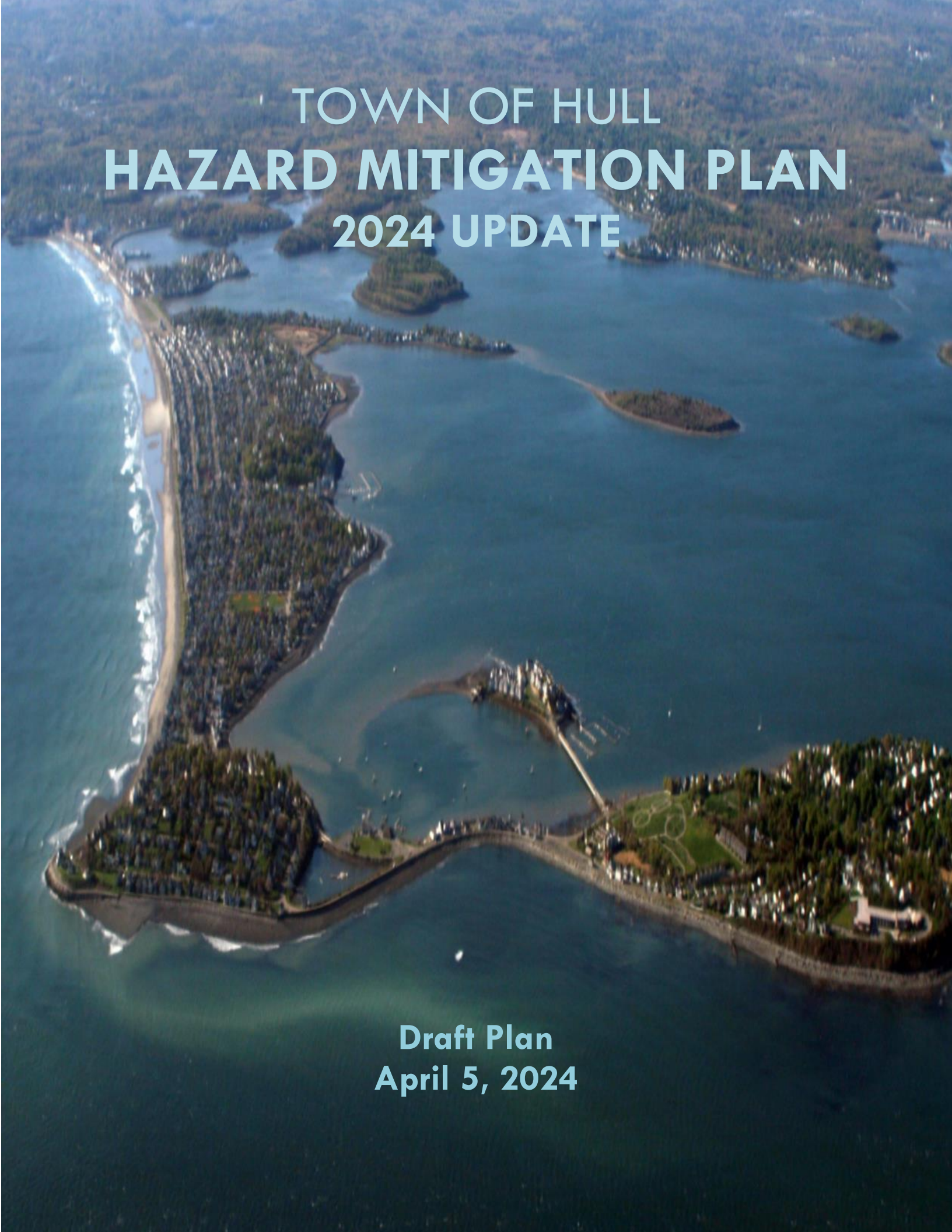

TOWN OF HULL
HAZARD MITIGATION PLAN
2024 UPDATE

Draft Plan
April 5, 2024

ACKNOWLEDGEMENTS AND CREDITS

This plan was prepared for the Town of Hull by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA). The plan was funded by the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP).

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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. Other common concerns are the impacts of extreme heat, drought, and nor'easters. This plan also considers how our changing climate will affect natural hazards. Warming temperatures will fuel changing precipitation patterns 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

This is an update to the Hull Hazard Mitigation Plan approved by FEMA on April 26, 2018, and is the Town' fourth Hazard Mitigation Plan. The original plan was approved by FEMA on February 22, 2007, and the first updated plan was approved by FEMA on March 8, 2013.

Planning for the Hazard Mitigation Plan update was led by the Hull Local Hazard Mitigation Planning Team, composed of staff from a number of Town Departments, including Emergency Management, Community and Economic Development, DPW, Health and Social Services, Town Administration, Sustainability, Council on Aging, Conservation. The Local Team met four times on the following dates:.

