence of wetlands
	Coastal Erosion	Changes in Precipitation, Extreme Precipitation	
	Tsunami	Rising Temperatures	
 **Rising Temperatures**	Average/Extreme Temperatures	N/A	Shifting in seasons (longer summer, early spring, including earlier timing of spring peak flow), increase in length of growing season, increase of invasive species, ecosystem stress, energy brownouts from higher energy demands, more intense heat waves, public health impacts from high heat exposure and poor outdoor air quality, drying of streams and wetlands, eutrophication of lakes and ponds
	Wildfires	Changes in Precipitation	
	Invasive Species	Changes in Precipitation, Extreme Weather	
 **Extreme Weather**	Hurricanes/Tropical Storms	Rising Temperatures, Changes in Precipitation	Increase in frequency and intensity of extreme weather events, resulting in greater damage to natural resources, property, and infrastructure, as well as increased potential for loss of life
	Severe Winter Storm / Nor'easter	Rising Temperatures, Changes in Precipitation	
	Tornadoes	Rising Temperatures, Changes in Precipitation	
	Other Severe Weather (Including Strong Wind and Extreme Precipitation)	Rising Temperatures, Changes in Precipitation	
Non-Climate-Influenced Hazards	Earthquake	Not Applicable	There is no established correlation between climate change and this hazard

OVERVIEW OF HAZARDS AND IMPACTS

Table 6 summarizes the frequency and severity of hazard risks for Massachusetts and the Town of Nahant. The Massachusetts frequency assessment is based on data in the SHMCAP. The Nahant frequency assessment reflects data from the National Climatic Data Center (NOAA) for Essex County*, from the SHMCAP** and, from the local Hazard Mitigation Team***.

Table 6: Hazards Risk Summary

Hazard	Frequency	
	Massachusetts	Nahant
Inland Flooding	43 floods per year	3.3 floods per year*
Drought	2% chance of drought warning in any given month	2% chance of drought warning in any given month**
Landslides	1 notable event every other year	None recorded***
Coastal Flooding	6 floods per year	2-3 floods per year*
Coastal Erosion	Highly variable (frequency can't be measured)	Periodic in limited locations***
Tsunami	1in 39 years	1 in 39 years**
Extreme Temperatures	2 heat events and 1.5 cold events yearly	1 heat event every 2.5 years and 1 cold event every five years*
Brush Fires	One notable event per year	Periodic in limited locations***
Invasives	Increasing	Increasing***
Hurricane/Tropical Storm	One storm every two years	1 tropical storm in 1888
Severe Winter Storms/Nor'easters	One notable winter storm and one nor'easter per year	2 per year*
Tornadoes	1.7 per year	None recorded
Other Severe Weather (Thunderstorms/High Winds)	20-30 thunderstorms annually; 43.5 high wind events annually	3 thunderstorms per year*
Earthquake	10 - 15% chance of Mag 5 in a 10-year period	10 - 15% chance of Mag 5 in a 10-year period ***

CHANGING PRECIPITATION PATTERNS

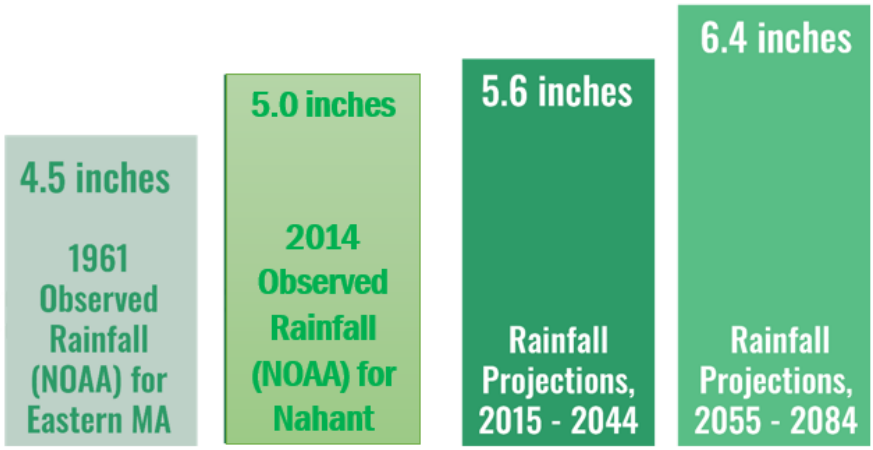
INLAND FLOODING

Inland flooding can be associated with overflowing rivers and streams, stormwater flooding associated with impervious surfaces and stormwater infrastructure, and in more rare cases ice jams, ground failures (erosion), and in some communities beaver dams. Inland flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Nor'easters can occur at any time of the year, but they are most common in winter. Hurricanes are most common in the summer and early fall. Large rainstorms or snowfalls can also lead to inland flooding. Climate change has the potential to exacerbate these issues over time due to increasing extreme rainfall events. Increase in average annual rainfall may also lead to more incidents of basement flooding caused by high seasonal groundwater levels.

The March 2010 rainstorms fit the profile of a type of event expected to increase in frequency as the climate warms. That is, significant precipitation, falling in late winter as rain rather than snow, on ground saturated with snow melt, and while vegetation is still dormant. The Blue Hill Observatory in Milton, MA recorded 17.7 inches of rain from three storms in the 19 days from March 13-31. The March 2010 storms were a federally declared disaster making federal assistance available to residents who did not carry flood insurance.

Precipitation frequency estimates, which are used to derive stormwater design standards, were published in 1961 by the U.S. Commerce Department in a document known as TP-40 (Technical Paper 40). The 10-year, 24-hour storm for eastern Massachusetts was calculated as a 4.5-inch event. Recently the National Oceanic and Atmospheric Administration published updated estimates (NOAA Atlas 14), which increased this design storm by 0.6 inches to 5.14 inches for eastern Massachusetts. In the future, based on projections developed for the City of Cambridge, the region will likely experience more frequent and intense precipitation events, including an increase in the standard "design storm" from historic levels of 4.5 inches to 6.4 inches by the late 21st century (Figure 8). According to data on ResilientMA.org, by mid- to late century, the region can anticipate 9-10 days with precipitation events with greater than one inch of rain, and an increase in total annual precipitation from 46 to 50 inches.

Figure 8: Design Storm Trends and Projections for a 10-year, 24-hour Storm



Source: NOAA; Cambridge Climate Vulnerability Assessment, 2017.

Flooding was the most prevalent serious natural hazard identified by local officials in Nahant. The Town of Nahant is subject to two kinds of flooding: coastal flooding (discussed further under Sea Level Rise) where wind and tide leads to flooding along the shore and tidal waterways; and localized, inland flooding where the rate of precipitation or amount of water overwhelms the capacity of natural and structured drainage systems to convey water causing it to overflow the system. Inland flooding can be significant in various areas across Nahant.

Significant historic flood events in the region (that also impacted Nahant) included:

- March 1968
- The Blizzard of 1978
- January 1979
- April 1987
- October 1991 ("The Perfect Storm")
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- March 2013
- January 2018
- March 2018

The best available local data on previous flooding events are for Essex County through the National Climatic Data Center. Between 2006 and 2020, Essex County, which includes the Town of Nahant, experienced 40 flood events (see Table 7). There were 2 deaths and 3 injuries reported and the total property damage in the county was over $20.6 million dollars. The March 2010 storms account for $13.1 million of those total damages from 2010 to 2020.

Table 7: Essex County Flood Events, 2006-2020

Date	Deaths	Injuries	Property Damage ($)
5/13/2006	**2**	0	7.00M
07/11/2006	0	0	10.00K
07/28/2006	0	0	20.00K
03/02/2007	0	0	20.00K
04/16/2007	0	0	45.00K
02/13/2008	0	0	30.00K
08/08/2008	0	0	25.00K
09/06/2008	0	0	5.00K
03/14/2010	0	**1**	9.800M
03/30/2010	0	**2**	3.270M
04/01/2010	0	0	0.00K
08/05/2010	0	0	7.00K
08/25/2010	0	0	0.00K
10/04/2011	0	0	305.00K

Date	Deaths	Injuries	Property Damage ($)
06/23/2012	0	0	0.00K
08/10/2012	0	0	0.00K
06/24/2013	0	0	5.00K
07/01/2013	0	0	0.00K
07/27/2014	0	0	0.00K
10/23/2014	0	0	30.00K
12/09/2014	0	0	0.00K
08/18/2015	0	0	0.00K
09/30/2015	0	0	0.00K
06/29/2016	0	0	0.00K
04/06/2017	0	0	0.00K
06/27/2017	0	0	2.00K
07/08/2017	0	0	0.00K
07/18/2017	0	0	0.00K
09/06/2017	0	0	0.00K
09/15/2017	0	0	10.00K
09/30/2017	0	0	4.00K
10/25/2017	0	0	0.00K
01/13/2018	0	0	5.00K
08/11/2018	0	0	10.00K
11/03/2018	0	0	0.00K
04/15/2019	0	0	0.00K
07/31/2019	0	0	3.00K
09/02/2019	0	0	10.50K
7/13/20	0	0	1.00K
7/23/20	0	0	0.00K
9/10/20	0	0	1.00K
Total	**2**	**3**	**20.62 M**

Source: NOAA, National Climatic Data Center

ICE JAMS

Ice jams occur in cold weather when normally flowing water begins to freeze effectively damming the waterway and causing localized flooding in the area. Flooding may also occur when ice jams break up and ice may pile up at culverts or around bridges. There is no recent history of ice jams leading to flooding in Nahant and Town staff did not identify this hazard as a critical issue for the town.

DAM FAILURE OR OVERTOPPING

Dams can fail because of structural problems or age, independent of any storm event. Earthquakes can be a cause of dam failure by causing structural damage. Dams can also fail structurally because of flooding arising from a storm, or they can overspill due to flooding. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the path of the dam's floodwaters. A concern for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight. In addition, some dams have not been properly maintained. The increasing intensity of precipitation is the primary climate concern related to dams, as they were most likely designed based on historic weather patterns. The SHMCAP indicates that changing precipitation patterns may increase the likelihood of overflow events. Dam failure is a highly infrequent occurrence, but a severe incident could result in loss of lives and significant property damage. According to the Association of State Dam Safety Officials, three dams have failed in Massachusetts since 1984, one of which resulted in a death.

DCR Dam Hazard Classification

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

There are no dams located within Nahant. Nahant is a located on a peninsula, with no river or stream connection to another community. It is therefore not impacted by an up or downstream dam failure in another community.

DROUGHT

Drought is a temporary irregularity in precipitation and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought is a period characterized by long durations of below normal precipitation. Drought conditions occur in virtually all climatic zones, yet its characteristics vary significantly from one region to another since it is relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

Five levels of drought have been developed to characterize drought severity: Normal, Advisory, Watch, Warning, and Emergency. These drought levels are based on the conditions of natural resources and are intended to provide information on the current status of water resources. The

levels provide a basic framework from which to take actions to assess, communicate, and respond to drought conditions.

As drought tends to be a regional natural hazard, Nahant does not collect local data on drought conditions. Drought is, however, still considered a town-wide hazard for Nahant. This plan references state data as the best available data for drought. The SHMCAP using data collected since 1850, calculates that statewide there is a 1% chance of being in a drought emergency in any given month. For drought warning and watch levels, the chance is 2% and 8% respectively in any given month (Table 8).

Table 8: Frequency of Massachusetts Drought Levels

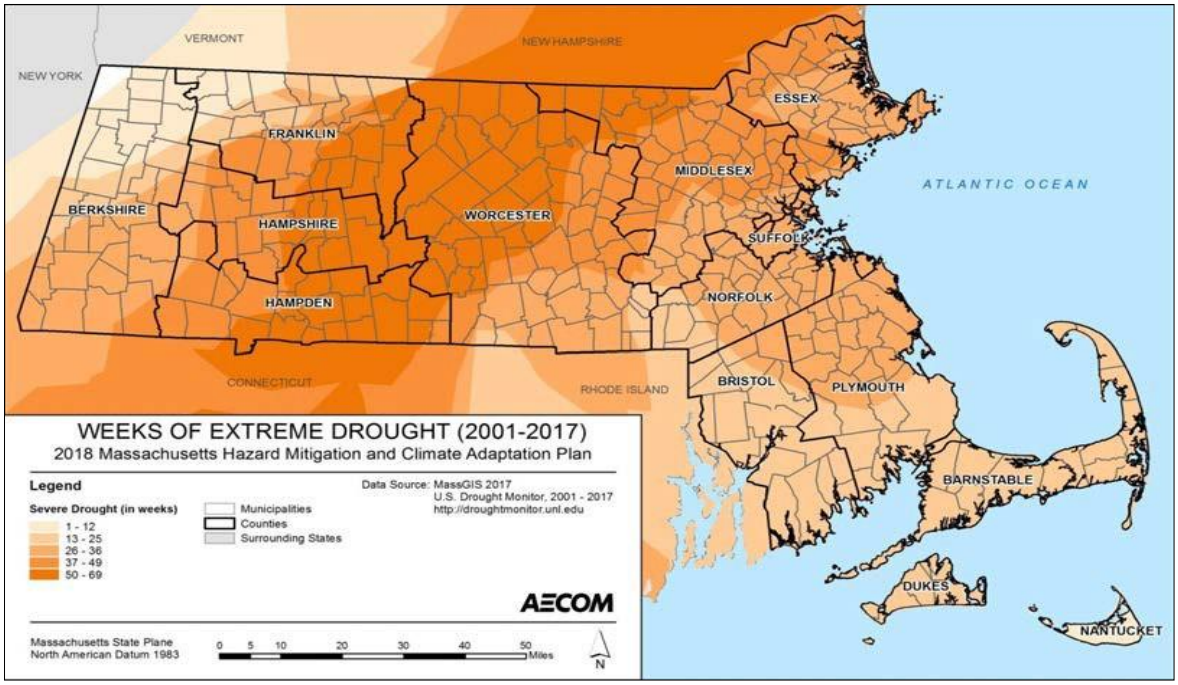
Drought Level	Frequency Since 1850	Probability of Occurrence in a Given Month
Drought Emergency	5 occurrences	1% chance
Drought Warning	5 occurrences	2% chance
Drought Watch	46 occurrences	8% chance

Source: SHMCAP

Drought emergencies have been reached infrequently, with five events occurring between 1850 and 2012: 1883, 1911, 1941, 1957, and 1965 to 1966. Due to its long duration, the drought from 1965 to 1966 is viewed as the most severe drought to have occurred in Massachusetts in modern times. The drought that extended from July 2016 to April 2017 reached the Drought Warning level. Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture, and the potential for forest fires.

The U.S. Drought Monitor characterizes droughts as moderate, severe, extreme, or exceptional. Severe drought is characterized by likely crop and pasture losses, water shortages, and water restrictions. As shown in Figure 9, Nahant experienced between 13 and 25 weeks of severe drought between 2001 and 2017.

Figure 9: Weeks of Severe Drought (2001-2017)



Source: SHMCAP

Droughts are projected to increase in frequency and intensity in the summer and fall as weather patterns change. Drought impacts can include reduced groundwater and surface water levels, affecting water quality and quantity, streamflow, and wetlands levels, and negatively impacting aquatic organisms that rely on riverine and wetland habitats. Drought also increases stress on plant communities, weakening trees, and increasing the likelihood of forest and brush fires. Potential damages of a severe drought include increased risk of wildfires. Extended drought could also cause losses of landscaped areas if outdoor watering is restricted for a long period, impacts to local agriculture, and potential loss of business revenues if water supplies were severely restricted for a prolonged period. Economic sectors impacted could potentially include commercial water users, recreation facilities, agriculture, landscaping, and forestry.

LANDSLIDES

According to the U.S. Geological Survey, "The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors." Among the contributing factors are erosion by rivers or ocean waves over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquake created stresses that make weak slopes fail; excess weight from accumulation of rain or snow; and stockpiling of rock or ore from waste piles or man-made structures. In Massachusetts, according to the SHMCAP, the most common cause of landslides are geologic conditions combined with steep slopes and/or heavy rains. Landslides associated with heavy rains typically occur on steep slopes with permeable soils underlain by till or bedrock.

There is no universally accepted measure of landslide extent, but it has been represented as a measure of destructiveness. Table 9 summarizes the estimated intensity for a range of landslides.

Table 9: Landslide Volume and Velocity

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

Source: A Geomorphological Approach to the Estimation of Landslide Hazards and Risks in Umbria, Central Italy, M. Cardinali et al, 2002

Landslides can result from human activities that destabilize an area or can occur as a secondary impact from another natural hazard, such as flooding. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies. Typically, a landslide occurs when the condition of a slope changes from stable to unstable. Natural precipitation such as heavy snow accumulation, torrential rain, and run-off may saturate soil, creating instability enough to contribute to a landslide. More frequent extreme rain events may increase the chance of landslides as saturated soils are conducive to landslides. Drought may also increase the likelihood of landslides if loss of vegetation decreases soil stability. The SHMCAP, utilizing data from the MA Department of Transportation from 1986 to 2006 to estimates that, on average, roughly one to three known landslides have occurred each year. A slope stability map published by the MA Geological Survey and UMass-Amherst indicates that the most significant risk of landslide is in western Massachusetts. According to the SHMCAP, factors that influence landslide severity include soil properties, topographic position and slope, and historical incidence.

Landslides are considered a town-wide hazard in Nahant. Portions of Little Nahant and the Causeway areas have been classified as having a low risk for landslides while the rest of Nahant is considered to be at moderate risk. There are no recorded instances of landslides having occurred in the Town of Nahant. The town has not made significant changes in regard to landslide hazard mitigation plan since the 2014 Plan was adopted but continues to enforce the MA State Building Code to as its primary source of landslide hazard mitigation.

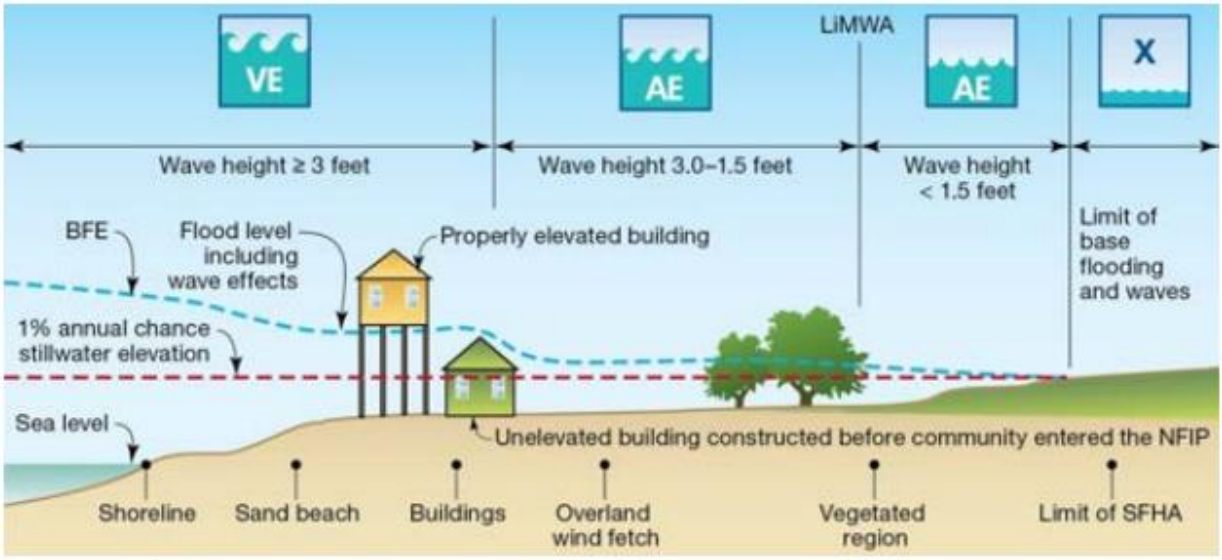
SEA LEVEL RISE

COASTAL FLOODING

Coastal flooding is most often associated with severe coastal storms that, through the combination of winds and tides, drive tidal waters to higher levels than normally experienced, leading to the inundation of low-lying land areas and the overtopping of sea walls. In low-lying areas coastal flooding can also be associated with routine tidal flooding or higher astronomic tides. Fueled by the warming climate, coastal flooding will become more frequent and severe due to the combination of sea level rise and more frequent and intense storms. Another significant impact will be more frequent and deeper flooding in the locations already subject to coastal flooding.

The extent of coastal flooding is identified by Special Flood Hazard Areas, as demonstrated in Figure 10 below.

Figure 10: FEMA Flood Zones



Source: SHMCAP

Nahant is essentially an island with a road connecting it to City of Lynn. Coastal flooding is identified as a town-wide hazard. Since the Town is an island, it has had previous experience with sea damage, and is thus more prepared than the surrounding communities. The greatest danger to people living here is being cut off from the mainland. During the case of a large floods or storms the Nahant Causeway which connects Nahant to Lynn would be underwater. If someone needed to get back to the mainland quickly, this may be a problem, however the overall population would remain above the flood surge.

Local data for previous coastal flooding occurrences are not collected by the Town of Nahant. The best available local data is for Essex County through the National Climatic Data Center. As noted in the SHMCAP, Eastern Essex County, which includes the Town of Nahant, reported 27 coastal flooding events between 2006 and 2017. Essex County also experienced the most FEMA

flood disaster declarations in the state between 1954 and 2017; total property damage assessed at approximately $7 million.

Map 9 in Appendix B identifies areas predicted to be inundated at mean high water for sea level rise scenarios of one, three, six, and ten feet. It should be noted that the maps reflect static sea level rise and do not take into account storm surge. Map 11 shows the projected future extent of flooding during the 1% storm with 1.2, 2.4, and 4.2 feet of sea level rise. Under the current FEMA FIRM, approximately 35% to 40% of identified critical buildings and facilities in Nahant are located in the Special Flood Hazard Area. With 1.2 feet of sea level rise 40% of these are in the 1% chance locations, with 2.4 feet of sea level rise the number increases to 50% and with 4.2 feet of sea level rise to 70%.