June 21, 2023
September 20, 2023
November 15, 2023
December 14, 2023

The Local Team reviewed and mapped updates to local hazard areas and critical facilities, and discussed where the impacts of natural hazards most affect the Town, 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 Hazard Mitigation Planning Team hosted two public meetings, the first on November 28, 2023 at Hull High School, and the second on April 17, 2024 hosted by the Select Board. Key stakeholders and neighboring communities were notified and invited to participate. The draft plan update was posted on a dedicated project web page for public review, and a project email, ResilienceHull@mapc.org, was set up to receive public comments and questions. Key town stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments.

RISK ASSESSMENT

The Hull Hazard Mitigation Plan assesses the potential impacts to the Town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought. These are described in Section IV of the plan and the locations of these hazards are shown on the map series in Appendix A.

The Hull Local Hazard Mitigation Planning Team identified 149 Critical Facilities. These are also shown on the map series and listed in Table 37, identifying which facilities are located within the mapped hazard zones.

A HAZUS-MH analysis provided estimates of damages from Hurricanes of category 100-year and 500-year recurrence ($30.8 million to $151.1 million), earthquakes of magnitudes 5 and 7 ($249.7 million to $1.65 billion), and flood damage estimates for the 100- and 500-year storms ($266.8 million to $$676.4 million).

HAZARD MITIGATION GOALS

The Hull Local Hazard Mitigation Planning Team identified the following hazard mitigation goals for the Town. All of the goals are considered critical for the Town and they are not listed in order of importance.

Goal 1: Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.

Goal 2: Identify and seek funding for measures to mitigate or eliminate each known significant hazard area.

Goal 3: Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

Goal 4: Prevent and reduce the damage to public infrastructure and natural resources resulting from all hazards.

Goal 5: Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

Goal 6: Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

Goal 7: Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

Goal 8: Take maximum advantage of resources from FEMA, MEMA, and MA Energy and Environmental Affairs to educate Town staff and the public about natural hazard risks and mitigation strategies.

Goal 9: Consider the potential impacts of climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning and other town plans, policies, and programs

Goal 10: Address the needs of priority populations such as seniors, low income, renters throughout hazard mitigation planning, including public outreach, analysis of impacts, and development and implementation of mitigation strategies.

HAZARD MITIGATION STRATEGY

The Hull Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. Historically, flooding from coastal storms has been the most significant natural hazard facing Hull. In 2016, Hull commissioned a "Coastal Climate Change Vulnerability Assessment and Adaptation Study" which considered additional threats posed by future climate change, and in particular sea level rise. The team added a Climate Resilience/Adaptation section that includes such mitigation measures as relocating the light plant to a higher elevation and increasing flood protection for the Memorial Middle School and elevating utilities at the sewer plant. Other recommendation include integrating climate considerations into capital plans, as well as open space and master plans, updating evacuation plans and educating residents on protection strategies.

Since the 2018 Hazard Mitigation Plan, the Town of Hull has conducted two significant efforts to increase the town's resilience to natural hazard. The Town completed a Municipal Vulnerability Preparedness project in 2019, which facilitated a community workshop to identify actions the Tonw can take to address climate change impacts. Hull has been designated an MVP Community by the Executive Office of Energy and Environmental Affairs. Several mitigation actions discussed at the MVP workshop have been integrated into this plan update. Based on the MVP designation, the Town secured an MVP Action Grant.

In 2022 a climate resilience project was conducted by MAPC for the Town of Hull. The project was conducted by Ann Herbst, Principal Environmental Planner at MAPC and former Conservation Agent for the Town of Hull. The project included a technical memo, "Massachusetts Coast Flood Risk Model, Hull Impact Analysis" which used the Massachusetts Coastal Flood Risk Model (MC-FRM) prepared by Woods Hole Group to analyze the impacts of future Sea Level Rise scenarios on the Town of Hull. The analysis focused on the "High" SLR scenario which projects increases of 1.2 feet in 2030., 2.4 feet in 2050, and 4.2 feet by 2070. Under these three SLR scenarios, maps were produced showing the annual chance of flooding and the depth of flooding for a 1% chance storm. The analysis also identified critical infrastructure that would be impacted in of the three future decades by 100% chance, 10% chance and 1% chance storm events. Figure ss shows the SLR scenario map for 2050 based on 2.4 feet of Sea Level Rise. The project also produced a Story Map, "Preparing for Climate Change"

Overall, the hazard mitigation strategy recognizes that mitigating hazards for Hull will be an ongoing process as our understanding of natural hazards and the steps that can be taken to mitigate their damages changes over time. Global climate change and a variety of other factors impact the Town's vulnerability now and in the future, and local officials will need to work together across municipal lines and with state and federal agencies in order 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

The process for developing Hull's Hazard Mitigation Plan 2018 Update is summarized in Table 1 below.