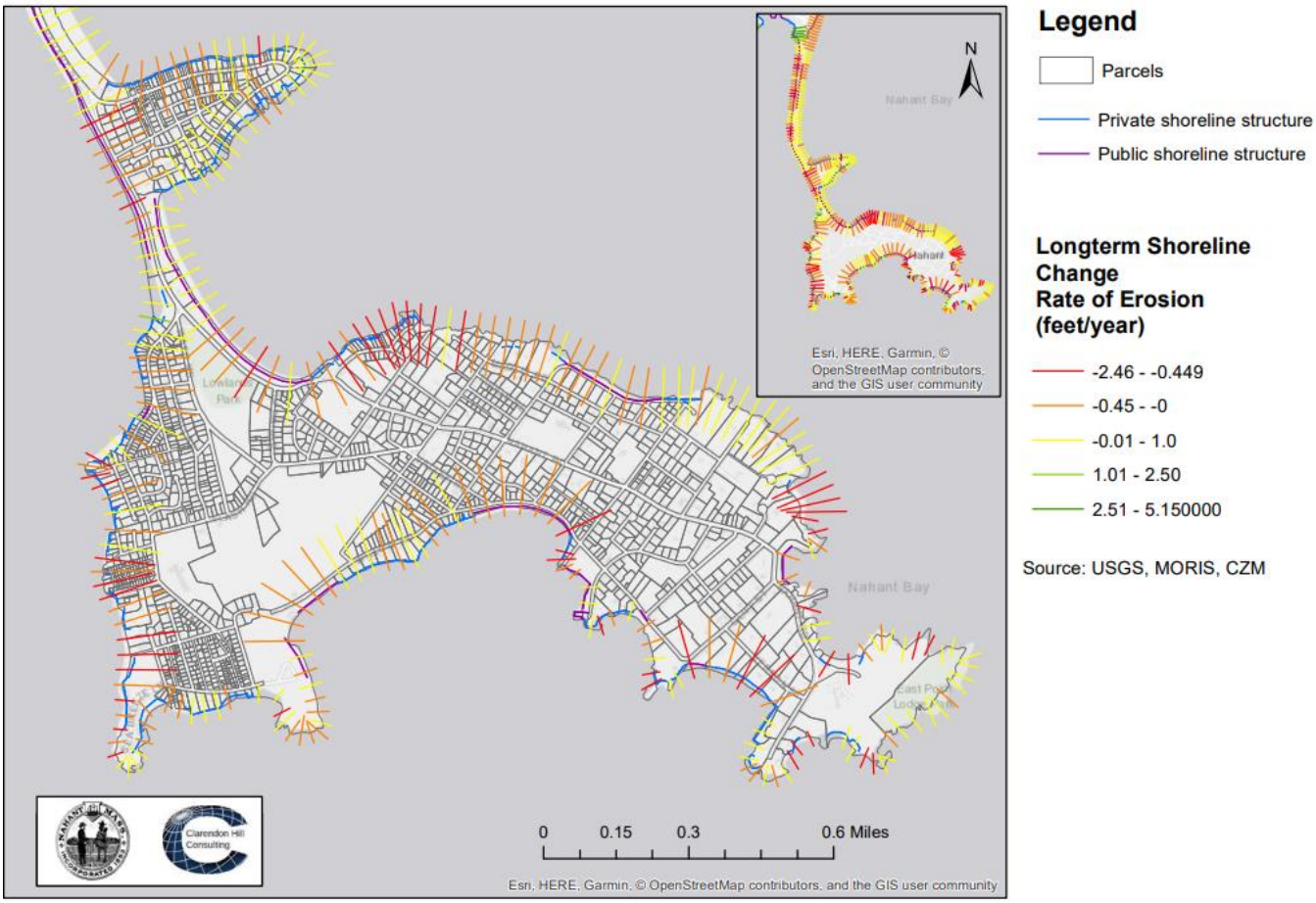
COASTAL EROSION

Coastal shorelines change constantly in response to storms, seasons, sea level, and human alterations. Coastal erosion is measured as a rate of change over time. According to the SHMCAP frequency of erosion cannot be measured. Risings seas and more frequent and intense storms will tend to increase erosion, although some areas may actually accrete material. Erosion may be exacerbated by efforts to protect shorelines as when engineered hard structures reduce sediment sources to downdrift areas or increase erosion seaward of structures due to interaction with waves. The severity of erosion is related to such factors as exposure to high energy waves, sediment size, sea level rise, near-shore bathymetry, and human interference with sediment supply. Massachusetts Coastal Zone Management in cooperation with the U.S. Geological Survey (USGS) provides shoreline change data for the Massachusetts coast. They provide long-term (1800's – 2014) and short-term (1970-2014) data. Figure 11 demonstrates long-term shoreline change projection for Nahant.

The Local HMP Team also identified three locations most vulnerable to coastal erosion: Forty Steps, Short Beach, and the north end of Ocean Street.

Shoreline change has also been identified as top concern in Nahant. Based on participant feedback during the Community Resilience Building Workshop, as part of Municipal Vulnerability Preparedness (MVP) planning program in 2019, coastal protection infrastructure in Nahant, such as armored walls and seawalls, have been damaged to a large extent during the winter 2018 storms.

Figure 11: Long-term Shoreline Changes in Nahant



Source: USGS; MORIS; CZM. Map created by Clarendon Hill Consulting for MVP Planning Workshop in 2019.

TSUNAMI

A tsunami is a surge of water typically caused by an offshore earthquake. Other cause may include volcanos and landslides. Tsunamis can cause wave heights of 100 feet or more. According to the SHMCAP, Massachusetts has never experienced a significant tsunami, although two tsunamis have occurred with no deaths or damages recorded. Damage from a tsunami could be very significant, but it is a low likelihood event, having occurred approximately once every 39 years along the entire east coast. No tsunami has impacted Massachusetts since 1950. According to the SHMCAP, collapse of glaciers resulting from our warming climate could cause landslides that could generate tsunamis more powerful than those caused by earthquakes. The severity of a tsunami is related to its wave height at the shore, and the extent of runup. Areas most at risk would be the locations that currently experience flooding during storm tides.

The extent of damage and impact from tsunami depends upon the source and severity of onset on the tide cycle. As such, all of Nahant would be considered vulnerable to coastal inundation from tsunami. While there have been no recorded instances of tsunamis in Essex County or Nahant to date, tsunamis are a town-wide hazard.

LOCALLY IDENTIFIED AREAS OF FLOODING

Inland and coastal flooding in Nahant often occur together, given Nahant's size and geographic location. According to participants at the 2019 MVP Planning workshop, in low-laying areas in Nahant, notably the Lowlands and Furbush areas, existing topography, geomorphology and changed drainage pattern hinder drainage. Especially during extreme events natural drainage cannot occur sufficiently nor are existing sewer systems able to handle the total precipitation capacity in a timely fashion when wind- and tide-driven coastal waters push into already flooded low-lying areas.

Information on potential flood hazard areas was taken from two sources. The first is the National Flood Insurance Rate Maps (FIRM). The FIRM flood zones are shown on Map 3 in Appendix B. The "Locally Identified Areas of Flooding" described below were identified by Town staff as areas where flooding is known to occur. These areas do not necessarily coincide with the flood zones on the FIRMs. Flood sources include inadequate drainage systems, high groundwater, coastal storms, or other local conditions that may not be within a Special Flood Hazard Area. The numbers listed below in Table 10 correspond to the numbers on Map 8, "Local Hazard Areas" in Appendix B.

Table 10: Locally Identified Areas of Flooding

Map ID	Name	Description
1	Nahant Causeway	Coastal flooding
2	Nahant Road	Coastal flooding between Little and Castle Roads
3	Basspoint Road	Coastal flooding; from Gardner to Trimountain Roads
4	Willow Road	Coastal flooding; from Oceanview to Winter Streets
5	Willow Road at Furbush Road	Coastal Flooding
6	Lowlands Area	Inland flooding, drainage issue
8	Furbush Road	Inland flooding, drainage issue

REPETITIVE LOSS STRUCTURES

As defined by FEMA, a repetitive loss property is any property which the National Flood Insurance Program (NFIP) has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978. As of February 28, 2014, there were 46 repetitive loss structures in Nahant, an increase from the 41 structures identified in the 2005 plan. Nahant's repetitive loss properties consist of 30 single-family residential structures, with six 2-4 family structures, six other residential structures and four non-residential structures. The properties are shown on Map 3 in Appendix B. Table 11 summarizes the number and location of repetitive loss structures located within Nahant and the number of losses associated with them.

For more information on repetitive losses, visit:
https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt and
https://www.fema.gov/repetitive-flood-claims-grant-program-fact-sheet.

Table 11: Summary of Repetitive Losses and Claims (2014)

	A, AE, AO, AH Zones	VE Zone	X Zones	Total
Number of Properties	1	1	2	4
Number of Losses	14	23	108	145

Source: FEMA Repetitive Loss data

** Latest data about Repetitive Losses and Claims for Nahant is pending FEMA's release. MAPC and the Local HMP Team has initially submitted a request for information from FEMA in June 2021.*

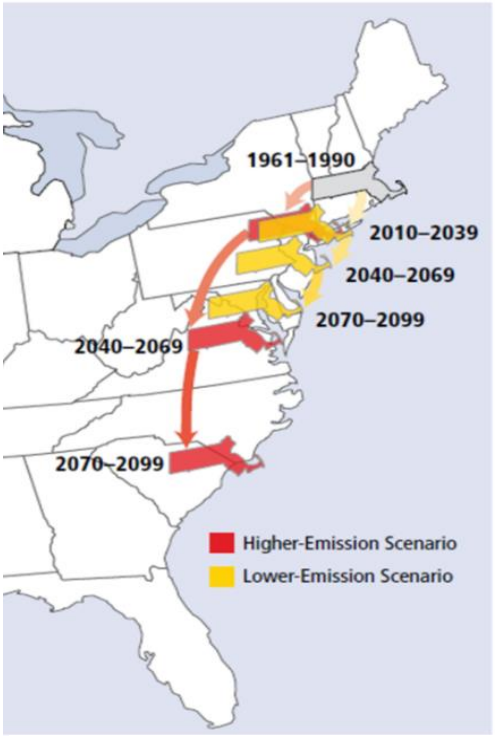
RISING TEMPERATURES

AVERAGE AND EXTREME TEMPERATURES

Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is a long stretch of excessively hot or cold weather. Nahant has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those that are far outside of the normal seasonal ranges for Massachusetts.

Average temperatures in Massachusetts are projected to increase by 3.8 to 10.8 degrees by the end of the century (SHMCAP). Over time our climate will become more similar to areas south of New England (see Figure 12). Impacts on natural resources include a longer growing season and northern migration of plants and animals, including invasive species. The SHMCAP identifies ecosystems that are expected to be particularly vulnerable to warming temperatures. These include cold-water fisheries, vernal pools, spruce-fir forests, northern hardwood forests (Maple, Beach, Birch), Hemlock forests, and urban forests (due to heat island impacts).

Figure 12: Temperature Change Scenarios



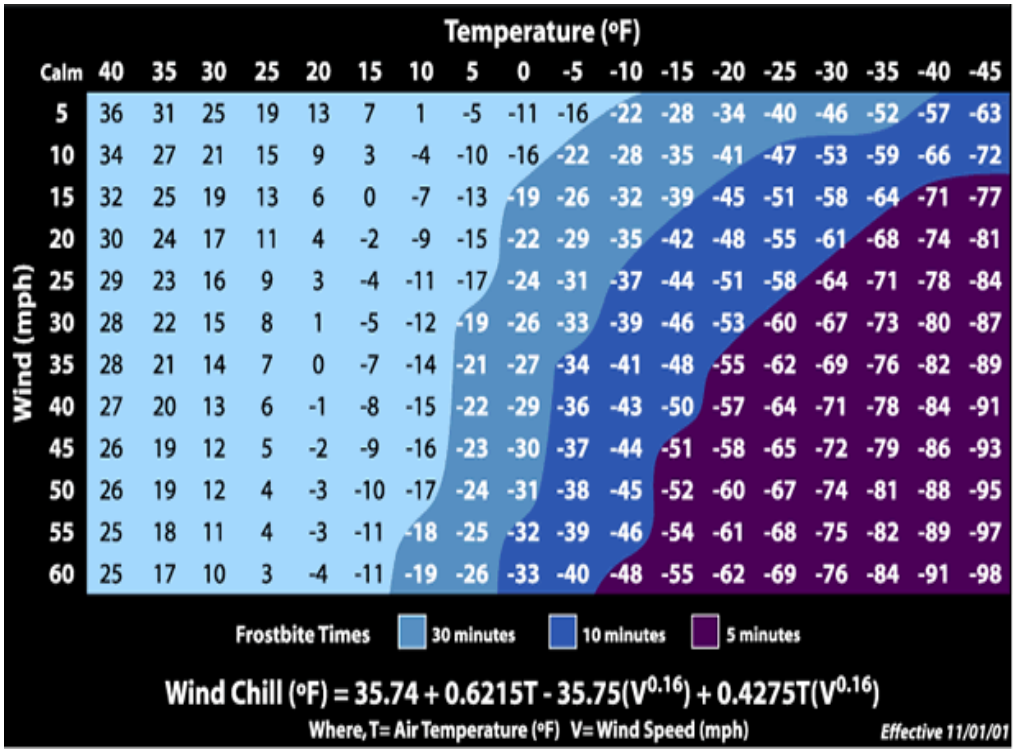
Source: Union of Concerned Scientists (2007)

EXTREME COLD

The severity of extreme cold temperature is typically measured using the Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed. The

index is provided in Figure 13. A Wind Chill warning is issued when the Wind Chill Index is forecast to fall below -25 degrees F for at least 3 hours. Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, those who are stranded, or those who live in homes that are poorly insulated or without heat.

Figure 13 Wind Chill Temperature Index and Frostbite Risk



Source: National Weather Service

The Town of Nahant does not collect data for previous occurrences of extreme cold. The best available local data are for Essex County, through the National Climatic Data Center (NCDC). There have been three extreme cold events in the past ten years, which caused no deaths, no injuries, or property damage. Extreme cold events are predicted to decrease in the future, while extreme heat days as well as average temperatures are projected to increase. Extreme cold is a town-wide hazard for Nahant.

Table 12: Norfolk County Extreme Cold and Wind Chill Occurrences 2010-2020

Date	Deaths	Injuries	Damages
2/15/2015	0	0	0
2/16/2015	0	0	0
2/13/2016	0	0	0
TOTAL	**0**	**0**	**0**

Source: NOAA, National Climatic Data Center

EXTREME HEAT

A heat wave in Massachusetts is defined as three or more consecutive days above 90°F. Another measure used for identifying extreme heat events relies on the Heat Index. According to the National Weather Service (NWS), the Heat Index is a measure of how hot it really feels relative humidity is factored in with the actual air temperature. The NWS issues an advisory when the heat index (Figure 14) is forecast to exceed 100°F for two or more hours; an excessive heat advisory is issued if the forecast predicts the temperature will rise above 105°F.

Figure 14: Heat Index Chart

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

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

Source: National Weather Service

The best available local data on past occurrences of extreme heat in Nahant are for Essex County, through the National Climatic Data Center. In the past ten years there have been three excessive heat events recorded, with no reported death, no injuries, and no property damage (see Table 13).

Table 13: Essex County Extreme Heat Occurrences 2010-2020

Date	Deaths	Injuries	Damage
7/22/2011	0	0	0
7/1/2018	0	0	0
7/3/2018	0	0	0
TOTAL	**0**	**0**	**0**

Source: NOAA, National Climatic Data Center

The projected increase in extreme heat and heat waves is the source of one of the key health concerns related to climate change. Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. People who perform manual labor, particularly those who work outdoors, are at increased risk for heat-related illnesses. Prolonged heat exposure and the poor air quality and high humidity that often accompany heat waves can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses.

Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions; in Nahant, 24 percent of the population is over age 65. People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage.

Due to what is termed the "heat island effect", areas with less shade and more dark surfaces (pavement and roofs) will experience even hotter temperatures; these surfaces absorb heat during the day and release it in the evening, keeping nighttime temperatures warmer as well. Map 10 in Appendix B displays areas that are among the hottest 5% of land in the MAPC region based on land surface temperature derived from satellite imagery on July 13, 2016, when the high temperature at Logan Airport was 92°F. Nahant does not have any hot spots.

WILDFIRE

A wildfire is a non-structure fire occurring in a forested, shrub or grassland areas. In the Boston Metro region these fires rarely grow to the size of a wildfire, as seen more typically in the western U.S. A more likely occurrence is brush fires that typically burn no more than the underbrush of a forested area. There are three different classes of wildfires:

- Surface fires are the most common type and burn along the floor of a forest, moving slowly and killing or damaging trees
- Ground fires are usually started by lightning and burn on or below the forest floor
- Crown fires spread rapidly by wind, jumping along the tops of trees

A wildfire differs greatly from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to unexpectedly change direction, and its ability to jump gaps such as roads, rivers, and fire breaks. Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat. As the climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation

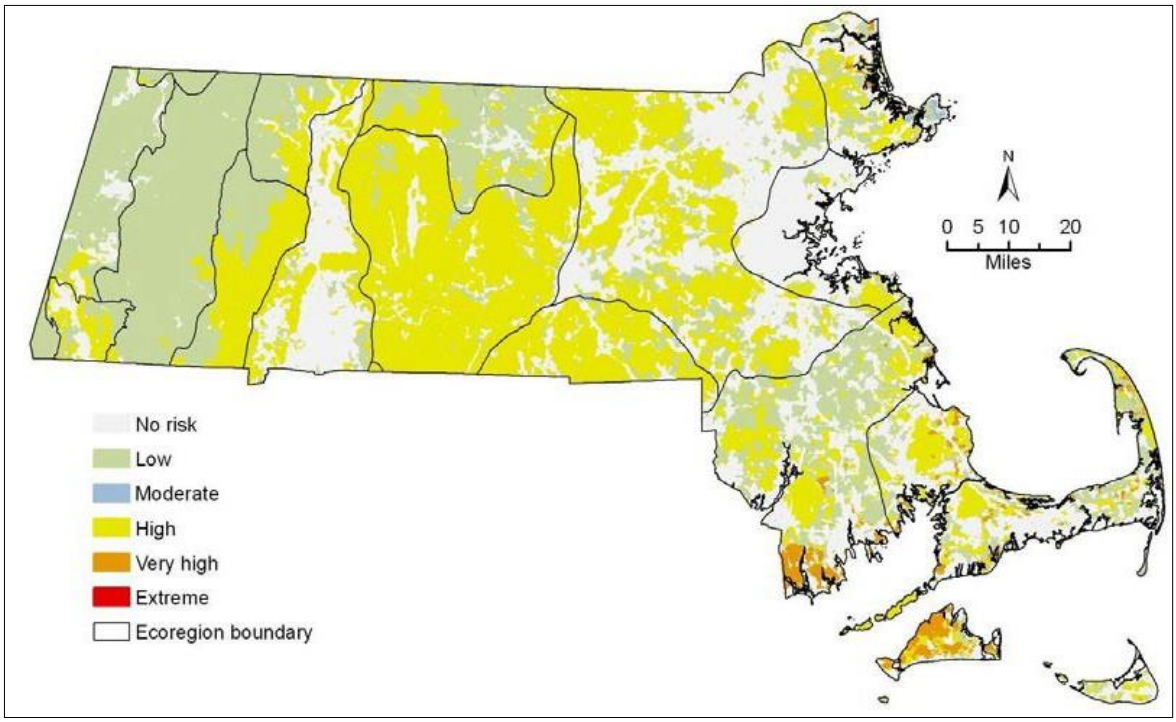
dries out and becomes more flammable. The National Wildfire Coordinating Group classifies the severity of wildfires based on their acreage.

Fires can present a hazard where there is the potential to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire the spread into homes. Protecting structures from fire poses special problems and can stretch firefighting resources to the limit. If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If the wildfire destroys the ground cover, then erosion becomes one of several potential problems.

POTENTIAL BRUSHFIRE HAZARD AREAS

The SCHMCAP depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 15). The wildland-urban interface reflects communities where housing and vegetation intermingle, and fire can spread from structures to vegetated areas. The most susceptible fuels are pitch pine, scrub oak and oak forests. Topography can affect the behavior of fires, as fire spreads more easily uphill. Nahant is shown in the no risk zone. The most common cause of wildfires is the careless disposal of smoking materials and untended campfires.

Figure 15: Wildfire Risk Areas



Source: SHMCAP

Table 14 below summarizes areas of Nahant were identified as having the highest potential for brush fires. The ID numbers correspond to the numbers on Map 8, "Hazard Areas" in Appendix B.

Table 14: Locally Identified Areas of Brushfire Risk

Map ID	Name
6	Lowlands Area
7	Willow Road at White Way
8	Furbush Road
9	Bailey's Hill (a densely populated area)
10	East Point Park

While there are areas of fire risk, town officials indicate that significant brush fires are not a common occurrence.

INVASIVE SPECIES

The 2018 SHMCAP includes invasive species as a natural hazard for the first time. They are defined as "non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health". In new habitats invasive species displace native species if they have competitive advantages including that they are not subject to biological controls from their native habitat. Some of the more recognizable invasive plant species noted in the SHMCAP include Norway maple, garlic mustard, Japanese barberry, black swallowwort, buckthorn, purple loosestrife, water milfoil, Japanese knotweed, and phragmites. Invasive pests include gypsy moth, hemlock wooly adelgid, and the Asian long-horned beetle. Green crabs are a notable marine invasive. The Massachusetts Invasive Plant Advisory Group categorizes invasive severity as either limited prevalence in Massachusetts, partial containment potential, or public health threat.

According to Nahant's Open Space and Recreation Plan (2008), abundant invasive exotic plants can be found in the Lowlands area, including Asiatic/Oriental bittersweet, Japanese knotweed, the tall Phragmites grass, multiflora rose, and purple loosestrife. The presence of these invasives may be due to previous use of a portion of the Lowlands as the Town Dump and is now designated as a composting area for plant rubbish collected from around the Town.

EXTREME WEATHER

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74 to 200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits land. A tropical storm has similar characteristics, but wind speeds are between 34 and 73 miles per hour. Climate models suggest that hurricanes and tropical storms will become more intense as warmer ocean waters provide more fuel for the storms. In addition, rainfall amounts associated with hurricanes are predicted to increase because warmer air can hold more water vapor. Since 1900, 39 tropical storms have impacted New England (NESEC). Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. Given its coastal location, the Town of

Nahant is highly vulnerable to hurricanes, which occur between June and November. Table 15 presents hurricane records for Massachusetts since 1938.

Table 15: Hurricane Records for Massachusetts, 1938 to 2018

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

* Category 3.
Source: National Oceanic and Atmospheric Administration

Hurricane intensity is measured according to the Saffir/Simpson scale, which categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. These are combined to estimate potential damage. Table 16 provides an overview of the wind speeds, surges, and range of damage caused by different hurricane categories.

Table 16: Saffir/Simpson Scale

Scale No. (Category)	Winds (mph)	Surge (ft)	Potential Damage
1	74 – 95	4 - 5	Minimal
2	96 – 110	6 - 8	Moderate
3	111 – 130	9 - 12	Extensive
4	131 – 155	13 - 18	Extreme
5	> 155	>18	Catastrophic

Source: NOAA

Hurricanes typically have regional impacts beyond their immediate tracks. Falling trees and branches are a significant problem because they can result in power outages when they fall on power lines or block traffic and emergency routes. Hurricanes are a town-wide hazard in Nahant. Total damages in Nahant are estimated at $4.5 million for a 100-year hurricane (equivalent to Category 2), and about $32 million for a 500-year hurricane (Category 4).

SEVERE WINTER STORM/NOR'EASTER

A northeast storm, known as a nor'easter, is typically a large counterclockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 10 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rain or snow, depending on temperatures. Many of the historic flood events identified in the previous section were precipitated by nor'easters, including the "Perfect Storm" event in 1991. More recently, blizzards in February 2013, January 2015, and in March 2018 were large nor'easters that caused significant snowfall amounts.

Frequently, nor'easters are coastal events for Massachusetts. As such, Nahant is vulnerable to both the wind and precipitation that accompany nor'easters. High winds can cause damage to structures, fallen trees, and downed power lines leading to power outages. Intense rainfall can overwhelm drainage systems causing localized flooding of rivers and streams as well as urban stormwater ponding and localized flooding. Fallen tree limbs as well as heavy snow accumulation and intense rainfall can impede local transportation corridors, and block access for emergency vehicles. Nor'easters are also a cause of coastal flooding.

A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow which reduces visibility to or below ¼ mile. These conditions must be the predominant condition over a three-hour period. Extremely cold temperatures are often associated with blizzard conditions but are not a formal part of the definition. The hazard related to the combination of snow, wind, and low visibility significantly increases when temperatures drop below 20 degrees.

The Regional Snowfall Index (RSI) characterizes and ranks the severity of northeast snowstorms. RSI has five categories: Extreme, Crippling, Major, Significant, and Notable. RSI scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The largest RSI values result from storms producing heavy snowfall over large areas that include major metropolitan centers. The RSI categories are summarized below:

Table 17: Regional Snowfall Index

Category	RSI	Value Description
1	1 – 3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18+	Extreme

Source: SHMCAP

Winter storms, including heavy snow, blizzards, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response. The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall. This in turn can cause property damage and potential injuries. Power outages may also result from fallen trees and utility lines. Winter storms are a town-wide hazard in Nahant. Map 6 in Appendix B illustrates the average annual average snowfall in Nahant, which is between 36 to 48 inches. A number of public safety issues can arise during snowstorms. Impassible streets are a challenge for emergency vehicles and affect residents and employers. Snow-covered sidewalks force people to walk in streets, which are already less safe due to snow, slush, puddles, and ice. Large piles of snow can also block sight lines for drivers, particularly at intersections. Refreezing of melting snow can cause dangerous roadway conditions. In addition, transit operations may be impacted, as they were in the 2015 blizzards which caused the closure of the MBTA system for one day and limited services on the commuter rail for several weeks.

As with hurricanes, warmer ocean water and air will provide more fuel for winter storms. According to the SHMCAP it appears that Atlantic coast nor'easters are increasing in frequency and intensity. Further, the SHMCAP notes that research suggests that warmer weather in the Artic is producing changes to atmospheric circulation patterns that favor the development of winter storms in the Eastern United States.

The Town of Nahant does not keep local records of winter storms. Data for Essex County is the best available data to help understand previous occurrences and impacts of heavy snow events. According to National Centers for Environmental Information (NCEI) records, from 2010 to 2020, Essex County experienced 25 days with heavy snowfall events, resulting in no injuries, deaths, and property damage of $65,000.

Table 18: Heavy Snow Events and Impacts in Essex County, 2010 to 2020

Date	Deaths	Injuries	Property Damage ($)
1/18/2010	0	0	0
2/16/2010	0	0	15,000
1/12/2011	0	0	0
1/26/2011	0	0	0
2/8/2013	0	0	0
3/7/2013	0	0	0
3/18/2013	0	0	0
12/14/2013	0	0	0
12/17/2013	0	0	0
1/2/2014	0	0	0
1/18/2014	0	0	10,000
2/5/2014	0	0	0
2/13/2014	0	0	0
2/18/2014	0	0	0

Date	Deaths	Injuries	Property Damage ($)
1/24/2015	0	0	0
1/26/2015	0	0	0
2/2/2015	0	0	0
2/8/2015	0	0	0
2/14/2015	0	0	0
2/5/2016	0	0	40,000
3/14/17	0	0	0
11/15/18	0	0	0
12/1/19	0	0	0
1/18/20	0	0	0
12/16/20	0	0	0
TOTAL	**0**	**0**	**$65,000**

Source: NOAA, National Climatic Data Center

The most significant winter storm in recent history was the "Blizzard of 1978," which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. In Eastern Massachusetts, blizzards and severe winter storms have occurred in the following years:

Table 19: Severe Weather Major Disaster Declarations in Eastern MA

Storm Event	Date
Severe Winter Storm and Snowstorm	March 2018
Severe Winter Storm, Snowstorm, and Flooding	January 2015
Severe Winter Storm, Snowstorm, and Flooding	February 2013
Hurricane Sandy	October/November 2012
Severe Storm and Snowstorm	October 2011
Tropical Storm Irene	August 2011
Severe Winter Storm and Snowstorm	January 2011
Severe Winter Storm and Flooding	December 2008
Severe Storms and Inland and Coastal Flooding	April 2007
Severe Storm and Flooding	October 2005
Severe Storms & Flooding	March 2001
Blizzard	January 1966
Winter Coastal Storm	December 1992
Severe Coastal Storm	October 1991
Hurricane Bob	August 1991
Hurricane Gloria	September 1985
Coastal Storm, Flood, Ice, Snow	February 1978

Storm Event	Date
Hurricane, floods	August 1955
Hurricanes	September 1954

Source: FEMA

ICE STORMS

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects, creating ice buildups of one-fourth of an inch or more. An ice storm warning, which is now included in the criteria for a winter storm warning, is issued when a half inch or more of accretion of freezing rain is expected. Nahant does not record specific data for previous ice storm occurrences. The best available local data is for Essex County through the National Climatic Data Center. Essex County experienced one ice storm events from 2008 to 2020. No deaths or injuries were reported and the total reported property damage in the county was estimated at $2 million. There is some indication that if winters warm, temperatures may be more likely to produce icing conditions.

Sleet and hail are other forms of frozen precipitation. Sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. The difference between sleet and hail is that sleet is a wintertime phenomenon whereas hail falls from convective clouds (usually thunderstorms), often during the warm spring and summer months. Hail size typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters:

Table 20: Hail Size Comparisons

Description	Diameter (inches)
Pea	0.25
Marble or mothball	0.50
Penny or dime	0.75
Nickel	0.88
Quarter	1.00
Half dollar	1.25
Walnut or ping pong ball	1.50
Golf ball	1.75
Hen's egg	2.00
Tennis ball	2.50
Baseball	2.75
Teacup	3.00
Grapefruit	4.00
Softball	4.50

Source: NOAA

While ice pellets and sleet are examples of these, the greatest hazard is created by freezing rain conditions, which is rain that freezes on contact with hard surfaces leading to a layer of ice on roads, walkways, trees, and other surfaces. The conditions created by freezing rain can make driving particularly dangerous and emergency response more difficult. The weight of ice on tree branches can also lead to falling branches damaging electric lines.

Compared to ice storms, hail events are much more frequent in Essex County. Records show that Essex County experienced 14 hail events from 2010 to 2020, with no recorded property damage, injuries, or deaths (Table 21).

Table 21: Hail Events in Essex County, 2010-2020

Date	Magnitude	Deaths	Injuries	Property Damage ($)
6/5/2010	1.5	0	0	0
6/20/2010	1	0	0	0
6/1/2011	0.75	0	0	0
6/23/2012	0.88	0	0	0
7/18/2012	0.75	0	0	0
5/21/2013	0.75	0	0	0
9/1/2013	0.75	0	0	0
8/7/2014	0.75	0	0	0
5/12/2015	0.75	0	0	0
6/23/2015	1	0	0	0
8/4/2015	1	0	0	0
6/30/2019	0.75	0	0	0
7/30/20	0.75	0	0	0
8/23/20	0.75	0	0	0
TOTAL		**0**	**0**	**0**

Magnitude refers to diameter of hail stones in inches.
Source: NOAA

TORNADOES

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. These events are spawned by thunderstorms and occasionally by hurricanes and may occur singularly or in multiples. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. Most vortices remain suspended in the atmosphere. Should they touch down, they become a force of destruction. Some ingredients for tornado formation include:

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

Tornado damage severity is measured by the Enhanced Fujita scale, which is based on the amount of damage created. As of February 1, 2007, the National Weather Service began rating tornados using the Enhanced Fujita-scale (EF-scale), which allows surveyors to create more precise assessments of tornado severity. The EF-scale is summarized below:

Table 22: Enhanced Fujita Scale

Scale	Wind speed		Relative frequency	Potential damage	
	mph	km/h			
EF0	65–85	105–137	53.5%	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.	
EF1	86–110	138–178	31.6%	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.	
EF2	111–135	179–218	10.7%	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.	
EF3	136–165	219–266	3.4%	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.	
EF4	166–200	267–322	0.7%	Extreme damage to near-total destruction. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.	
EF5	>200	>322	<0.1%	Massive Damage. Strong frame houses leveled off foundations and swept away; steel-reinforced concrete structures critically damaged; high-rise buildings have severe structural deformation. Incredible phenomena will occur.	

Source: SHMCAP 2018

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC). Recent tornado events in Massachusetts were in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in four deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16, moved north into Revere's business district along Broadway, and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damages and 13 homes and businesses were rendered uninhabitable.

Since 1951, there have been 12 tornadoes in Essex County recorded by the NCEI. Two tornadoes were F2, eight were F1, and two were F0. These tornadoes resulted in no fatalities and four injuries and $560.280 million in damages, as summarized in Table 24 below.

Table 23: Tornado Records for Essex County

Date	Fujita Scale	Fatalities	Injuries	Width (yard)	Length (mile)	Property Damage ($)
8/21/1951	F2	0	0	100	9.3	2.50K
6/13/1956	F1	0	0	10	1	2.50K
11/21/1956	F2	0	0	17	0.8	25.00K
12/18/1956	F1	0	0	23	0.5	0.25K
7/13/1960	F0	0	0	33	0.1	0.03K
7/21/1962	F1	0	3	33	2.7	25.00K
5/19/1964	F0	0	0	300	0.1	2.50K
5/19/1964	F1	0	0	300	2	2.50K
8/10/1965	F1	0	0	33	3.6	0
7/1/1968	F1	0	1	100	0.3	250.00K
7/21/1972	F1	0	0	20	0.3	2.50K
8/15/1991	F1	0	0	300	0.8	250.00K
TOTAL		**0**	**4**			**562.78K**

Source: NOAA

Buildings constructed prior to current building codes may be more vulnerable to damages caused by tornadoes. Evacuation of impacted areas may be required on short notice. Sheltering and mass feeding efforts may be required along with debris clearance, search and rescue, and emergency fire and medical services. Key routes may be blocked by downed trees and other debris, and widespread power outages are also typically associated with tornadoes.

Tornados are Town-wide hazards. On average, there are six tornados that touchdown somewhere in the northeast region every year. Tornados are most common in the summer, June through August and most form in the afternoon or evening. Tornados are associated with strong thunderstorms. Based on the record of previous occurrences since 1950, tornado events in Nahant are a "Medium" frequency event. According to the SHMCAP, it is possible that severe thunderstorms which can include tornadoes may increase in frequency and intensity. However, scientists have less confidence in the models that seek to project future changes in tornado activity. The Town of Nahant has adopted the Massachusetts State Building Code. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence.

OTHER SEVERE WEATHER

SEVERE THUNDERSTORMS

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. A thunderstorm typically features lightning, strong winds, rain, and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes. A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The severity of thunderstorms ranges from commonplace and of short duration to intense storms that cause damage due to high winds, flooding, or lightning strikes.

The best available data on previous occurrences of thunderstorms in Nahant is for Essex County through the National Climatic Data Center (NCDC). For the years 2010 to 2020, NCDC records show 46 thunderstorm events in Essex County (Table 24). These storms resulted in a total of $1.81 million in property damage. No injuries or death reported.

Table 24: Essex County Thunderstorm Events, 2010 to 2020

DATE	MAGNITUDE (knots)	DEATHS	INJURIES	PROPERTY DAMAGE $
6/3/2010	50	0	0	71000
6/5/2010	50	0	0	60000
6/6/2010	52	0	0	79500
6/24/2010	50	0	0	65750
7/12/2010	50	0	0	30000
7/19/2010	50	0	0	25000
6/9/2011	50	0	0	207000
7/4/2011	50	0	0	31000
7/18/2011	39	0	0	20000
8/19/2011	50	0	0	60000
10/4/2011	50	0	0	10000
6/23/2012	50	0	0	75500
6/25/2012	40	0	0	5000
7/4/2012	50	0	0	5000
6/24/2013	50	0	0	25000
7/1/2013	50	0	0	18000
7/3/2014	50	0	0	100000
7/15/2014	50	0	0	15000
7/28/2014	50	0	0	15000
9/2/2014	45	0	0	5000
9/6/2014	50	0	0	2385000
5/28/2015	61	0	0	50000
5/28/2015	50	0	0	81000

DATE	MAGNITUDE (knots)	DEATHS	INJURIES	PROPERTY DAMAGE $
6/23/2015	60	0	0	5000
7/27/2015	45	0	0	1000
8/4/2015	50	0	0	65000
2/25/2016	50	0	0	21000
6/29/2016	50	0	0	25000
7/1/2016	50	0	0	15000
7/18/2016	70	0	0	105000
7/23/2016	50	0	0	155000
9/11/2016	50	0	0	10000
05/18/2017	50	0	0	29000
06/23/2017	50	0	0	26500
06/27/2017	50	0	0	10.00K
06/18/2018	50	0	0	46500
09/18/2018	61	0	0	16000
06/30/2019	40	0	0	6000
07/17/2019	50	0	0	1750
07/31/2019	50	0	0	40000
08/21/2019	50	0	0	3.00K
6/6/2020	50	0	0	1500
7/5/2020	50	0	0	1300
7/13/2020	50	0	0	1000
7/23/2020	50	0	0	1800
7/30/2020	50	0	0	8500
8/23/2020	50	0	0	9600
TOTAL		**0**	**0**	**$1.81M**

*Magnitude refers to maximum wind speed
Source: NOAA, National Climatic Data Center

Severe thunderstorms are a town-wide hazard for Nahant. The town's vulnerability to severe thunderstorms is similar to that of nor'easters. High winds can cause falling trees and power outages, as well as obstruction of key routes and emergency access. Heavy precipitation may also cause localized flooding, both riverine and urban drainage related.

Based on the record of previous occurrences, thunderstorms in Nahant are high frequency events as this hazard has occurred an average of three times per year in the past ten years. As noted previously, the intensity of rainfall events has increased significantly, and those trends are expected to continue. The SHMCAP does not specifically address whether climate will affect the intensity or frequency of thunderstorms.

NON-CLIMATE INFLUENCED HAZARDS

EARTHQUAKES

Earthquakes are the sole natural hazard for which there is no established correlation with climate impacts. Damages in an earthquake stem from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology (NESEC).

Seismologists use a magnitude scale known as the Richter scale to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized below:

Table 25: Richter Scale and Effects

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

Source: Nevada Seismological Library (NSL), 2005

From 1668 to 2016, 408 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes in the distant past, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 26.

Table 26: Historic Earthquakes in Massachusetts or Surrounding Area

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA

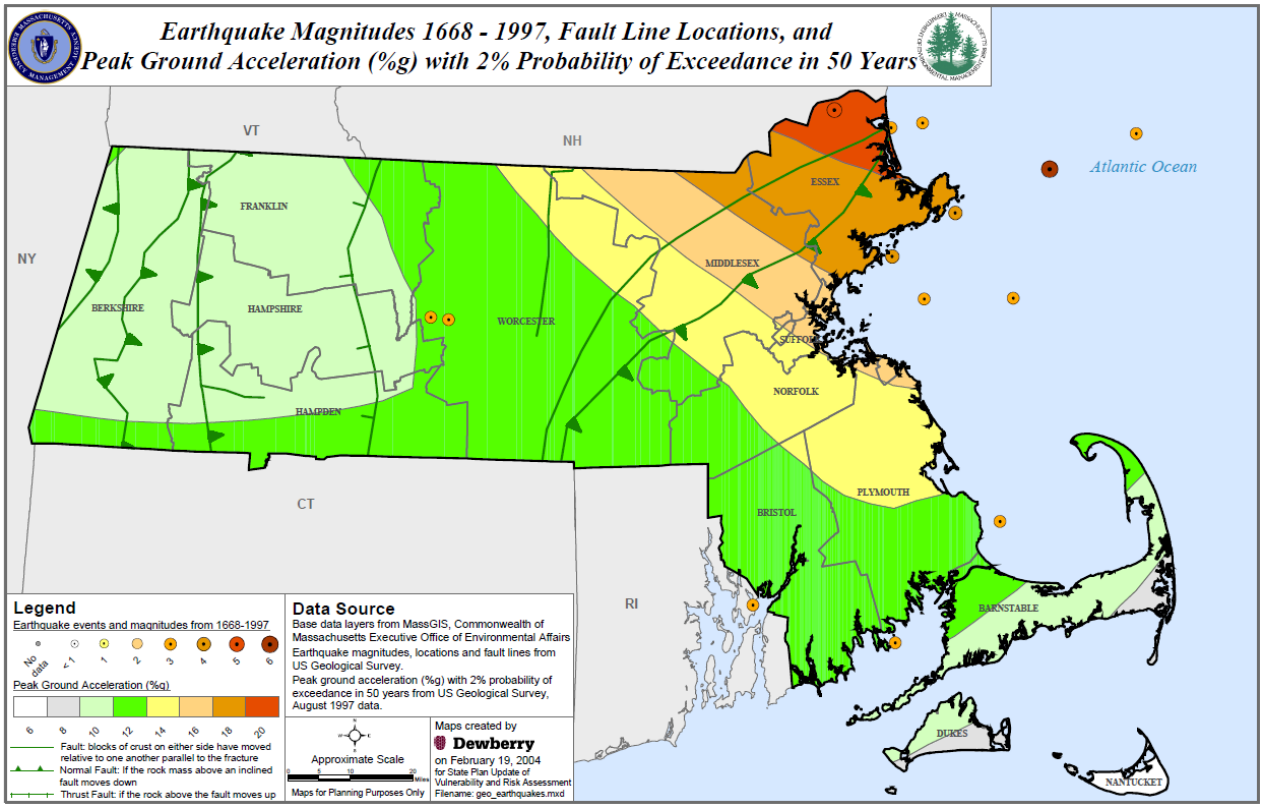
Location	Date	Magnitude
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA - Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA - Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA - Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA - Brewster	8/8/1847	4.2
MA - Boxford	5/12/1880	NA
MA - Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA - Nantucket	10/25/1965	NA
MA - Boston	12/27/74	2.3
MA - Nantucket	4/12/12	4.5
ME - Hollis	10/17/12	4.0

Source: Boston HIRA

One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (%g). The range of peak ground acceleration in Massachusetts is from 10 %g to 20 %g, with a 2% probability of exceedance in 50 years. Nahant is in the higher part of the range for Massachusetts, at 16-18 %g, making it a relatively moderate high area of earthquake risk within the state, although the state as a whole is considered to have a low risk of earthquakes compared to the rest of the country. There have been no recorded earthquake epicenters within Nahant.

Although New England has not experienced a damaging earthquake since 1755, seismologists state that a serious earthquake occurrence is possible. There are five seismological faults in Massachusetts, but there is no discernible pattern of previous earthquakes along these fault lines. Earthquakes occur without warning and may be followed by aftershocks. The majority of older buildings and infrastructure were constructed without specific earthquake resistant design features.

Figure 16: State of Massachusetts Earthquake Probability Map



Source: SHMCAP

Earthquakes are a hazard with multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage which may or may not be readily apparent. Earthquakes can cause major damage to roadways, making emergency response difficult. Water lines and gas lines can break, causing flooding and fires. Another potential vulnerability is equipment within structures. For example, a hospital may be structurally engineered to withstand an earthquake, but if the equipment inside the building is not properly secured, the operations at the hospital could be severely impacted during an earthquake. Earthquakes can also trigger landslides.

According the SHMCAP there is a 10-15% chance of a magnitude 5 earthquake in a given ten-year period. Earthquakes are a potential town-wide hazard in Nahant. Development in filled, sandy or clay soils is more vulnerable to earthquake pressures that other soils. The southwestern section of Nahant including the golf course may be more vulnerable to liquefaction than more bedrock upland areas. Potential earthquake damages to Nahant have been estimated using HAZUS-MH. Total The economic loss estimated for a 5.0 magnitude earthquake is $67.5 million, and approximately $ 195.5 million for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 30.

LAND USE AND DEVELOPMENT TRENDS

Existing Land Use

The most recent land use statistics available from the state are from aerial imagery completed in 2016. Table 27 shows the acreage and percentage of land in Nahant. If the primary residential categories are aggregated, residential uses make up 42.2% of the area of the town. Commercial use makes up 1.3% of the town. There is no land use for Agriculture or Industrial. Open Land makes up a total of 7% of the land. The tax-exempt category represents nearly 25% of Nahant's land. Most of this land is additional open space.

Table 27: Town of Nahant, MA 2016 Land Use

Land Use Type	Acres	Percentage
Residential - single family	291	36
Residential - multi-family	46	5.7
Residential – other	4	0.5
Commercial	10	1.3
Mixed use - other	2	0.2
Water	79	10
Industrial	0	0
Agriculture	0	0
Open land	58	7
Unknown	42	5.3
Right-of-way	70	9
Tax exempt	198	25
Total	**800**	**100**

For more information on how the land use statistics were developed and the definitions of the categories, please go to https://docs.digital.mass.gov/dataset/massgis-data-land-use-2005.

Economic Elements

Lobstering is the primary industry on Nahant, employing about 25- 30 people. The Town has a function hall, a golf course, two restaurants, a bank, a car-repair garage, three convenience stores, a real-estate office, and the Town of Nahant offices.

NATURAL, CULTURAL, AND HISTORICAL RESOURCE AREAS

By the late 1800's, Nahant had grown to become thriving summer resort community featuring many summer estates of the wealthy Bostonians. The Town features several significant historical and cultural landmarks, as well as heritage landscapes, including the following:

- **Bailey's Cove - Lewis Cove - Bass Point:** Fine ocean views from Bailey's Hill and Bass Point are found here. Bailey's Hill is now protected open space owned by the Town.

- **East Point Neighborhood**: Once the site of the Henry Cabot Lodge, Jr. summer estate and now the Henry Cabot. East Point also features Lodge Villa on Cliff Street, a National Historic Landmark, the Hammond House, Charles Gibson House and the Village Church.
- **Maolis Gardens**: Part of the former Tudor Estate, the Gardens once contained an entire amusement park and dining halls.
- **Rock Temple**: Designed by inventor John Hammond.
- **Nahant Country Club**: The clubhouse is imbedded in the original 1824 John Tudor estate house.
- **Spouting Horn Neighborhood**: An area on Nahant's north coast containing several large estates and coastal features

Due to its location and spectacular natural beauty, Nahant historically has drawn thousands of visitors from other communities. By the middle of the eighteenth century, it was a major tourist resort and vacation spot for Bostonians escaping the summer heat. Today, the peninsula attracts people for beach-going, jogging, sport fishing, kite flying, windsurfing, kayaking, nature study, and bicycling—to name just a few of the kinds of recreation enjoyed here.

Since the peninsula is important as a feeding and resting spot for migratory songbirds and shorebirds, as well as a home to a number of nesting species, the conflicting needs between people and wildlife must also be considered. According to the town's Open Space and Recreation Plan, Nahant has three State-designated Barrier Beaches, one of which is Nahant Beach. The Massachusetts Department of Conservation and Recreation manages a 3,202,000-squarefoot reservation along the causeway connecting Nahant and Lynn, which includes Nahant Beach, a bike path, bathroom facilities, and public parking. Use by non-residents of the many other recreational resources, including Lodge Park, Tudor Wharf, Tudor Beach, Marjoram Park, Bailey's Hill, and Short Beach is permitted but as a practical matter is limited due to the lack of public parking.

DEVELOPMENT TRENDS

The overall growth pattern in Nahant is toward residential rather than commercial use. Some sections of the town are hilly, with complex street patterns and small lots. Other areas, mostly in the Eastern section of Big Nahant, have sizable homes on large lots. There are a few apartment buildings. The largest is the 128-unit Bass Point Apartments, built in 1973 (after a change in the zoning bylaws in 1969), with swimming pool and tennis court. The former J. T. Wilson School on Nahant Road was converted to elderly housing in 1983, and the former Valley Road School was recently acquired by the Nahant Preservation Trust (a nonprofit organization) and is currently used as a Community Center with business office space. Even though the population is in decline, the number of dwelling units is increasing. In the 1960s, it was thought that only one hundred more houses could be built in Nahant, but at least 120 houses were built between then and 1989. Between 1970 and 1980, the number of dwelling units increased about 10 percent (from 1,397 to 1,547), while the population declined by about 5 percent. Noted in the 2014 Plan Update, there was a concern that the town's zoning bylaw allowing the subdivision of existing lots in the

Residential 2 and Residential One Districts into 10,000 square-foot and 30,000 square-foot lots respectively, may threaten the Town's character, increasing density and potentially increasing the number of homes threatened by flooding and storm surge. Current zoning allows for residential development only. And as pressure has intensified, land once considered inadequate, unsuitable, or protected by State or Federal statute has been developed. This is plainly visible when looking at houses recently built on stilts or on rock ledges.

Development trends throughout the metropolitan region are tracked by MassBuilds, MAPC's Development Database, which provides an inventory of new development over the last decade. The database tracks both completed developments and those currently under construction. There have not been major development projects recorded for Town of Nahant.

POTENTIAL FUTURE DEVELOPMENT

MAPC also consulted with town staff to determine areas that are likely to be developed in the future, defined for the purposes of this plan as a ten-year time horizon. Town staff did not indicate any specific areas that they felt were targeted for potential development. The only potential major development is a proposed Northeastern University expansion; however, nothing has materialized. As an outcome of this potential expansion, the Town has committed to developing 13 former single family Coast Guard Housing units currently being utilized as rental units to market-priced (lottery) single-family lots.

CRITICAL FACILITIES & INFRASTRUCTURE IN HAZARD AREAS

Critical facilities and infrastructure include facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, communications, and electricity) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 31 critical facilities identified in Nahant. One additional critical facility located in Lynn, which the Town of Nahant is also paying close attention to is the MWRA Bypass Valve. These are listed in Table 28 and are shown on the maps in Appendix B.

Explanation of Columns in Table 30

- ***Column 1: ID #:*** The first column in Table 32 is an ID number which appears on the maps that are part of this plan. See Appendix B.
- ***Column 2: Name****:* The second column is the name of the site.
- ***Column 3: Type*:** The third column indicates what type of site it is.
- ***Column 4: FEMA Flood Zone*:** The fourth column addresses the risk of flooding. A "No" entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone. as follows:
  - **Zone A** Areas subject to inundation by the 1-percent-annual-chance flood event. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.
  - **Zone AE** (1% annual chance) Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply. Zones AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by detailed methods. Mandatory flood insurance purchase requirements apply
  - **Zone AH** Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are 1–3 feet. BFEs derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.
  - **Zone X** (0.2% annual chance) Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (formerly Zone B)
  - **Zone VE** (1% annual chance) - Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
- ***Column 5: Locally Identified Area of Flooding*:** The fifth column indicates the risk of flooding in local hazard areas. If there is an entry in this column, it indicates the local hazard area.
- ***Column 6:*** Hot spots indicates areas that are within the 5% of hottest areas in the MAPC region based on satellite data from 2016.
- ***Column 7:*** The seventh column indicates the risk of brushfire. If there is an entry in this column, it indicates the local hazard area.
- ***Column 8:*** This column indicates locations subject to inundation at Mean Higher High Water with 3 feet of sea level rise.

Table 28: Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	FEMA Flood Zone	Locally Identified Flood Area	Hot Spot	Brushfire Risk	Sea Level Rise
1	Town Hall	Municipal Facility					
2	Spindrift Elder Housing	Elder Housing					
3	Nahant Police Station/EOC	Municipal Facility					
4	Jesmond Nursing Home	Nursing Home					
5	Power Substation (National Grid)	Electric Substation	AH	x		x	
6	Nahant Fire Station	Municipal Facility	AE				
7	Johnson School (PK-6)	School					
8	Lowlands Wastewater Pump Station	Pump Station	AE	x		x	
9	DPW Office/Garage	Municipal Facility					
10	The Causeway	Barrier Beach	VE				
11	Short Beach	Barrier Beach	VE	x			x
12	Communication Tower	Infrastructure					
13	Emergency Dispensing Station	Emergency Site					
14	Calgon Station	Water Treatment Facility	VE	x			
15	Ward Bathhouse (seasonal)	Public Facility	VE	x			
16	DCR Maintenance Facility	State Facility	VE	x			
17	Kelly Greens	Pump Station	AE	x			
18	Lafayette	Pump Station	VE				
19	Lowlands	Pump Station	AE	x		x	
20	Maolis	Pump Station	VE				
21	Nahant Road	Pump Station	VE			x	
22	Pearl	Pump Station					
23	Range Road	Pump Station					
24	Rollins Ave	Pump Station					
25	Walton Road	Pump Station	AE			x	
26	Wharf St. Wastewater Pump Station	Pump Station	AE			x	
27	White Way	Pump Station	VE				
28	Winter Street	Pump Station	VE			x	
29	Bear Pond Stormwater Pumping System	Pump Station	VE	x			
30	Natural Gas Pressure Reducing Valve Station (National Grid)	Natural Gas Facility	AE				

VULNERABILITY ASSESSMENT

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding through the HAZUS-MH software.

Introduction to HAZUS-MH

HAZUS- MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. The following overview of HAZUS-MH is taken from the FEMA website. For more information on the HAZUS-MH software, go to https://www.fema.gov/hazus/

> "HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods, and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response and recovery planning.
>
> HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations."

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data. Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the Town of Nahant, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is "subject to a great deal of uncertainty."

However, for the purposes of this plan, the analysis is useful. This plan is attempting to generally indicate the possible extent of damages due to certain types of natural disasters and to allow for a comparison between different types of disasters. Therefore, this analysis should be considered to be a starting point for understanding potential damages from the hazards.

ESTIMATED DAMAGES FROM HURRICANES

The HAZUS software was used to model potential damages to the community from a 100-year and 500-year hurricane event; storms that are 1% and 0.2% likely to happen in a given year, and roughly equivalent to a Category 2 and Category 4 hurricane. The damages caused by these hypothetical storms were modeled as if the storm track passed directly through the town, bringing the strongest winds and greatest damage potential.

Though there are no recorded instances of a hurricane equivalent to a 500-year storm passing through Massachusetts, this model was included in order to present a reasonable "worst case scenario" that would help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter into a period of more intense and frequent storms.

Table 29: HAZUS Estimated Damages from Hurricanes

	Category 2 (100-yr)	Category 4 (500-yr)
Building Characteristics		
Estimated total number of buildings	1,449	
Estimated total building replacement value (2014 $)	$557,211,000	
Building Damages		
# of buildings sustaining minor damage	132	436
# of buildings sustaining moderate damage	14	142
# of buildings sustaining severe damage	0.5	21
# of buildings destroyed	0.5	17
Population Needs		
# of households displaced	0	9
# of people seeking public shelter	0	2
Debris		
Building debris generated (tons)	692	3,215
Tree debris generated (tons)	302	916
# of truckloads to clear building debris	16	92
Value of Damages		
Total property damage (buildings and content)	$4,515,000	$32,590,000
Total losses due to business interruption	$280,570	$3,499,000

ESTIMATED DAMAGES FROM EARTHQUAKES

The HAZUS earthquake module allows users to define an earthquake magnitude and model the potential damages caused by that earthquake as if its epicenter had been at the geographic center of the study area. For the purposes of this plan, two earthquakes were selected: magnitude 5.0 and a magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5.0 event occurred in 1963.

Table 30: HAZUS Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	1,449	
Estimated total building replacement value (2014 $)	$557,211,000	

	Magnitude 5.0	Magnitude 7.0
Building Damages		
# of buildings sustaining slight damage	431	466
# of buildings sustaining moderate damage	225	385
# of buildings sustaining extensive damage	58	133
# of buildings completely damaged	14	137
Population Needs		
# of households displaced	65	259
# of people seeking public shelter	28	112
Debris		
Building debris generated (tons)	9,000	40,000
# of truckloads to clear debris (@ 25 tons/truck)	360	1,600
Value of Damages		
Total property damage	$67,370,000	$195,110,000
Total losses due to business interruption	$8,758,100	$29,266,500

ESTIMATED DAMAGES FROM FLOODING

The HAZUS flooding module allows users model the potential damages caused by a 100-year flood event and a 500-year flood event.

Table 31: HAZUS Estimated Damages from Flooding

	100-Year Flood	500-Year Flood
Building Characteristics		
Estimated total number of buildings	1,449	
Estimated total building replacement value (2014 $)	$557,211,000	
Building Damages		
# of buildings sustaining limited damage	6	9
# of buildings sustaining moderate damage	22	29
# of buildings sustaining extensive damage	0	1
# of buildings substantially damaged	2	3
Population Needs		
# of households displaced	495	560
# of people seeking public shelter	16	18
Value of Damages		
Total property damage	$16,510,000	$21,060,000
Total losses due to business interruption	$18,640,000	$20,570,000

IMPACTS ON PEOPLE

Just as some locations in Nahant will be more vulnerable to climate impacts than others, it is also true that climate change and natural hazards will not affect all residents of Nahant equally. People who may be more susceptible to negative health effects can include older adults, young children, pregnant women, people with disabilities, and people with pre-existing health conditions, as they are more likely to be physically vulnerable to the health impacts of extreme heat and poor air quality. Individuals with physical mobility constraints may need additional assistance with emergency response. Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions. People who live in substandard housing and in housing without air conditioning have increased vulnerability to heat-related illnesses. Black and Latino residents in Massachusetts are hospitalized for asthma at considerably higher rates than the population as whole, reflecting the reality that longstanding societal inequities can lead to differential health outcomes based on race and ethnicity.

Low-income people are often more susceptible to financial shocks, which can occur after extreme weather, and which can impact financial security and the ability to secure safe shelter and meet medical needs. Social isolation can also influence vulnerability, as it limits access to critical information, municipal resources, and social support systems. In the absence of strong social support networks and translation services, people living alone and those with limited English language proficiency may experience social isolation. People of color and undocumented immigrants may also experience social isolation where there are historically strained or tenuous relationships with government officials and first responders. Certain occupations may also experience more severe impacts. People who work outdoors, or in unregulated temperatures, are at increased risk for heat-related illnesses.

In developing mitigation measures the Town of Nahant will want to consider the needs of all of its residents. In Nahant approximately 3% of residents are below the poverty level (4-person household earning less than $24,563) (American Community Survey, 2019). Approximately 24% of residents are age 65 or older, and about 5% of the seniors are below the poverty level (American Community Survey, 2019).

RISK ASSESSMENT SUMMARY

CLIMATE CHANGE	NATURAL HAZARD	PRIORITY (H/M/L)	KEY CONCERNS SOCIETY	KEY CONCERNS BUILT ENVIRONMENT	KEY CONCERNS NATURAL RESOURCES
Changes in Precipitation 	Inland Flooding	High	Evacuation needed in Bass Point area (2018 storm events)	Lowlands area's pump station capacity and infiltration – the area won't have discharge outlet if this station shuts down. General: Need more frequent cleaning & maintenance of pump & outfall.	Disruption to the discharge system from Lowland to Bear Pond, which is a natural trench system.
	Drought	Low	Town-wide impact	NA	NA
	Landslide	Low	NA	NA	NA
Sea Level Rise 	Coastal Flooding	High	Restrained access to and from mainland (via Lynn)	The neck from Big Nahant to Little Nahant (Short Beach dune) – extreme weak point – main access to mainland. The rotary (Lynn-Nahant shared management) – access issue. Spring Road; Willow Road (stretch of Tudor Beach – 0 Willow Road down to the wharf) – problematic during high tide; Castle Road; Lowlands and Furbush areas (due to their lower elevation)	Short Beach dune (developing plan to address issues)
	Coastal Erosion	High	NA	Coastal protection infrastructure, such as armored walls and seawalls, were significantly damaged during the winter 2018 storms	Forty Steps Coastal Bank – slowly eroding; Short Beach; north end of Ocean Street. Shoreline changes overtime.
	Tsunami	Low (frequency); High (impact)	Town-wide impact	Town-wide impact	Town-wide impact

CLIMATE CHANGE	NATURAL HAZARD	PRIORITY (H/M/L)	KEY CONCERNS SOCIETY	KEY CONCERNS BUILT ENVIRONMENT	KEY CONCERNS NATURAL RESOURCES
Rising Temperatures 	Average and Extreme Temperatures	Medium/Low	NA (Nahant is usually about 10 degrees cooler than mainland)	NA	NA
	Wildfires	Low	NA	NA	NA
	Invasive species	Medium/Low	NA	NA	Phragmites – in channel system from Lowlands to the golf course.
Extreme Weather 	Hurricanes / Tropical Storms	High	Exacerbate flooding issues when storm events take place during astronomical high tides. Lack of emergency shelters	Damage was associated with storms stone debris that was lifted over the seawall by storm surge wave action and pushed onto roads - particularly, Bass Point Road and Willow Road received road damage during the January and March 2018 storms.	NA
	Severe Winter Storms	High	Same issues as above	Same issues as above	NA
	Tornadoes	Low (frequency); High (impact)	Town-wide impact	Town-wide impact	Town-wide impact
	Other (Wind/ Thunderstorms)	Medium/High	Town-wide impact	Newer constructions are lightweight. Utility lines are above ground, electrical grid in Little Nahant area especially vulnerable.	NA
Non-Climate Hazard	Earthquake	Low (frequency); High (impact	Town-wide impact	Town-wide impact	Town-wide impact

SECTION 5: HAZARD MITIGATION GOALS

The Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2014 Hazard Mitigation Plan for the Town of Nahant. All of the goals are considered critical for the town, and they are not listed in order of importance. Prior to the Hazard Mitigation Plan update process, the Town of Nahant developed a climate change planning process as part of the state Municipal Vulnerability Preparedness (MVP) program. The Local HMP Team decided to incorporate climate considerations as noted in Goal 7.

GOAL 1: Promote cost-effective hazard mitigation actions that protect and promote public health and safety from all hazards with a particular emphasis on reducing damage to repetitive and severe repetitive loss properties.

GOAL 2: Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.

GOAL 3: Ensure that critical infrastructure sites are protected from natural hazards.

GOAL 4: Protect the Town's ability to respond to various natural hazard events.

GOAL 5: Increase awareness of the benefits of hazard mitigation through outreach and education.

GOAL 6: Increase coordination and cooperation between Town departments in implementing sound hazard mitigation planning and sustainable development.

GOAL 7: Consider the potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.

SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Nahant are a combination of zoning, land use, and environmental regulations, infrastructure maintenance, and drainage infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems, while large scale capacity problems may require pipe replacement or invert elevation modifications. These more expensive projects are subject to the capital budget process and lack of funding is one of the biggest obstacles to completion of some of these.

The Town's existing mitigation measures, which were in place prior to the original 2005 Plan, are listed by hazard type here and are summarized in Table 34 below. Many upgrades to existing measures have occurred and are noted in the following sections.

EXISTING TOWN-WIDE MITIGATION FOR FLOOD-RELATED HAZARDS

It is an ongoing effort for Nahant to address both inland and coastal flooding across town. Existing town-wide mitigation measures include the following:

National Flood Insurance Program (NFIP)

Flooding is the most frequent and widespread hazard in Nahant and the Town employs a number of practices to help minimize potential flooding its impacts. Active participation in the National Flood Insurance Program (NFIP) is one of the Town's key mitigation strategies. The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements. The Town also encourages all eligible homeowners to obtain insurance.

FEMA maintains a database on flood insurance policies and claims. MAPC, on behalf of the Town of Nahant, has requested updated data, which FEMA anticipates releasing by end of 2021. The following information is the latest available for the Town of Nahant:

Flood insurance policies in force (as of December 31, 2014)	256
Coverage amount of flood insurance policies	$67,079,500
Premiums paid	$476,400
Closed losses (Losses that have been paid)	311
Total payments (Total amount paid on losses)	$4,569,694.50

The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.

Public Works Operations/Maintenance Activities

The Public Works Department (DPW) actively maintains the Town's storm drain system. The following specific activities serve to maintain the capability of the drainage system through the reduction of sediment and litter build up and proper maintenance and repair.

- Street sweeping is conducted weekly.
- Catch basins are cleaned once every two years to prevent sedimentation. The Town has continued replacing dysfunctional catch basins with new deep-sump catch basins.
- Roadway treatments: Streets are treated with a 50/50 mix of sand and salt.
- Continued repair and rehabilitation of drainage systems. Routine maintenance and systematic replacements are part of DPW's operating budget.

The Town also programs infrastructure special projects into its Capital Improvements Plan.

Town of Nahant Master Plan

The most recent Nahant Master Plan was adopted in 1986. The Town is currently working with a consultant to complete an updated Master Plan; hazard mitigation measures, particularly related to sea level rise, have been incorporated into the final draft.

Nahant Open Space Plan

The latest comprehensive Open Space and Recreation Plan was completed in 2008. The plan identifies a number of open space parcels and actions to improve environmental quality, which could also benefit hazard mitigation efforts. In 2016, the town conducted a conceptual design exercise which began primarily as an analysis of the existing recreation features located throughout the Flash Road recreation facility, as part of the upcoming Open Space & Recreation Master Plan.

An Open Space and Recreation Plan Committee was appointed in late May 2019 as a joint appointment by the Moderator and Board of Selectmen (pursuant to Article 29 of the 2014 Annual Town Meeting). The Committee is charged with drafting and implementing an updated Open Space and Recreation Plan that will include an inventory of open spaces and recreation areas in Nahant. Due to COVID-19 pandemic, efforts to update the Plan have been significantly delayed and begun to continue again in 2021. Over the Summer of 2021, the Committee released a community survey to capture what the townspeople would like to see in Nahant open spaces and parks. Completion of the updated Open Space and Recreation Plan is in progress.

Community Preservation Act

The Town adopted the Community Preservation Act in 2004.

Floodplain District Zoning

Zoning is intended to protect the public health and safety through the regulation of land use. The Nahant Zoning Bylaw includes a Flood Plain District (Section 10). The purposes of this district are:

- To provide that lands in the Town of Nahant, subject to seasonal or periodic flooding, as described hereinafter, shall not be used in such a manner as to endanger the health or safety

of the occupants thereof, or of the public generally, or as to burden the public with cost resulting from unwise individual choices of land use.

- To assure the continuation of the natural flow pattern of the water courses within the Town and to minimize the impact of coastal storms, in order to protect persons and property against the hazards of flood inundation.

The Floodplain District is an overlay district and is defined as all lands in the Town which are within the boundaries of the areas designated as "A", or "V" zones, as delineated on a map entitled, "Flood Insurance Rate Map", dated September 28, 1984. Certain areas shown on the map as within or not within the flood plain may be subject to a Determination of Applicability by the Conservation Commission, in accordance with the state Wetlands Protection Regulations.

Within the District, no new construction of buildings, or substantial improvements to, or relocation of existing buildings shall be undertaken except as provided through a Special Permit issued by the Zoning Board of Appeals. "Substantial improvements", as used in this Section 10 is any repair, reconstruction or improvement of a structure, the cost of which equals or exceeds 50% of the actual cash value of the structure, either before the improvement is started or, if the structure has been damaged and is being restored, before the damage occurred. No dwelling lawfully existing prior to the adoption of the Flood Plain District regulations may be altered or enlarged by the addition of more than 20% of the existing ground coverage, and no existing structures in the Coastal High Hazard Area designated as IV-311 on the Map shall be expanded except by Special Permit.

Reconstruction, substantial improvements, and relocations are permitted by Special Permit within the Flood Plain District, if they are:

- Located landward of the reach of high tide;
- Elevated on adequately anchored piles with lowest floor level, including basement, at or above base flood elevation as shown on the FIRM map, with space below lowest floor free of obstructions.
- All new or replaced utilities and facilities, such as sewer, septic, gas, electrical and water systems are to be located and constructed to minimize flood damage and adequate drainage shall be provided so as to reduce exposure to flood hazards.
- No fill shall be used for structural support, and there must be a certification by the registered architect or engineer that the structure is secured to pilings in such a manner as will withstand velocity waters and hurricane wave wash.

In addition, all development activity in the District must meet all other applicable codes and regulations.

Site Plan Review- Section 9.09

Site Plan Review applies within the B-1 and B-2 zoning districts to all proposed change of uses involving at least 1,000 square feet of gross floor area within an existing structure and greater than 500 square feet of gross floor area in new structures. All projects must, in addition to other requirements, meet the following conditions:

- Minimize tree and soil removal. All grade changes must be in keeping with the surrounding neighborhood.
- Surface drainage must not adversely impact neighboring properties, or the public storm drain system.
- All open and enclosed spaces must be designed to facilitate building evacuation and maximize access by emergency personnel and equipment.
- Projects must minimize impacts from all new structures and hard-surface ground coverage on all light, air and water resources.

Natural Resource Protection District – Section 4.10

The Natural Resource District is intended for natural resource and recreation uses in accordance with the following purposes:

- The preservation and maintenance of protected wildlife and wetlands resource areas and habitats.
- The protection of the Town against the costs which may be incurred when unsuitable development occurs in swamps, marshes, along water courses, in areas of high impact due to overcrowding of land and undue concentration of population, or on slopes subject to erosion.
- To preserve and increase the amenities of the Town and foster enjoyment of its remaining natural resources as recreational values.
- To conserve natural conditions, wildlife and open space for the education, passive and active recreation and general welfare of the public.

Allowed uses, by Special Permit granted by the Zoning Board of Appeals include the following:

- Boathouses and other non-profit recreational uses;
- Utility lines where other access is not feasible; and
- Environmental restoration or reclamation projects.

Subdivision Control Regulations

Section 4.13 of the Rules Governing the Subdivision of Land states that lots shall be prepared and graded in such a manner that the development of one shall not cause detrimental drainage on another.

Section 4.14 (B)- Easements mandates that stormwater easements must be provided where a waterway crosses a subdivision.

Section 4.19- Floodplains and Wetlands requires that subdivision meet requirements of MGL Chapter 131, Section 40 and the Nahant Flood Plain District, where applicable.

Section 4.18 - Natural Features calls for the due regard and preservation of natural features within the proposed subdivision and the prohibition on the taking of larger trees from the site, unless found not to be in conflict with lot drainage concerns and allowed by the Planning Board.

Stormwater Management and Construction Site Management Ordinance & Stormwater Management Plan

Nahant has an up-to-date Stormwater Management Plan that meets its NPDES MS4 permit requirements, including bylaws to address onsite stormwater management and runoff.

DCR Dam Safety Regulations

The state has enacted dam safety regulations mandating inspections and emergency action plans. All new dams are subject to state permitting. There are no dams located within Nahant.

Public Outreach and Education

The Emergency Management Department provides some information on flooding, fire safety and snow hazards, respectively, on its website. The Town also offers information and outreach on stormwater management and water conservation at its stormwater management homepage. The Town also plans to increase outreach to identified repetitive loss property owners.

EXISTING TOWN-WIDE MITIGATION FOR WIND-RELATED HAZARDS

Massachusetts State Building Code

The town enforces the Massachusetts State Building Code whose provisions are generally adequate to protect against most wind damage. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence. If a tornado were to occur, the potential for severe damages would be extremely high.

Tree-trimming program

The Town and National Grid conduct tree maintenance on public property. The Town has equipment to trim and remove trees as needed.

EXISTING TOWN-WIDE MITIGATION FOR WINTER-RELATED HAZARDS

Snow disposal

The town conducts general snow removal operations with its own equipment and has adequate snow storage/disposal space. Where necessary, snow is removed and dumped on other Town properties.

Massachusetts State Building Code

The town enforces the Massachusetts State Building Code, which contains regulations regarding snow loads on building roofs. The town has adopted the state building code.

EXISTING TOWN-WIDE MITIGATION FOR FIRE-RELATED HAZARDS

Burn Permits

The Nahant Fire Department follows the State guidelines for outdoor burning. Outdoor burn season is from January 15 through May 1 and a permit is required.

Subdivision/Development Review

The Fire Department participates in the review of new subdivisions and development projects.

EXISTING TOWN-WIDE MITIGATION FOR GEOLOGIC HAZARDS

Massachusetts State Building Code

The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is "to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake". This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be "prudent and economically justified" for the protection of life safety. The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

EXISTING TOWN-WIDE MITIGATION FOR MULTIPLE HAZARDS

Comprehensive Emergency Management Plan (CEMP)

Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, hurricanes, tornadoes, dam failures, earthquakes, and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to all of the hazards discussed in this plan.

Local Emergency Planning Committee (LEPC)

The LEPC is active and led by the Fire Department, which meets on a quarterly or as-needed basis.

Communications Equipment

Nahant has full police and fire radio coverage and is in the process of upgrading to ultra-high band width frequencies. Incident command units are available through Essex County and MEMA. The Town has added Reverse 911 capacity.

Emergency Power Generators

The Town maintains emergency power generators in several important public facilities and emergency shelters. These include the Johnson Elementary School (emergency shelter), the Fire Station and the DPW facility. In the past five years, the Town installed fixed, natural gas generator at Town Hall, and upgraded other critical facility generators as needed.

Massachusetts State Building Code

The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads. The Town has adopted the state building code.

COMPILATION OF EXISTING MITIGATION

Table 32 summarizes the many existing natural hazard mitigation measures already in place in Nahant when the last Hazard Mitigation Plan was developed in 2014. Because of the number of entities, public and private, involved in natural hazard mitigation, it is likely that this list is a starting point for a more comprehensive inventory of all measures.

Table 32: Existing Natural Hazard Mitigation Measures in Nahant

Type of Existing Mitigation	Effectiveness Y/N	Improvements/Changes Needed (since 2014 Plan)
FLOOD HAZARDS		
1) National Flood Insurance Program (NFIP)	Y	Encourage all eligible homeowners to obtain insurance.
2) Street sweeping	Y	
3) Catch basin cleaning	Y	
4) Roadway treatments	Y	
5) Town Master Plan	Y	In progress – Incorporating hazard mitigation and sea level rise mitigation into final adopted draft.
6) Conservation/Recreation Open Space Plan	N	In progress – Plan being updated
7) Community Preservation Act	Y	
8) Floodplain Zoning District	Y	
9) Site Plan Review- Section 9.09	Y	
10) Natural Resource Protection District – Section 4.10	Y	
11) Subdivision Control Regulations	Y	
12) Stormwater Management and Construction Site Management Ordinance	Y	
13) DCR Dam safety regulations/ Dam maintenance and safety	N/A	
14) Public Education	Y	Increasing outreach to repetitive loss property owners.

Type of Existing Mitigation	Effectiveness Y/N	Improvements/Changes Needed (since 2014 Plan)
WIND HAZARDS		
15) Massachusetts State Building Code	Y	
16) Tree-trimming program	Y	
WINTER HAZARDS		
17) Snow disposal	Y	
FIRE HAZARDS		
18) Burn Permits	Y	
19) Subdivision/Development Review	Y	
GEOLOGIC HAZARDS		
20) Massachusetts State Building Code	Y	
MULTI-HAZARDS		
21) Comprehensive Emergency Management Plan (CEMP)	Y	
22) Local Emergency Planning Committee (LEPC)	Y	The LEPC would like to investigate additional training for air crash response and oil spill containment in conjunction with Revere and Winthrop LEPCs.
23) Communications Equipment	Y	Added Reverse 911 capacity
24) Emergency Power Generators	Y	Installed fixed, natural gas fueled generator at Town Hall. Upgrade other critical facility generators as needed.
25) Massachusetts State Building Code	Y	

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

Under the Massachusetts system of "Home Rule," the Town of Nahant is authorized to adopt and from time to time amend local ordinances and regulations that support the town's capabilities to mitigate natural hazards. These include Zoning Ordinances, Subdivision and Site Plan Review Regulations, Wetlands Ordinance, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Ordinances may be amended by the Town Council to improve the town's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission. The Town of Nahant has recognized several existing mitigation measures that require implementation or improvements and has the capacity within its local boards and departments to address these.

The Town can improve its hazard mitigation capabilities with the following measures:

- Update the Floodplain District to incorporate requirements of the new state model Floodplain bylaw.

- Consider adopting Low Impact Development (LID) best practices and/or incorporating LID requirements more formally into a bylaw to ensure it becomes widely adopted in new developments and redevelopments
- Consider adopting a Stormwater Utility or stormwater user fee to provide a dedicated, predictable revenue stream to finance upgrades to the stormwater infrastructure. This would address the noted need for additional funds for DPW for maintenance and rehabilitation of stormwater systems.
- Incorporate climate resilience in the local wetlands bylaw and regulations.
- Analyze future threats to critical infrastructure, facilities, and residences based on projections of sea level rise and increasing storms.

SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

The Local HMP Team reviewed the mitigation measures identified in the 2014 Nahant Hazard Mitigation Plan and determined whether each measure had been implemented or deferred. Of those measures that had been deferred, the committee evaluated whether the measure should be deleted or carried forward into this Hazard Mitigation Plan 2021 Update. The decision on whether to delete or retain a particular measure was based on the committee's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the Town to take action on the measure. Table 33 summarizes the status of mitigation measures from the 2014 Plan.

Table 33: Mitigation Measures from the 2014 Plan

Recommended Mitigation Action (in 2014 Plan) *Note: Measures retained from 2005 Plan are marked with (*)*	**Priority**	**Current Status**	**Include in 2021 Plan**
1. *Forty Steps Beach: finish repairs to seawall.	High	In progress – in permitting; Received FEMA grant to complete project in the next 2 years.	Yes
2. *Tudor Beach/Town Wharf Seawall: finish repairs and repointing of seawalls.	High	Complete repairs. Repointing is ongoing.	Yes – change to "Medium" Priority
3. *Bear Pond tributaries: Complete the dredging of Bear Pond tributaries	High	Complete – the Town has completed dredging the ditches as planned. This project is now just a routine maintenance program.	No
4. *Repair Wilson Road Seawall (MA DCR)	High	This action is now a coordination program with DCR to continue repairing and maintaining the seawall.	No
5. *Reconstruct the Nahant Causeway (drainage system) (MA DCR)	High	Complete	No
6. Floodplain District Management	High	This action is now part of the Town's ongoing coordination program to continue updating the Floodplain Zoning District and associated building regulations for floodplain areas to remain consistent with FEMA guidelines and floodplain mapping.	No
7. Floodplain Mapping	High	This action is now part of the Town's ongoing program to maintain maps of local FEMA's identified floodplains.	No
8. Assess and Map Community Risk (for multi-hazards)	High	In progress – due to limited funding and staff capacity, the Town is still working on developing	Yes

Recommended Mitigation Action (in 2014 Plan) *Note: Measures retained from 2005 Plan are marked with (*)*	Priority	Current Status	Include in 2021 Plan
		a database to track community vulnerability to known hazards.	
9. Integrate Mitigation into Local Planning	High	This action is now part of the Town's best practices and criteria, to be applied in upcoming capital improvement, master, and open space planning efforts.	No
10. Incentivize Hazard Mitigation	High	Not started – due to limited funding and staff capacity.	Yes
11. Increase Hazard Education and Risk Awareness	High	This action is now part of the Town's ongoing public outreach program.	No
12. Replace/upgrade emergency power generators for: sewer lift station backup capacity; Town Hall; fire and emergency shelter.	High	Not started – due to limited funding and staff capacity.	Yes
13. Purchase new pumps for emergency water removal and post-event pump out needs.	High	Complete – purchased in Fall 2019.	No
14. Purchase a new ladder/pumper truck	High	Complete – ladder purchased in 2014 and pumper truck in 2018.	No
15. Update Police, Fire and DPW handheld radio units	High	Police Dept - in progress; DPW - not started, anticipated 2022; Fire Dept – completed; ordered 24 new portable radios in 2021.	No
16. Construct new Public Safety Facility	High	Not started – due to limited funding and staff capacity.	Yes
17. Identify more resources for more frequent maintenance of Town-owned drainage facilities and infrastructure	Medium/High	This action is now part of the Town's ongoing routine and maintenance program. The Town is also considering purchase of drones to support with pre-and post-storm assessments (Police, Fire, DPW)	No
18. Complete Master Plan update, including section on climate change awareness and preparation	Medium	In progress – due to limited funding and staff capacity, this planning process is still in development.	No
19. Research and implement coastal storm emergency preparedness and outreach programs	Medium	Not started – due to limited funding and staff capacity.	Yes
20. Consider committing to the voluntary flood plain management activities within the National Flood Insurance Program's Community Rating System	Medium	Not started – due to limited funding and staff capacity.	Yes

Recommended Mitigation Action (in 2014 Plan) *Note: Measures retained from 2005 Plan are marked with (*)*	Priority	Current Status	Include in 2021 Plan
21.Repetitive Loss Area Property Owner Outreach	Medium	This action is now part of the Town's ongoing public outreach program.	No
22. Acquisition of Vacant Flood Prone Lands	Medium	Not started – due to limited funding and staff capacity.	Yes
23. Investigate and install a Reverse 911 system for emergency services messaging	Medium	Complete	No
24.Develop an inventory and assess the earthquake vulnerability of all public and commercial buildings	Low	Not started – due to limited funding and staff capacity.	Yes
25. Develop and implement a structural retrofitting program	Low	Not started – due to limited funding and staff capacity.	Yes
26. Mitigation measures for landslides	Low	Not started – due to limited funding and staff capacity.	
27. Identify options to increase manpower available to respond to pre and post hazard mitigation response	Low	Not started – Need to assess resources after the incident/event occurs. Tend to outsource to third party for staffing capacity (private contractor) rather than through Mutual Aid. Town wants to re-evaluate the process.	Yes – change to "High" priority
28. Increase outreach to Town residents on stormwater, emergency preparedness and storm event response	Low	This action is now part of the Town's ongoing public outreach program.	No
29. Participate in a regional Sea Level Rise Action Work Group with neighboring coastal communities	Low	Not started. The Town continues conversations with neighboring communities and would be interested in participating in a regional group as appropriate.	Yes
30. Protect buildings and infrastructure by retrofitting	Low	The Town continues to communicate and promote the importance/benefits of retrofitting building and infrastructure; however, the Town has not established any initiative due to limited funding and staff capacity.	Yes
31. Use snow fences or "living snow fences"	Low	Not started – due to limited funding and staff capacity.	Yes
32. Identify specific at-risk populations that may be exceptionally vulnerable in the event of long-term power outages	Low	Not started – due to limited funding and staff capacity.	Yes – change to "High" priority
33. Assess vulnerability to severe winds	Low	Not started – due to limited funding and staff capacity.	No

Recommended Mitigation Action (in 2014 Plan) *Note: Measures retained from 2005 Plan are marked with (*)*	Priority	Current Status	Include in 2021 Plan
34. Work with the local electrical utility provider and Town Department of Public Works (on wind-related hazard mitigation)	Low	This action is now part of the Town's routine maintenance program.	No
35. Promote the construction of safe rooms for tornados	Low	Not started – areas have been identified, but the Town has not involved in any project due to limited funding and staff capacity.	No
36. Encourage all Town Departments to work closely with landowners and developers to identify and mitigate conditions that aggravate wildfires	Low	This action is now part of the Town's ongoing routine and maintenance program for wildfire prevention. The Town will also continue communicating/coordinating with landowners.	No
37. Identify appropriate shelters for people who may need to evacuate due to loss of electricity and heat and make their locations known to the public	Low	This action is now part of the Town's ongoing operations program. This is now also a high priority for the community.	No
38. Develop and maintain a database to track the location of any wildfire hazard event	Low	Complete - Fire Dept has database to track MIFA.	No
39. Include the consideration of wildfire risk and mitigation in any comprehensive, capital, emergency response or open space planning efforts	Low	Complete – training and pre-planning efforts completed in 2021	No
40. Perform arson prevention cleanup activities in areas of abandoned or collapsed structures, accumulated trash or debris, and any area where spills or dumping may have occurred	Low	Complete – no attributable areas identified.	No
41. Routinely inspect the functionality of fire hydrants	Low	This action is now part of the Town's ongoing operations program. Flow testing every five years, flushing annually	No
42. Promote drought tolerant landscape design	Low	This action is now part of the Town's ongoing public outreach program.	No
43. Green Buildings and Parking areas to reduce urban heat island impacts	Low	This action is now part of the Town's ongoing public outreach program.	No

As indicated in Table 33 above, Nahant has made progress implementing mitigation measures identified in the 2005 as well as 2014 HMPs. Since 2014, high priority projects that were completed include repairing the seawalls at Tudor Beach/Town Wharf; working with DCR to

reconstruct the drainage system at the Nahant Causeway; dredging of Bear Pond tributaries; and purchasing emergency water and firefighting equipment. Many of the mitigation measures are also in progress or got built in as part of the Town's ongoing operations and maintenance efforts and public outreach program. Most retain the same priority in this 2021 Update, a couple measures previously indicated as "Low" will be elevated to "High" priority in this plan.

Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision-making processes. The challenges the Town faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the Town prioritize the best use of its limited resources for enhanced mitigation of natural hazards.

SECTION 8: HAZARD MITIGATION STRATEGY

WHAT IS HAZARD MITIGATION?

Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, education programs, infrastructure projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation program (PDM), and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

https://www.fema.gov/hazard-mitigation-grant-program
https://www.fema.gov/pre-disaster-mitigation-grant-program
https://www.fema.gov/flood-mitigation-assistance-grant-program

According to FEMA Local Multi-Hazard Mitigation Planning Guidance, identified measures can generally be sorted into the following groups:

- **Prevention**: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection**: Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter resistant glass.
- **Public Education & Awareness**: Actions to inform and educate citizens, elected officials, and property owners about the potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- **Natural Resource Protection**: Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Structural Projects**: Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms.
- **Emergency Services Protection**: Actions that will protect emergency services before, during, and immediately after an occurrence. Examples of these actions include protection of warning system capability, protection of critical facilities, and protection of emergency response infrastructure.

REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. Other issues are inter-community and require cooperation between two or more municipalities. There is a third level of mitigation which is regional and may involve a state, regional or federal agency or three or more municipalities.

REGIONAL PARTNERS

In developed urban and suburban communities such as the metropolitan Boston area, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are complex systems of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including the Town, the Department of Conservation and Recreation (DCR), the Massachusetts Department of Transportation (MassDOT) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operation, and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities' regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and they must make decisions about numerous competing priorities.

Following, is a brief overview of regional facilities found in Nahant and a discussion of inter-municipal issues.

OVERVIEW OF REGIONAL FACILITIES WITHIN NAHANT

Major facilities owned, operated, and maintained by state or regional entities include:

- The Lynn-Nahant Causeway (Mass DCR)
- DCR Maintenance Facility (Mass DCR)
- MWRA Bypass Valve (MWRA)
- Nahant Thicket Wildlife Sanctuary (Mass Audubon)

INTER-COMMUNITY CONSIDERATIONS

Nahant, along with the neighboring communities of Revere and Winthrop are in close proximity to Logan International Airport which is one of the nation's busiest airports. As a consequence, Nahant emergency personnel have expressed a desire to work with both Revere and Winthrop emergency responders to be trained in how all three communities can serve as staging areas for air accidents occurring either at Logan Airport or in the surrounding Atlantic Ocean.

Furthermore, Nahant is also interested in collaborating with the City of Lynn on various climate mitigation and resiliency planning efforts, given Nahant's single access to the mainland is via the Causeway and Lynn Rotary.

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan update, the Town considered the issues related to new development, redevelopment, and infrastructure needs in order limit future risks.

Taking into consideration the town's Wetlands bylaw enforced by the Conservation Commission, the floodplain zoning overlay, the stormwater bylaw, the Open Space and Recreation Plan, and the Municipal Vulnerability Preparedness priority actions, the town determined that existing regulatory measures are taking good advantage Home Rule land use regulatory authority to minimize natural hazard impacts of development. Priorities for the future include conducting a town-wide assessment of roads and culverts vulnerable to drainage problems and prioritize improvement projects.

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

The last step in developing the Town's mitigation strategy is to assign a level of priority to each mitigation measure so as to guide the focus of the Town's limited resources towards those actions with the greatest potential benefit. At this stage in the process, the Local Hazard Mitigation Planning Team had limited access to detailed analyses of the cost and benefits of any given mitigation measure, so prioritization is based on the local team members' understanding of existing and potential hazard impacts and an approximate sense of the costs associated with pursuing any given mitigation measure.

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the Town's goals. In addition, the Local HMP Team also took into consideration factors such as the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

Table 34 below demonstrates the prioritization of the Town's potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event

Estimated Costs	
High	Estimated costs greater than $100,000
Medium	Estimated costs between $10,000 to $100,000
Low	Estimated costs less than $10,000 and/or staff time
Priority	
High	Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure
Medium	Action may have political and public support and necessary maintenance has potential to occur following the project
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project

INTRODUCTION TO MITIGATION MEASURES TABLE

Description of the Mitigation Measure – The description of each mitigation measure is brief and cost information is given only if cost data were already available from the community. The cost data represent a point in time and would need to be adjusted for inflation and for any changes or refinements in the design of a particular mitigation measure.

Priority – As described above and summarized in Table 34, the designation of high, medium, or low priority was done considering potential benefits and estimated project costs, as well as other factors in the STAPLEE (Social, Technical, Administrative, Legal, Economic, and Environmental) analysis.

Implementation Responsibility – The designation of implementation responsibility was done based on a general knowledge of what each municipal department is responsible for. It is likely that most mitigation measures will require that several departments work together and assigning staff is the sole responsibility of the governing body of each community.

Time Frame – The time frame was based on a combination of the priority for that measure, the complexity of the measure and whether or not the measure is conceptual, in design, or already designed and awaiting funding. Because the time frame for this plan is five years, the timing for all mitigation measures has been kept within this framework. The identification of a likely time frame is not meant to constrain a community from taking advantage of funding opportunities as they arise.

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated, or designed, or if it is still in the conceptual stages. MEMA and DCR assisted MAPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency has specific eligibility requirements that would need to be taken into

consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for, or selected for, funding. Upon adoption of this plan, the local team responsible for its implementation should begin to explore the funding sources in more detail.

Additional information on funding sources – The best way to determine eligibility for a particular funding source is to review the project with a staff person at the funding agency. The following websites provide an overview of programs and funding sources.

Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is http://www.nae.usace.army.mil/. The ACOE provides assistance in a number of types of projects including shoreline/streambank protection, flood damage reduction, flood plain management services and planning services.

Massachusetts Emergency Management Agency (MEMA) – The grants page https://www.mass.gov/hazard-mitigation-assistance-grant-programs describes the various Hazard Mitigation Assistance Program.

Table 34: Mitigation Measures Prioritization

CLIMATE CHANGE	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
Changes in Precipitation 	**INLAND FLOODING**							
	Evaluate drainage solutions through a combination of green infrastructure solutions and installation of storm water pumping stations or pumping basins.	Town-wide	DPW	1-2 years	High	High	State grant FEMA/BRIC	High
	Develop an implementation plan to improve drainage in the Lowlands areas.	Site specific	DPW	1-2 years	High	Medium	State grant FEMA/BRIC	High
	Assess the need for adding a stormwater pumping station or pumping station in the Furbush Road area.	Site-specific	DPW	1-2 years	High	Medium	State grant	High
	Dredge natural ditches and upgrade water storage capacity in the Lowlands and Furbush Road area.	Site-specific	DPW	3-5 years	High	High	State grant	High
	Repair and replace the stormwater drainage system on Castle Road to improve drainage in the Lowlands.	Site specific	DPW	3-5 years	High	High	State grant	High
	Develop a plan to identify and correct infiltration issues associated with the sewer system.	Town-wide	DPW	1-2 years	High	Medium	Town	High
	Address flooding concerns of the Lynn Rotary.	Rotary	DPW	Ongoing	High	Medium	Town	High
	Review local regulations and bylaws to encourage green infrastructure installations to reduce stormwater runoff.	Town-wide	DPW Inspection + Conservation Comm.	1-2 years	High	Low	Town	Medium

CLIMATE CHANGE	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
	Create large water storage, detention areas or bioswales, and assess potential solutions for fast water removal.	Town-wide	DPW	3-5 years	High	High	Town	Medium
	Consider the use of pervious materials such as wooden slats and evaluate the use of fabric synthetic material as alternatives to concrete or paved walkways at selected locations.	Town-wide	DPW	Ongoing	Medium	Medium	Town	Medium
	Conduct a town-wide study of roads vulnerable to flooding.	Town-wide	DPW	1-2 years	High	Medium	State grant	High
	In a regional approach with neighboring communities, develop a long-term plan to reduce combined sewer overflow to maintain beach water quality.	Regional	DPW	3-5 years	High	Medium	State grant	High
	Establish a "flood protection" section on the Town's website.	Town-wide	DPW Emergency Management	1-2 years	Medium	Low	Town	Medium
	Work with private property owners on ways to mitigate/minimize stormwater inflow from properties and/or incentive program for installation of on-site rainwater infiltration and storage (e.g., rain barrels, etc.).	Site-specific	DPW	1-2 years	High	High	FEMA	High
	Explore opportunities working with FEMA to identify strategic solutions for individual property locations.	Site-specific	DPW	1-2 years	High	Low	FEMA	High
	DROUGHT							
	Promote installation of natural rain gardens, rain barrels, and other natural storage areas for water, especially in the Lowlands.	Town-wide (prioritized Lowlands)	Conservation Commission	1-2 years	Medium	Low	Town	Medium

CLIMATE CHANGE	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
	Require drought resilient landscaping in development permits.	Town-wide	Inspection Services?	1-2 years	Medium	Low	Town	Medium
	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
	LANDSLIDE							
	Assess steep slopes that are potentially vulnerable to failure.	Site specific	DPW	3-5 years	Medium?	Medium	Town	Medium
Sea Level Rise 	**COASTAL FLOODING (AND TSUNAMIS)**							
	Develop a long-term coastal defense plan.	Town-wide	Emergency Management	3-5 years	High	Medium	State grant	Medium
	Develop a coastal resilience plan.	Town-wide	Emergency Management	1-2 years	High	Medium	State grant	High
	Enhance protection of town's pump stations and basins.	Town-wide	DPW	3-5	High	Medium?	FEMA/BRIC State grant	High
	COASTAL EROSION							
	Restore the coastal dune along Short Beach to prevent flooding from storm events.	Site specific	DPW	3-5 years	High	High	FEMA/BRIC	High
	Develop town policies for dune management.	Town-wide	DPW	1-2 years	High	Medium	Town	High
	Coordinate with the Massachusetts Office for Coastal Zone Management (CZM) and incorporate more living shoreline at selected beaches.	Town-wide	DPW Emergency Management	3-5 years	Medium	Medium	State grant	Medium
	Continue monitoring identified coastal erosion sites	Town-wide	Emergency Management	Ongoing	Medium	Low	Town	Medium
	Continue pursuing funding for land acquisition.	Town-wide	Emergency Management	Ongoing	Medium	High	State grant	Medium/ Low?
	EXTREME HEAT AND HEAT WAVES							

CLIMATE CHANGE	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
Rising Temperatures 	Implement site design requirements to increase tree planting.	Town-wide	Planning Board?	1-2 years	Medium	Low	Town	Medium
	Maintain and increase native tree species around town.	Town-wide	Conservation Commission	1-2 years	Medium	Low	Town	Medium
	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
	WILDFIRES							
	Continue promoting brush fire and fire prevention education.	Town-wide	Emergency Management	Ongoing	Medium	Low	Town	Low
	INVASIVE SPECIES							
	Coordinate with state agencies on beach /dune management, invasive species removal and management through the Safe Water Initiative Massachusetts (SWIM) program.	Town-wide	Conservation Commission?	1-2 years	Medium	Low	State grant	Medium
	Develop education program on benefits of nature-based solutions, invasive species management, and regenerative practices, along with the use of pesticides.	Town-wide	Conservation Commission	1-2 years	Medium	Low	Town	Medium
	Review town tree policy to enforce removal of invasive species as necessary.	Town-wide	Conservation Commission	1-2 years	Medium	Low	Town	Medium
	Include invasives management in permit requirements.	Town-wide	Conservation Commission	1-2 years	Medium	Low	Town	Medium
	SEVERE WINTER STORM/NOR'EASTER							
	Replace selected impervious surfaces with permeable solutions.	Site-specific	DPW	3-5 years	Medium	High	State grant	Medium

CLIMATE CHANGE	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
	Floodproof electric and gas utilities located in the Lowlands area.	Site-specific	DPW	3-5 years	High	High	State grant	High
	Enhance natural ecosystems including eelgrass habitats and living shorelines to reduce the vulnerability to storm damage.	Town-wide	Conservation Commission	3-5 years	High	Medium	State grant	Medium?
	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
	OTHER SEVERE WEATHER (STRONG WINDS, THUNDERSTORMS)							
	Advocate for putting existing overhead electrical lines underground.	Town-wide	DPW	3-5 years	Medium	High	State grant	Medium
	Evaluate vulnerabilities of municipal buildings.	Muni buildings	DPW	1-2 years	High	Medium	Town State grant	High
Multi-hazards	**MULTI-HAZARDS**							
	Continue coordination with Lynn and Swampscott and their schools to arrange for "across the Causeway" shelters in case of emergency.	Site-specific	Emergency Management	Ongoing	Medium	Low	Town	Low
	Continue pursuing federal program for military surplus vehicles to supply medical supplies, food, staffing during emergencies with access limitations.	Town-wide	Emergency Management	Ongoing	Medium	Medium	Town	Medium
	Review and update emergency planning documents (including EOC communications, LEPC evaluation, and CEMP).	Town-wide	Emergency Management	Ongoing	Medium	Low	Town	Medium
Non-Climate Hazard	**EARTHQUAKE**							
	Education and outreach on earthquake risks.	Town-wide	Emergency Management	3-5 years	Low	Low	Town	Low

DESCRIPTION OF MITIGATION MEASURES

CHANGES IN PRECIPITATION

Inland Flooding

Evaluate drainage solutions: Conduct an updated drainage study and remedial action plan, with particular prioritization for the Lowlands area, along the golf course, and Furbush area. Solutions include a combination of installing green infrastructure and storm water pumping stations or pumping basins.

Develop an implementation plan to improve drainage in the Lowlands areas, including replacing or enlarging drainage pipes, and installing a stormwater pumping station or pumping basin in the Lowlands area.

Assess the need for adding a stormwater pumping station or pumping station in the Furbush Road area.

Dredge natural ditches and upgrade water storage capacity in the Lowlands and Furbush Road area, including culvert improvements along the ditches.

Repair and replace the stormwater drainage system on Castle Road to improve drainage in the Lowlands.

Develop a plan to **identify and correct infiltration issues** associated with the sewer system.

Collaborate with Department of Conservation & Recreation (DCR) and neighboring communities, including City of Lynn, to **address flooding concerns of the Lynn Rotary**. This includes integrating flooding concerns into existing traffic study for the Lynn Rotary for redesign (long term) and improving support for emergency communications associated with causeway access.

Review local regulations and bylaws to encourage green infrastructure installations. Example solutions include (but are not limited to) rain gardens, bioswales, and/or use of permeable surfaces such as porous pavers to reduce stormwater runoff.

Create large water storage, detention areas or bioswales, and **assess potential solutions for fast water removal**.

Consider the use of pervious materials such as wooden slats and evaluate the use of fabric synthetic material as alternatives to concrete or paved walkways at selected locations.

Conduct a town-wide study of roads vulnerable to flooding. The study should identify and evaluate areas (of vulnerable roads) that need to be regrade. It should also explore feasibility of installing bioswales at select locations in town to support additional capacity of water runoff if necessary.

In a regional approach with neighboring communities, **develop a long-term plan to reduce combined sewer overflow** to maintain beach water quality. The Town of Nahant is currently in compliance with EPA and MWRA requirements associated to wastewater management. This

regional collaboration will also help further support City of Lynn and Town of Swampscott with their compliance.

Establish a "flood protection" section on the Town's website and have flood protection publications available that address flood proofing and mold protection measures. Identify resources and best practices to address mold mitigation problems due to flooding.

Work with private property owners on ways to mitigate/minimize stormwater inflow from properties and/or incentive program for installation of on-site rainwater infiltration and storage (e.g., rain barrels, etc.). Evaluate opportunities for collaboration and increased participation of residents, including:

- Identifying areas for citizen volunteer involvement to install green infrastructure solutions; look into establishing programs such as "adopt a rain barrel" etc.
- Identifying instances for key private property owner involvement; explore incentives such as matching state, municipal, private, and other grants.
- Consider the restoration and maintenance plan for the Mass Audubon Furbush thicket.

Explore opportunities **working with FEMA to identify strategic solutions** for individual property locations.

Drought

Promote installation of natural rain gardens, rain barrels, and other natural storage areas for water, especially in the Lowlands.

Require drought resilient landscaping in development permits.

Landslide

Identify areas of potential landslide risk. The Town will review potential landslide risk locations. Assess steep slopes that are potentially vulnerable to failure.

SEA LEVEL RISE

Coastal Flooding (and Tsunamis)

Restore the coastal dune along Short Beach. This project will restore the continuous coastal dune along Short Beach to prevent coastal storms from flooding Nahant Road, the only evacuation route for 60% of Nahant's residents. Specifically, the project will increase the height of 2,860 LF of the dune fronting the Nahant Life Saving Station on Short Beach from 14-15' to 18' and raise and restore the three public access points to Short Beach. The existing concrete access points cut through the dune and serve as conduits for storm surge, flooding Nahant Road and low-lying areas of Town.

Develop a long-term coastal defense plan for the entire coastline to enhance natural ecosystems to reduce the vulnerability to storm damage including a living shoreline & dune management plan.

Develop a coastal resilience plan. This plan will identify and prioritize mitigation and resilience solutions to address more specific coastal hazards in Nahant such as flooding, shore erosion, etc.

Coastal Erosion

Work with private property owner to mitigate coastal erosion areas: Identify locations at risk and work with property owners to institute appropriate strategies to reduce coastal erosion.

Enhance protection of town's pump stations and basins. With the majority of pump stations and basins in Nahant located in flood-prone areas, it will be critical to continue planning for and incorporate measures to protect these systems from overwhelming flows.

Develop town policies for dune management, including restoration, mowing plans, and access plans (for DPW). Recommendations for priority dune restoration include the Castle Road Beach, between the Dill and Quinn homes, Doggie Beach (also known as Black Rock Beach) and Short Beach.

Coordinate with the Massachusetts Office for Coastal Zone Management (CZM) and incorporate more living shoreline at selected beaches. Dune restoration will help to stabilize the sand and control further erosion. Recommendations for priority dune restoration include the Castle Road Beach, between the Dill and Quinn homes, Doggie Beach (also known as Black Rock Beach) and Short Beach.

Continue monitoring identified coastal erosion sites. The Town will continue, in collaboration with community members, to track as well as to identify any additional potential sites susceptible and/or at higher risk of coastal erosion.

Continue pursuing funding for land acquisition. Work with state agencies and private landowners in town to acquire and/or purchase conservation easements. Land acquisition serves as a mitigation technique to prevent further developments and protect specific areas in town against natural hazards. The Town will continue identifying appropriate potential areas for acquisition consideration, including places that are in floodplains, highly susceptible to brushfire risk, steep slopes, etc.

RISING TEMPERATURES

Extreme Heat and Heatwaves

Implement site design requirements to increase tree planting. Implement site design requirements to increase tree cover in areas such as parking lots and "larger" developments.

Maintain and increase native tree species around town. Explore volunteer planting programs.

Wildfires

Continue promoting brush fire and fire prevention education. The Fire Department participates in community events providing targeted outreach and informational brochures. The Fire Department maintains a web page with fire prevention materials.

Invasive Species

Coordinate with state agencies on beach /dune management, invasive species removal and management through the Safe Water Initiative Massachusetts (SWIM) program.

Develop education program on benefits of nature-based solutions, invasive species management, and regenerative practices, along with the use of pesticides. Develop town policies for dune management, including restoration, mowing plans, and access plans (for DPW). Organize a community beach cleanup team and/or cleanup days (e.g. trash and invasive species removal).

Review town tree policy to enforce removal of invasive species as necessary.

Include invasives management in permit requirements.

EXTREME WEATHER

Severe Winter Storm/Nor'easter

Replace selected impervious surfaces with permeable solutions, which create flood pathways in case of storms with storm surges. Potential locations include the parking lots at Short Beach/Spring Road, Nahant Road, and Castle Road entrances.

Floodproof electric and gas utilities, particular for those located in the Lowlands. Example of floodproofing measures include elevating generator, raising building, and replacing current pipes with non-corrosive gas pipes.

Enhance natural ecosystems including eelgrass habitats and living shorelines **to reduce the vulnerability to storm damage.**

Other Severe Weather (Strong Winds, Thunderstorms)

Advocate for putting existing overhead electrical lines underground. Where possible, potentially in new or redevelopment sites, relocate electrical lines underground to prevent power outages due to high winds during extreme weather events.

Evaluate vulnerabilities of municipal buildings. Many of the municipal buildings also serve as emergency shelters. As such, it is critical to assess and ensure that these facilities are in good shape and safe in the event of town-wide emergency services.

Multi-hazards

Continue coordination with Lynn and Swampscott and their schools to arrange for "across the Causeway" shelters in case of emergency. It should be noted that some arrangements are already in place.

Continue pursuing federal program for military surplus vehicles to supply medical supplies, food, staffing during emergencies with access limitations.

Review and update critical emergency planning documents, including EOC communications, LEPC evaluation, and CEMP.

NON-CLIMATE HAZARD

Earthquake

Continue providing education and outreach on earthquake risks. While earthquake is a low probability, it can have significant impact to the town and its residents. Therefore, it is necessary to understand the associated risks and be prepared for.

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION

The Nahant Hazard Mitigation Plan 2021 Update was adopted by the Town Council on **February 18, 2022**. See Appendix D for documentation. The plan was approved by FEMA on **February 28, 2022**, for a five-year period that will expire on **February 27, 2027**.

PLAN MAINTENANCE

MAPC worked with the Nahant Local Hazard Mitigation Planning Team to prepare this plan. This group will continue to meet on an as-needed basis to coordinate the implementation and maintenance of this plan. A member of the Town staff will be designated as the team coordinator. Additional members could be added to the local team from businesses, non-profits, and institutions. The Town will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Hazard Mitigation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Team will be publicly noticed in accordance with town and state open meeting laws.

IMPLEMENTATION AND EVALUATION SCHEDULE

Mid-Term Survey on Progress – The coordinator of the Hazard Mitigation Team will prepare and distribute a survey in year three of the plan. The survey will be distributed to all the local team members and other interested local stakeholders. The survey will poll the members on progress and accomplishments for implementation, any new hazards or problem areas that have been identified, and any changes or revisions to the plan that may be needed.

This information will be used to prepare a report or addendum to the local hazard mitigation plan in order to evaluate its effectiveness in meeting the plan's goals and identify areas that need to be updated in the next plan. The Hazard Mitigation Implementation Team will have primary responsibility for tracking progress, evaluating, and updating the plan.

Begin to 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 in order 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 Hazard Mitigation Implementation Team will begin to prepare for an update of the plan in year three. This will help the Town avoid a lapse in its approved plan status and grant eligibility when the current plan expires.

The Hazard Mitigation Implementation Team will use the information from the Mid-Term progress review to identify the needs and priorities for the plan update and seek funding for the plan update process. Potential sources of funding may include FEMA Pre-Disaster Mitigation grants and the Hazard Mitigation Grant Program. Both grant programs can pay for 75% of a planning project, with a 25% local cost share required

Prepare and Adopt an Updated Local Hazard Mitigation Plan – Once the resources have been secured to update the plan, the Hazard Mitigation Team may decide to undertake the update themselves, contract with MAPC to update the plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the Town will need to review

the current FEMA hazard mitigation plan guidelines for any changes in requirements for hazard mitigation plans since the previous plan. Once the next plan update is prepared, the Town will submit it to MEMA and FEMA for review and approval and adopt the plan update in order to obtain formal FEMA approval of the plan.

INTEGRATION OF THE PLANS WITH OTHER PLANNING INITIATIVES

Upon approval of the Nahant Hazard Mitigation Plan 2021 Update by FEMA, the Local Hazard Mitigation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire/Emergency Management
- Police
- Public Works/Highway
- Planning and Community Development
- Conservation
- Parks and Recreation
- Health
- Building

Other groups that will be coordinated with include large institutions, Chambers of Commerce, land conservation organizations and watershed groups. The plan will also be posted on the Town's website with the caveat that a local team coordinator will review the plan for sensitive information that would be inappropriate for public posting. The posting of the plan on the website will include a mechanism for citizen feedback such as an e-mail address to send comments.

The Town of Nahant has taken steps to implement findings from the 2014 Hazard Mitigation Plan into policy, programmatic areas, and plans, including two planning efforts currently in progress: the Master Plan Update and the Open Space and Recreation Plan. In addition, hazard vulnerabilities and mitigation measures were also considered and aligned during the action prioritization of the MVP Community Resilience Building Workshop in 2019. The Hazard Mitigation Plan will also be integrated into other town plans and policies as they are updated and renewed, including the Comprehensive Emergency Management Plan, and Capital Plan.

SECTION 10: LIST OF REFERENCES

- Nahant Zoning Bylaws
- Town of Nahant Community Resilience Building Workshop Summary of Findings 2019
- Town of Nahant Open Space Plans, 2016
- Nahant Wetlands Protection By-law, 2019
- Blue Hill Observatory
- Boston HIRA
- FEMA, Flood Insurance Rate Maps for Essex County, MA, 2013
- FEMA, Hazards U.S. Multi-Hazard
- FEMA, Local Mitigation Plan Review Guide, October 2011
- Fourth National Climate Assessment, 2018
- Massachusetts Flood Hazard Management Program
- Massachusetts Office of Coastal Zone Management Shoreline Change Data
- Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams 2018
- Massachusetts State Hazard Mitigation Plan, 2013
- Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
- Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data
- National Weather Service
- Nevada Seismological Library
- New England Seismic Network, Boston College Weston Observatory, http://aki.bc.edu/index.htm
- NOAA National Climatic Data Center, http://www.ncdc.noaa.gov/
- Northeast Climate Adaptation Science Center
- Northeast States Emergency Consortium, http://www.nesec.org/
- Tornado History Project
- US Census, 2010 and American Community Survey 2019 5-Year Estimates
- USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis
- USDA Forest Service, Wildfire Risk to Communities, www.wildfirerisk.org

APPENDIX A: MEETING AGENDAS

Nahant Hazard Mitigation Plan - 2021 Update

Local Hazard Mitigation Planning Team

June 10, 2021
9:30 AM - 11:00 AM
Via Zoom Conference Call

MEETING #1 - AGENDA

---

1. **Introductions** (5 minutes)
2. **Overview of Planning Process and Schedule** (5 minutes)
3. **Overview of Climate Change Impacts/Plan Integration** (5 minutes)
4. **Review hazards & Identify key concerns** (25 minutes)
5. **Update local hazard areas** (30 minutes)
    a) Flooding
    b) Fires (brushfires/wildfires)
    c) Winter Storms
    d) Extreme Heat
    e) Others (geologic, wind related, etc.)
6. **Review Critical Infrastructure** (15 minutes)
7. **Conclusion & Next Steps** (5 minutes)
    a) Schedule Local Team Meeting #2

Nahant Hazard Mitigation Plan - 2021 Update

Local Hazard Mitigation Planning Team

August 12, 2021
3:30 PM - 5:00 PM
Via Zoom Conference Call

MEETING #2 - AGENDA

---

1. **Introductions** (5 minutes)

2. **Review and Update Hazard Mitigation Goals** (10 minutes)

3. **Review and Update Existing Mitigation Measures from 2014 Plan** (35 minutes)
   These are all existing (ongoing) mitigation activities in the Town. For this exercise, we will review these activities to confirm their effectiveness, and any improvements or changes to these activities that we'll need to note/update for the 2021 Plan Update. See Section VI of the 2014 Plan (page 73) for details of these existing mitigation measures.

4. **Review and Update Recommended Mitigation Measures from 2014 Plan** (35 minutes)
   These are recommended mitigation measures identified in the 2014 Plan (which may include some carried forth from the 2005 Plan as well); see Section VII and VIII of the 2014 Plan (starting on p. 81). For this exercise, we will review all these strategies, their completion status, potential changes in priority, and confirmation whether to continue including in the 2021 Plan.

5. **Public Meetings** (5 minutes)

   b) Identify date and time for Public Meeting #1 (~September)
   c) Identify stakeholders for meeting outreach

Nahant Hazard Mitigation Plan - 2021 Update

Local Hazard Mitigation Planning Team

November 9, 2021
9:00 AM - 10:30 AM
Via Zoom Conference Call

MEETING #3 - AGENDA

---

1. Develop New Mitigation Measures for the 2021 Plan Update

d) Overview of mitigation table categories and evaluation criteria for prioritization (estimated benefits, costs, and overall priority)
e) Review of MVP priority actions to be included in the 2021 Plan Update

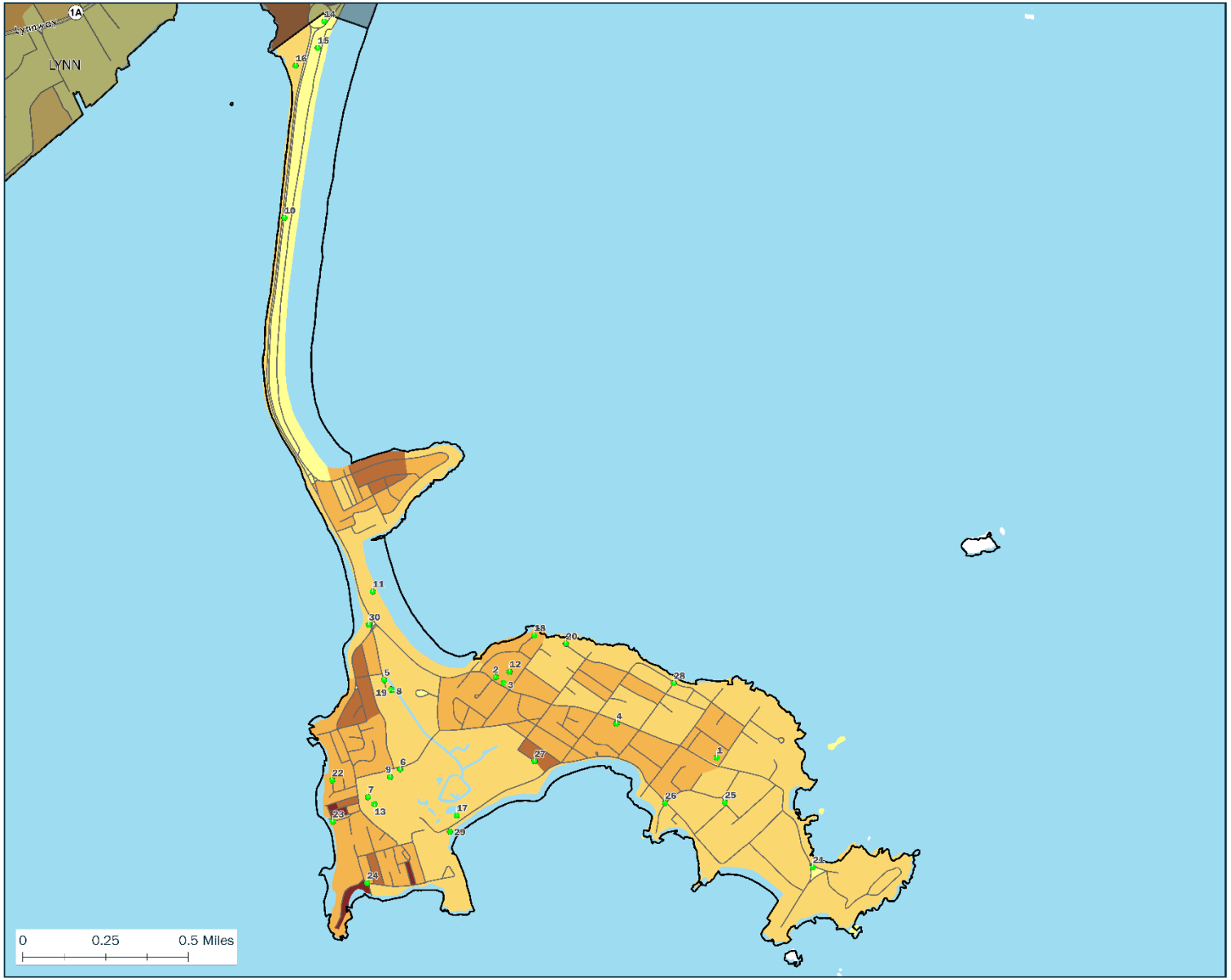
2. Next steps (10 minutes)

a) Draft plan development (November)
b) Final public meeting/invite public input (early December) – standalone or group with another department's meeting?
c) Deadline for Local Team's review & feedback (mid-December)
d) Deadline for submission to MEMA (end of December)

APPENDIX B: HAZARD MAPPING

Maps:

1. Population density
2. Land use
3. Flood zones
4. Earthquake/landslides
5. Hurricane/tornadoes
6. Average snowfall
7. Composite Natural Hazards
8. Local Hazard Areas
9. High Land Surface Temp
10. Sea level rise
11. Annual chance of coast flooding – future projections



MAPC dcr

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NAHANT, MA

Map 1: Population Density

Sites
- Critical Infrastructure*
- Development Areas

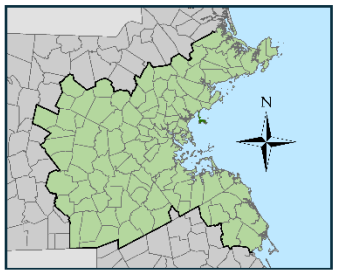
* See details in separate table

Water Bodies

Population Density
Census 2010 Blocks
People per acre
- 0 or No Data
- 0.1 - 5.0
- 5.1 - 15.0
- 15.1 - 30.0
- More than 30

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

Rail
- Stations
- Commuter Rail



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Federal Emergency Management Agency (FEMA)

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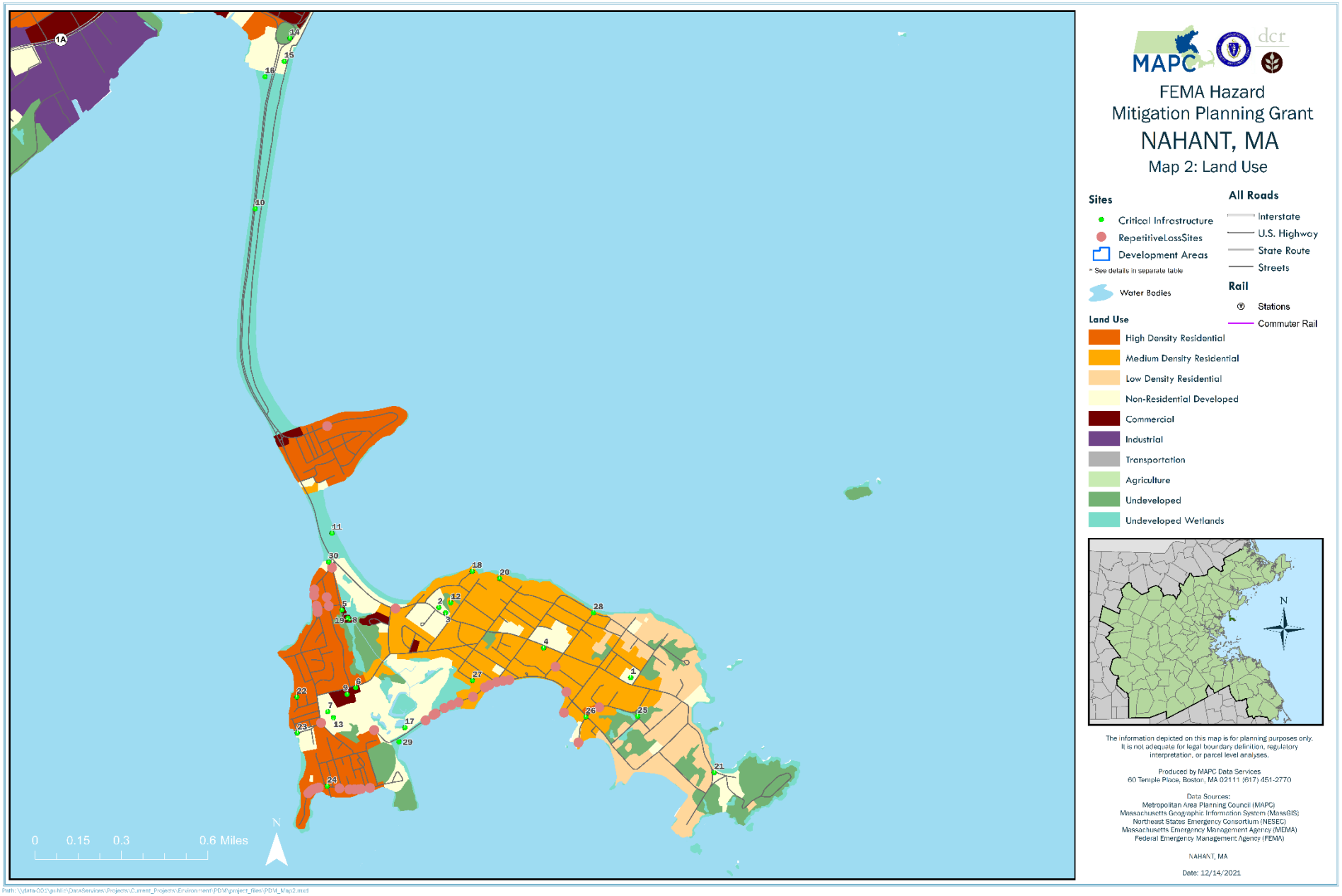
Date: 12/14/2021

Path: \\data-001\public\DataServices\Projects\Current_Projects\Environment\PDM\project_files\PDM


FEMA Hazard
Mitigation Planning Grant
NAHANT, MA
Map 2: Land Use
Sites
Critical Infrastructure
RepetitiveLossSites
Development Areas
* See details in separate table
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Streets
Rail
Stations
Commuter Rail
Land Use
High Density Residential
Medium Density Residential
Low Density Residential
Non-Residential Developed
Commercial
Industrial
Transportation
Agriculture
Undeveloped
Undeveloped Wetlands
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Federal Emergency Management Agency (FEMA)
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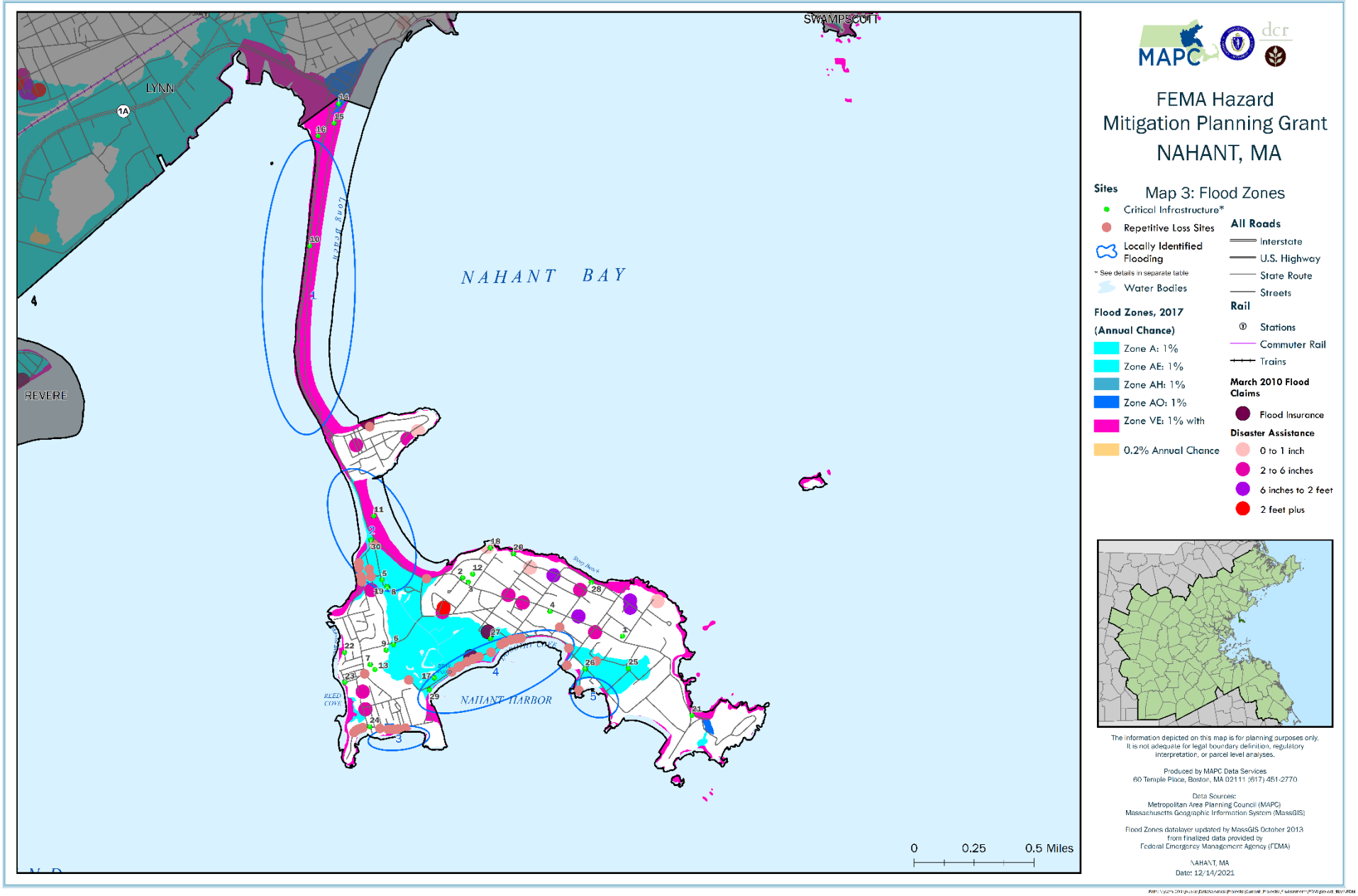
Date: 12/14/2021
0 0.15 0.3 0.6 Miles
N


SWAMPSCOTT
LYNN
REVERE
NAHANT BAY
NAHANT HARBOR
Long Beach
Swing Beach
Reed Cove
Nahant Cove
0
0.25
0.5 Miles
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
NAHANT, MA
Map 3: Flood Zones
Sites
Critical Infrastructure*
Repetitive Loss Sites
Locally Identified Flooding
* See details in separate table
Water Bodies
Flood Zones, 2017
(Annual Chance)
Zone A: 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with
0.2% Annual Chance
All Roads
Interstate
U.S. Highway
State Route
Streets
Rail
Stations
Commuter Rail
Trains
March 2010 Flood Claims
Flood Insurance
Disaster Assistance
0 to 1 inch
2 to 6 inches
6 inches to 2 feet
2 feet plus
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Flood Zones datalayer updated by MassGIS October 2013 from finalized data provided by Federal Emergency Management Agency (FEMA)
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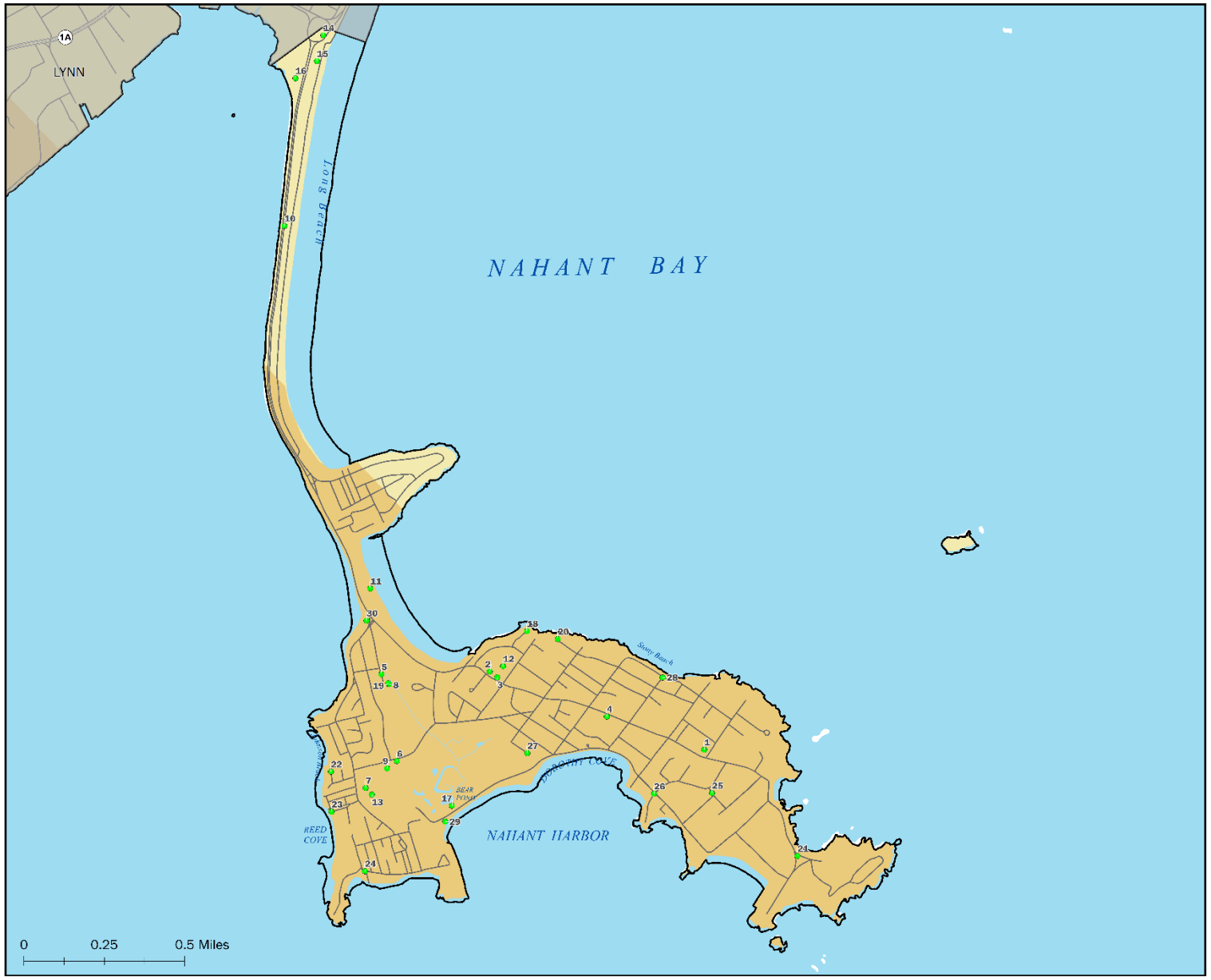

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Map 4: Earthquakes / Landslides

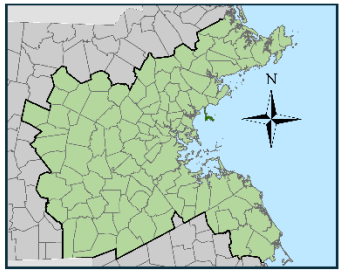
Sites
- Critical Infrastructure Sites*
  - * See details in separate table
- Train Stations
- Commuter Rail Lines
- Trains

Water Bodies

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

Earthquakes
- Epicenters

Landslides
- High landslide incidence (greater than 15% of the area is involved in landsliding)
- High susceptibility to landsliding and moderate incidence
- High susceptibility to landsliding and low incidence
- Moderate susceptibility to landsliding and low incidence
- Low landslide incidence (less than 1.5 % of the area is involved in landsliding



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Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Geological Survey (USGS)

Date: 12/14/2021

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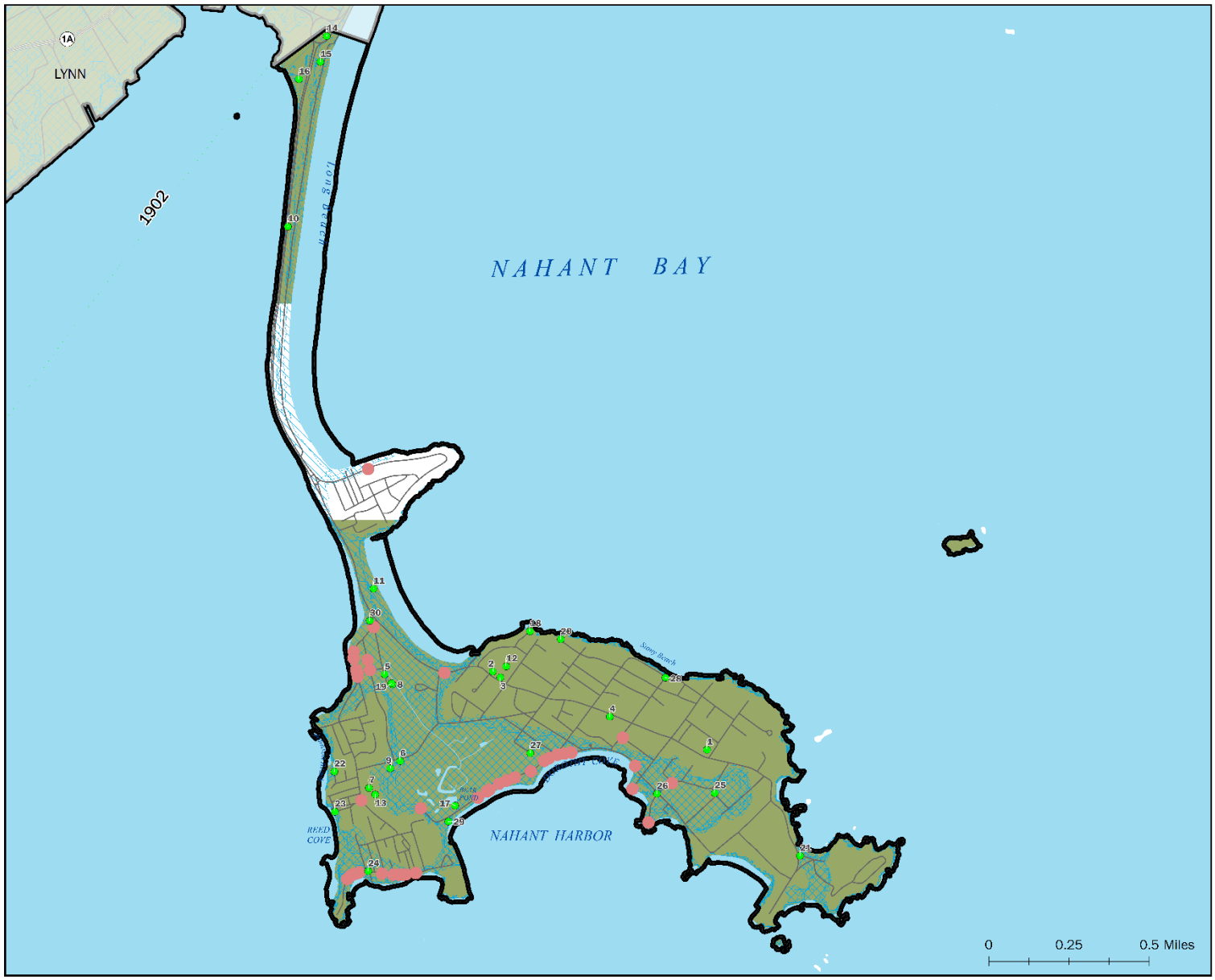

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Map 5: Hurricanes / Tornadoes

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites

* See details in separate table

- Train Stations
- Commuter Rail Lines
- Trains

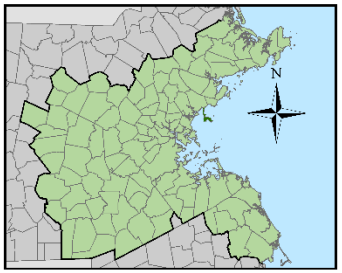
Tornadoes
- Tornado

Storm Tracks
- Tropical Depression
- Tropical Storm
- Category 1 Hurricane
- Category 2 Hurricane
- Category 3 Hurricane

Year of storm noted on map

- Hurricane Surge Inundation Area
- Water Bodies

100 Year Wind Speeds
Miles Per Hour
- 90 MPH
- 100 MPH
- 110 MPH
- 120 MPH
- 130 MPH



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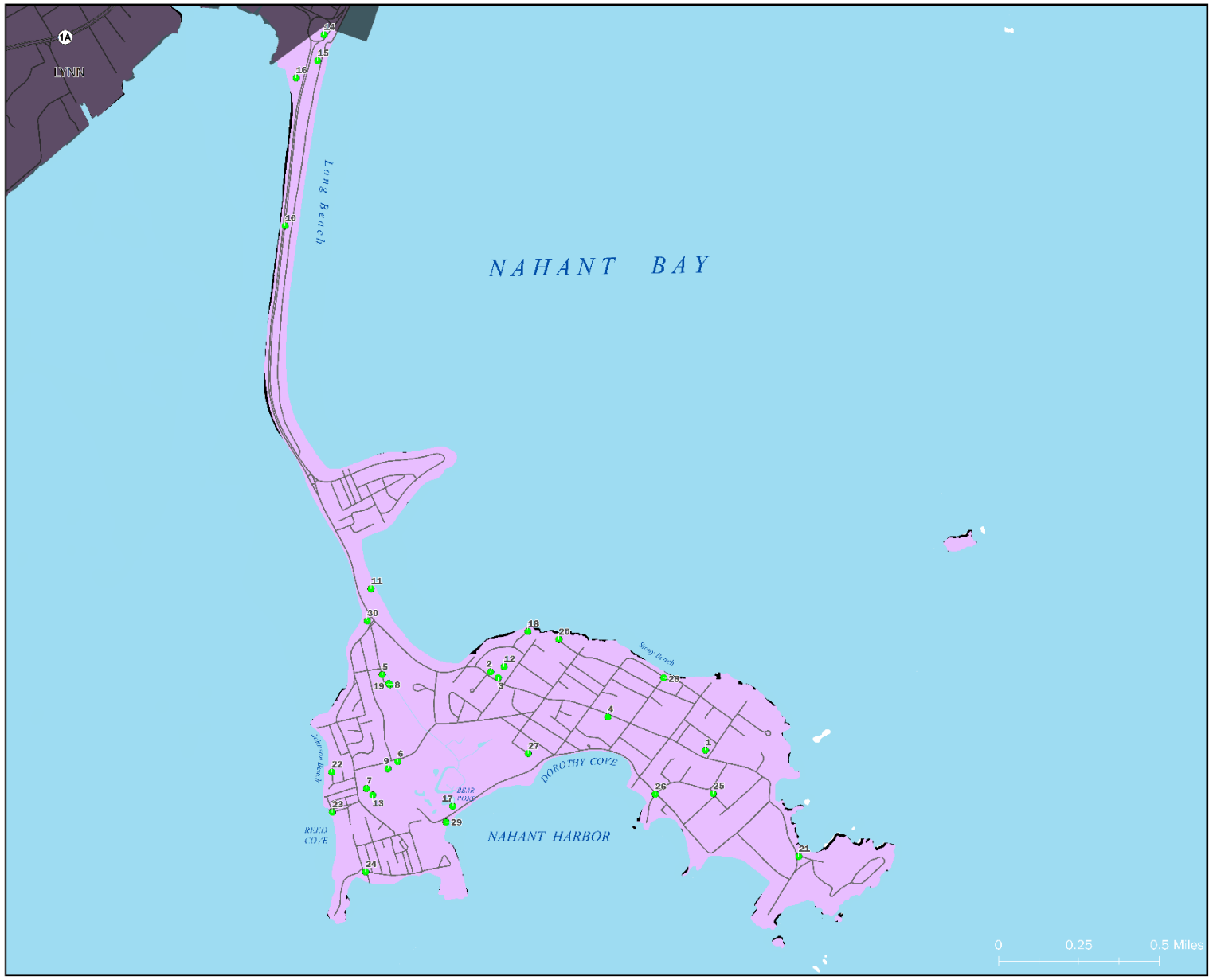
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
National Oceanographic and Atmospheric Administration (NOAA)
Date: 12/14/2021



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Map 6: Average Snowfall

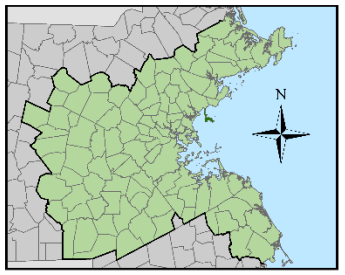
Sites
- Critical Infrastructure Sites*

* See details in separate table

Average Annual Snowfall
- 36.1 to 48.0 inches
- 48.1 to 72.0 inches

- Water Bodies
- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street



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Federal Emergency Management Agency (FEMA)

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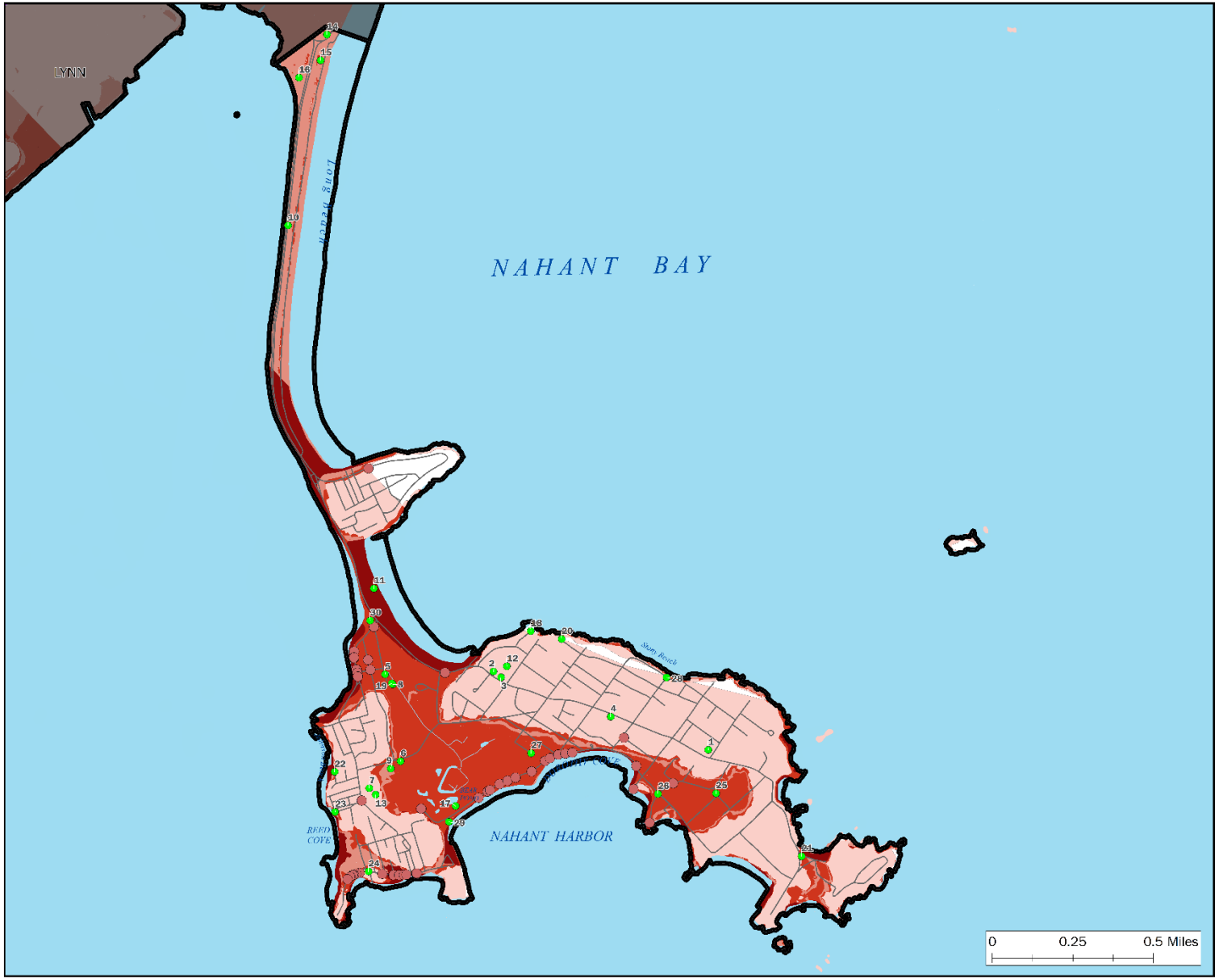

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Map 7: Composite Natural Hazards

Sites

- Critical Infrastructure
- Repetitive Loss Sites
- Development Areas
  * See details in separate table

Composite Natural Hazards

- Low (2 Hazards)
- Moderate (3 Hazards)
- High (4 Hazards)
- Very High (5 Hazards)

Composite natural hazards shown for areas of existing development. Hazards include:

- 100 year wind speed of 110 MPH or higher
- Moderate landslide risk
- FEMA flood zones (100 year and 500 year)
- Average snowfall of 36.1" or more
- Hurricane surge inundation areas

Water Bodies

All Roads

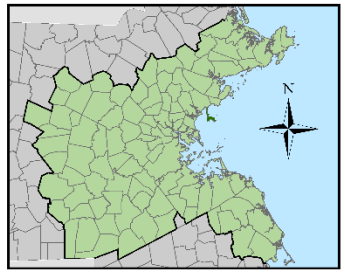
- Interstate
- U.S. Highway
- State Route
- Street

Train Stations

- Commuter Rail Lines
- Trains

Subway Lines

- Blue
- Green
- Orange
- Red
- Silver



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Data Sources

Composite Natural Hazard:
Wind, Landslide Risk, Snow - Northeast States Emergency Consortium (NESEC)
Flood Zones - 2013 FEMA/MassGIS
Hurricane Surge - 2013 U.S. Army Corps of Engineers, New England District
Roads/Trains: MassDOT/ CTPS
Repetitive Loss Sites: DCR/Office of Flood Hazard Management
Critical Infrastructure: Metropolitan Area Planning Council (MAPC) /

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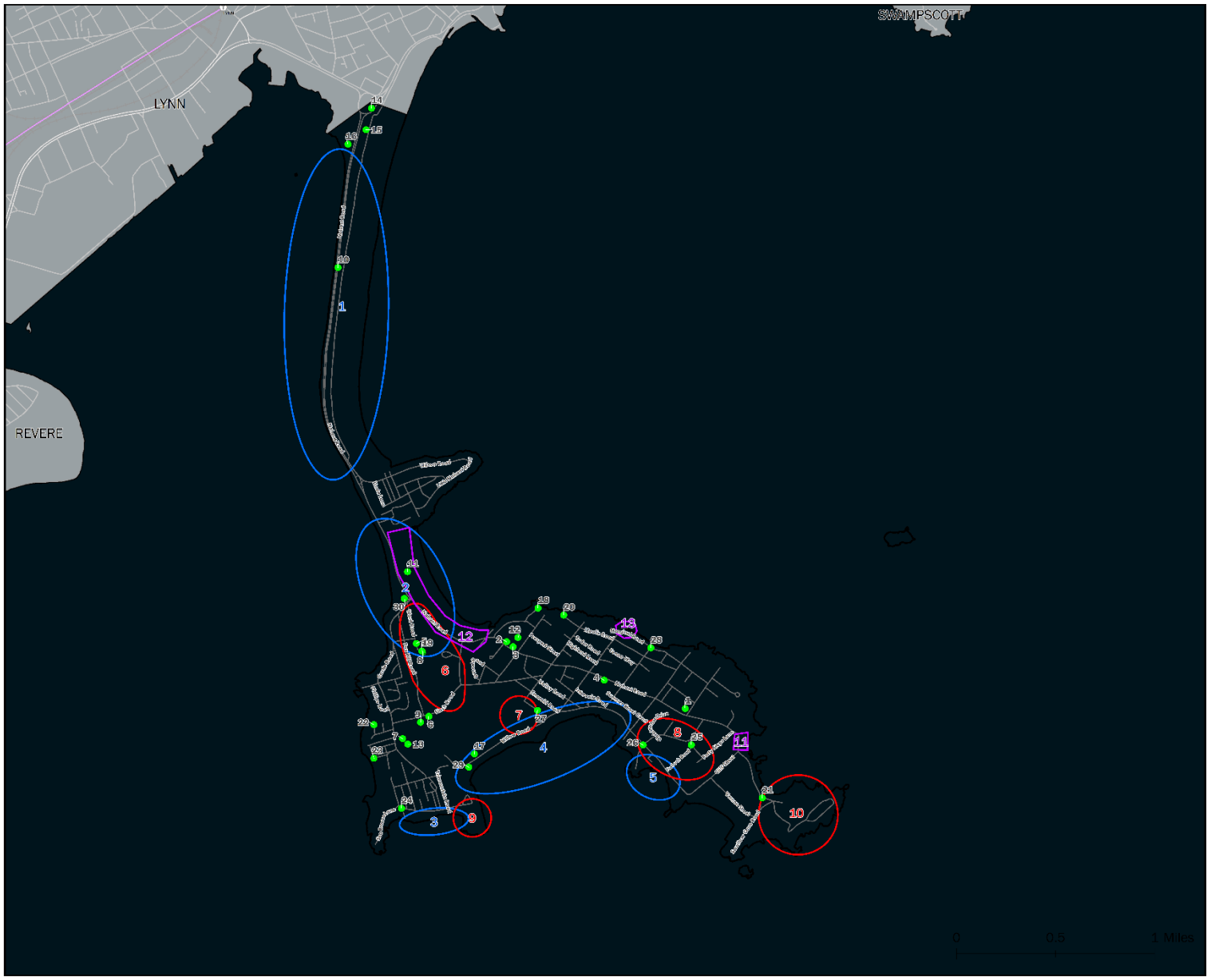
Date: 12/14/2021



MAPC

dcr

FEMA Hazard
Mitigation Planning Grant

NAHANT, MA

Map 8: Local Hazard Areas

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites

* See details in separate table

Locally Identified Hazard Areas
- Brush Fires
- Flooding
- Historic

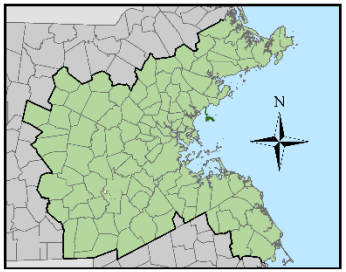
* See Section IV Risk Assessment

- Development Sites

* See details in separate table

- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street



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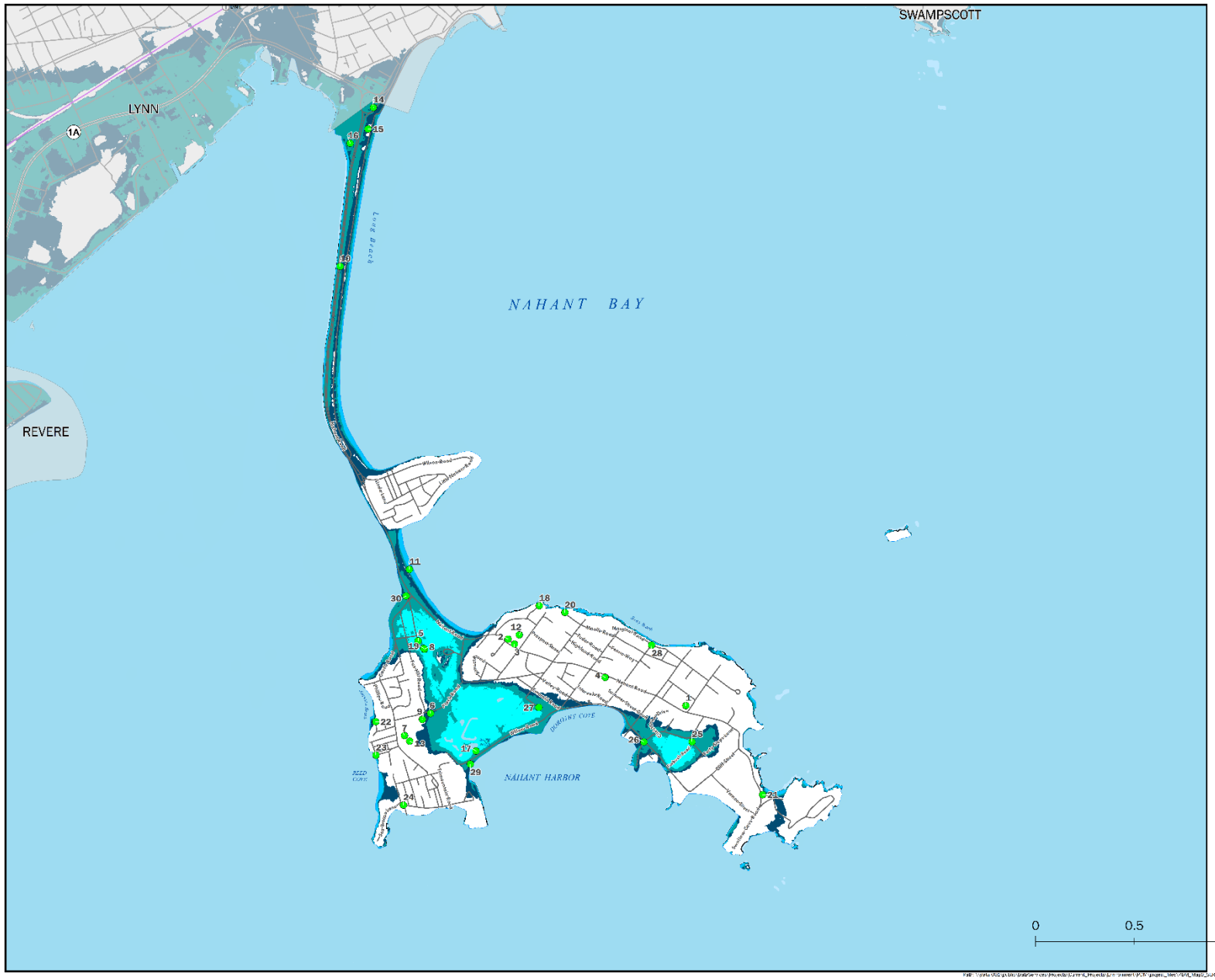

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FEMA Hazard Mitigation Planning Grant

NAHANT, MA

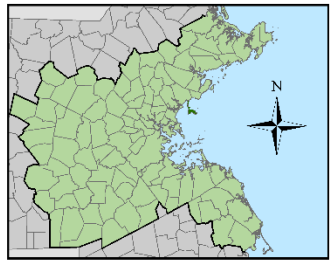
Map 9: Sea Level Rise

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites
- Development Sites

Train Stations
Commuter Rail Lines
Trains

Future Coastline
- Sea Level Rise (1 ft.)
- Sea Level Rise (3 ft.)
- Sea Level Rise (6 ft.)
- Sea Level Rise (10 ft.)

All Roads
- Interstate
- U.S. Highway
- State Route
- Street



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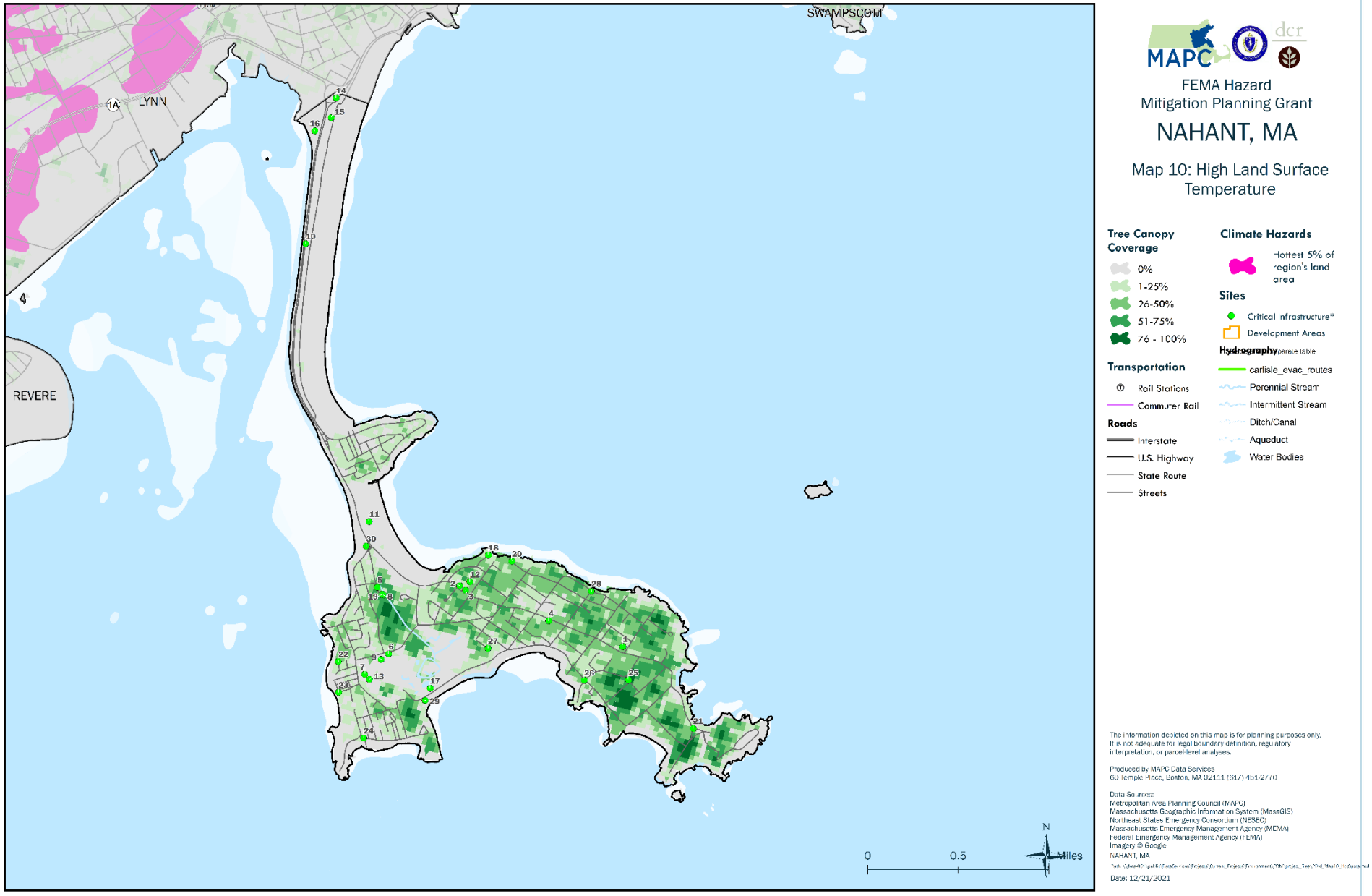
SWAMPSCOTT
LYNN
1A
REVERE
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
NAHANT, MA
Map 10: High Land Surface Temperature
Tree Canopy Coverage
0%
1-25%
26-50%
51-75%
76 - 100%
Transportation
Rail Stations
Commuter Rail
Roads
Interstate
U.S. Highway
State Route
Streets
Climate Hazards
Hottest 5% of region's land area
Sites
Critical Infrastructure*
Development Areas
Hydrography
carlisle_evac_routes
Perennial Stream
Intermittent Stream
Ditch/Canal
Aqueduct
Water Bodies
0
0.5
Miles
N
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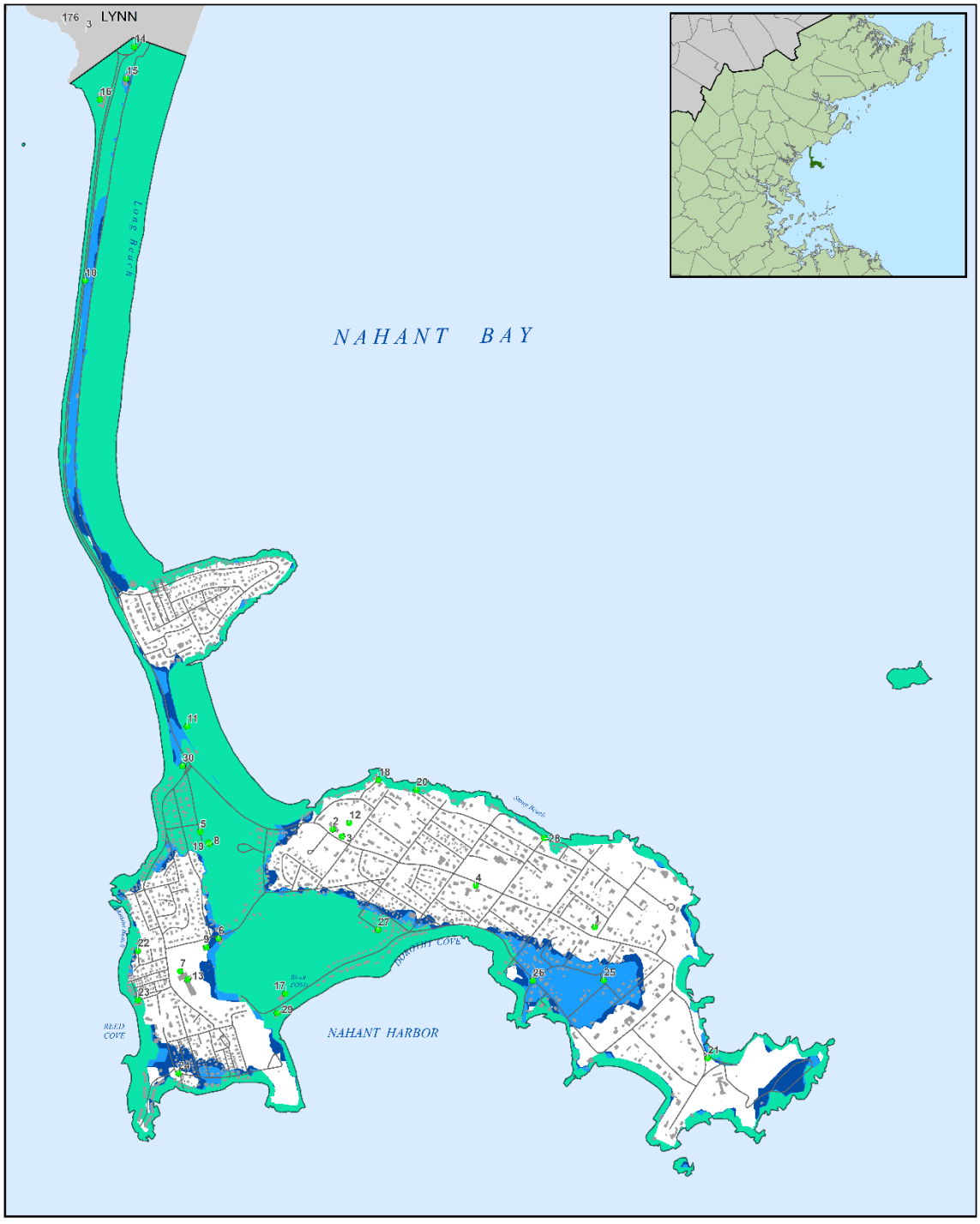

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Map 11:
Coastal Flooding 1% Storm Floodplains
Comparison of Future Predictions

- Critical Infrastructure
- Building Roofprints
- Roads

Annual Chance

- 1.2ft Mean Sea Level (NAVD88),
- 2.4ft Mean Sea Level (NAVD88),
- 4.2ft Mean Sea Level (NAVD88),

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Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
MC-FRM: MassDOT, UMass Boston, Woods Hole Group (2021)

N

0 0.25 0.5
Miles

Date: 12/21/2021

APPENDIX C: PUBLIC MEETINGS

Hazard Mitigation Plan
Public Meeting

Natural hazards can have serious impacts on the Nahant and its residents and businesses



The Town of Nahant is updating its Hazard Mitigation Plan to reduce its vulnerability to natural hazards such as flooding, hurricanes, and winter storms. Please join us to learn more about Nahant's climate and hazard preparations to date and provide your input for the plan!

Date: Wednesday, October 13, 2021

Time: 6:00 pm – 7:00 pm

Location: Zoom Meeting | Register in advance here: **https://bit.ly/3u6lyi1**

For more information, please contact Van Du at vdu@mapc.org.

MAPC
METROPOLITAN AREA PLANNING COUNCIL

Committee Name	Nahant Conservation Commission
Meeting Location	Virtual Meeting Space due to COVID-19 State of Emergency Join Zoom Meeting https://us02web.zoom.us/j/89936056475 Meeting ID: 899 3605 6475 Dial by your location +1 301 715 8592 US (Washington DC) +1 312 626 6799 US (Chicago) +1 929 205 6099 US (New York) +1 253 215 8782 US (Tacoma) +1 346 248 7799 US (Houston) +1 669 900 6833 US (San Jose)
Date and Time of Meeting	Wednesday, December 15, 2021 at 7:00 PM

AGENDA

1. Presentation of Nahant's Draft Hazard Mitigation Plan by the Metropolitan Area Planning Council.

2. Continued Notice of Intent, 35 Castle Road
   Construction of a garage, patio, retaining wall and walkways within buffer zone to Coastal Bank and Land Subject to Coastal Storm Flowage.

3. Notice of Intent, 430 Nahant Road (047-0594)
   Construction of a seawater pumping system, including a pumphouse and new intake and discharge lines within Land Under the Ocean, Land Containing Shellfish, Land Subject to Coastal Storm Flowage and buffer zone to Bank and Bordering Vegetated Wetlands.

   Other Business:
   - Enforcement Order issued for 64 Willow Road on 11/17/21.

APPENDIX D: PLAN ADOPTION

CERTIFICATE OF ADOPTION
BOARD OF SELECTMEN
TOWN OF NAHANT, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF NAHANT HAZARD MITIGATION PLAN 2021 UPDATE

WHEREAS, the Town of Nahant established a Committee to prepare the *Town of Nahant Hazard Mitigation Plan 2021 Update*; and

WHEREAS, the *Town of Nahant Hazard Mitigation Plan 2021 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Nahant, and

WHEREAS, duly noticed public meetings were held by the LOCAL HAZARD MITIGATION PLANNING TEAM on October 13 and December 15, 2021, and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Nahant Board of Selectmen adopts the *Town of Nahant Hazard Mitigation Plan 2021 Update*, in accordance with M.G.L. 40s §4 or the charter and bylaws of the Town of Nahant.

ADOPTED AND SIGNED this Date. 2/18/2022

Name/Title

JOSHUA A. ANTRIM
CHAIR, BOS

Signature

APPENDIX E: MVP WORKSHOP RESULTS

Top recommendations from the 2019 Municipal Vulnerability Preparedness workshop that focused on preparing for climate impacts in Nahant.

Infrastructure

1. Establish a long-term strategy to upgrade and maintain the storm water and natural drainage systems including green infrastructure solutions to reduce inland flooding
    - Conduct an updated drainage study and remedial action plan, focusing on the Lowlands area along with the golf course and Furbush area.
    - Dredge natural ditches and upgrade water storage capacity in the Lowlands and Furbush Road area.
    - Educate property owners on ways to mitigate storm water, e.g. through a financial incentive or rebate program that minimizes stormwater inflow from properties including sump pumps and rewards on-site rain water infiltration and storage (e.g. through rain barrels).
2. Establish a holistic long-term plan to reduce flood risk by incorporating natural solutions (such as living shorelines) with grey infrastructure (seawall) upgrades to reduce the impacts from coastal flooding.
3. Upgrade sewer system infrastructure including pump stations.
4. Collaborate with DCR to identify next steps and responsibilities to upgrade the rotary and Causeway.

Societal

1. Increase awareness and educate as to hazards and risks and as to how to prepare for it. This includes information on individual mitigation or adaptation actions that residents can take on their own and/or in coordination with their neighbors.
2. Encourage interested citizens to volunteer for activities which increase hazard awareness including communication on hazard preparedness.
3. Selectmen and Town Administrator shall evaluate staffing/capacity and make recommendations for added staffing / volunteer opportunities.

Environmental

1. Implement natural green infrastructure solutions for storing / removing access water.
    - Restore natural drainage systems to become fully functional and increase maintenance efforts.
    - Evaluate existing maintenance plans. Identify opportunities for low-to-no-cost natural green infrastructure solutions.
    - Review local regulations and bylaws to encourage green infrastructure installations such as rain gardens, bioswales and/or use of permeable surfaces such as porous pavers or permeable pavements (e.g. porous asphalt) etc. that reduce storm water runoff.
    - Evaluate opportunities for collaboration and increased participation of residents.

2. Reduce flood pathway impacts (e.g. at beach parking locations) by installing permeable surfaces.
    - Replace selected impervious surfaces with permeable solutions, e.g. parking lots at Short Beach / Spring Road, Nahant Road, and Castle Road entrances (which create flood pathways in case of storms with storm surges).
    - Consider the use of pervious materials such as wooden slats and evaluate the use of fabric synthetic material as alternatives to concrete or paved walkways at selected locations.
3. Develop a long-term coastal defense plan for the entire coastline to enhance natural ecosystems in order to reduce the vulnerability to storm damage including a living shoreline & dune management plan.
    - Develop a living shoreline plan that identifies natural coastal barriers / protection
    - Develop a dune management / nourishment plan that goes beyond the existing trash removal program to foster dune stabilization to limit sand movement.
    - Develop town policies for dune management which may include dune planting program, removal of invasive species, bird protection, and replacing paved walkways with sand or boardwalks (to stabilize dunes).
    - Identify areas for citizen volunteer involvement.