Table 1 Plan Review and Update Process

Section	Reviews and Updates
III – 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 and the Board of Selectmen. The plan was also available on the Town's website for public comment. No public comments were received. Outreach efforts to publicize these engagement opportunities included webpage content, social media posts, email, flyers, and press outreach.
IV – 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. Town staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. MAPC also used the most recently available version of HAZUS to assess potential impacts of flooding, earthquakes, and hurricanes.
V - Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Hull Local Hazard Mitigation Planning Team.
VI – Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the Town.
VII & VIII – Hazard Mitigation Strategy	Mitigation measures from the 2018 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 2024 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2018 plan. The

	Local Hazard Mitigation Team prioritized all of these measures based on current and future conditions.
IX – Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan for implementation review and a 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 on Section VI, Mitigation Measure from the 2018 Plan, Hull made progress on implementing mitigation measures identified in the 2018 Hazard Mitigation Plan. The following eight mitigation measures have been implemented:

1. Relocate Weir River Water Pipes
2. D Street Pumping station
3. Caddish Avenue, A Street to XYZ Street
4. Paving reduction program
5. Open Space Plan update
6. Mutual aid agreement with Plymouth County for brushfire truck
7. Evaluate public buildings for ability to withstand snow loads
8. Public building seismic assessment

Two dozen other projects have been partially completed or in the process of being implemented. These include many significant upgrades to stormwater and drainage facilities, coastal protection infrastructure, and roadway improvements

1. A to L Streets drainage improvement
2. Bay Avenue East Project
3. Beach Ave drainage improvement
4. Lagoon Pump for Draper and Newport
5. Encourage Building Elevation – Freeboard
6. Repair Nantasket Seawalls (DCR project)
7. Repair of Town Seawalls, Dikes, and Jetties
8. GIS Floodplain mapping
9. Pursue public ownership of beach lots to protect Nantasket Beach dune
10. Protect electric lines, complete to Pemberton Point
11. Install alarm system for Straits Pond tide gate
12. Encourage drought resistant landscaping
13. Rehabilitate Village Fire Station B
14. Develop evacuation plan considering sea level rise
15. Elevate electricity and gas at sewer plan
16. Consider plan to protect DPW barn from future flooding
17. Promote bicycle/pedestrian transportation to reduce auto use
18. Pursue opportunities to extend and expand Nantasket Beach dune
19. Implement the Coastal Climate Change Vulnerability Assessment and Adaptation Study
20. Evaluate options to protect sewer plant from future flooding risk

21. Develop property owner flood protection and flood insurance education program
22. Research ownership and status of WBZ dike tidegate to determine repair options
23. Install cameras in shoreline areas to monitor storm conditions
24. Conduct drone surveys to document pre and post storm shoreline conditions

Several other projects that have not been completed will be carried over into this 2024 plan update. In addition, the Town has identified new mitigation measures to pursue, including:

- Adopt Floodplain Management Bylaw (Floodplain Overlay District Bylaw) and develop cloud-based Floodplain development permitting system.
- Improve high water barrier adjacent to Moreland Ave, Bay St, and Hampton Circle, develop nature-based protection to the HCA, and construct WWTF pump station to be resilient to 2070 (or longer)
- Encourage Building Elevation–Freeboard. Develop a Community Elevation Program–Identify Homes to benefit; engage and assist residents; do elevation work collectively for cost savings
- Perform stormwater drainage improvements at Phipps Street & Manomet Avenue
- Pursue Point Allerton Seawall construction with DCR
- Acquire brush fire apparatus and equipment
- Annual tree trimming program to keep problem trees away from power lines
- Provide additional staff resources to expand the Town's capacity for managing town-wide access during winter storm events
- Reconfigure Nantasket Ave – Pedestrian/bike accommodation (including 2-way street proposal and meshing with DCR climate adaptation/resiliency effort for the Reservation)

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 Hazard Mitigation Team, consisting of the Town Manager and Department Heads from Planning and Community Development, Conservation, Building, Public Works, Light Plant, Police, Fire, Harbormaster, Wastewater Treatment, and Health, coordinated the implementation of the 2018 plan over the last five years. The Team will continue this role as described in Section IX, Plan Adoption and Maintenance.

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.

Federal hazard mitigation planning and grant programs are administered by the Federal Emergency Management Agency (FEMA) 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 Hull contracted with the Metropolitan Area Planning Council (MAPC), to assist the Town in updating its local Hazard Mitigation Plan, which was first adopted in 2007 as a multijurisdictional plan for ten South Shore towns. The local Hazard Mitigation Plan update produced under this contract is designed to individually meet the requirements of the Disaster Mitigation Act for the Town of Hull while addressing regional concerns and hazards that impact the Town.

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. FEMA's 2022 Local Mitigation Planning Policy Guide recognized that adapting to the expected impacts of climate change is a form of hazard mitigation. Therefore, this plan incorporates consideration of future risks due to projections for the increased frequency and severity of extreme weather fueled by global climate change effects.

PREVIOUS FEDERAL/STATE DISASTERS

The Town of Hull has experienced 26 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table 2 below. The majority of these events involved flooding, while eight were due to hurricanes or nor'easters, and seven were due to severe winter weather.

Figure 1. Natural Hazards and Climate Change

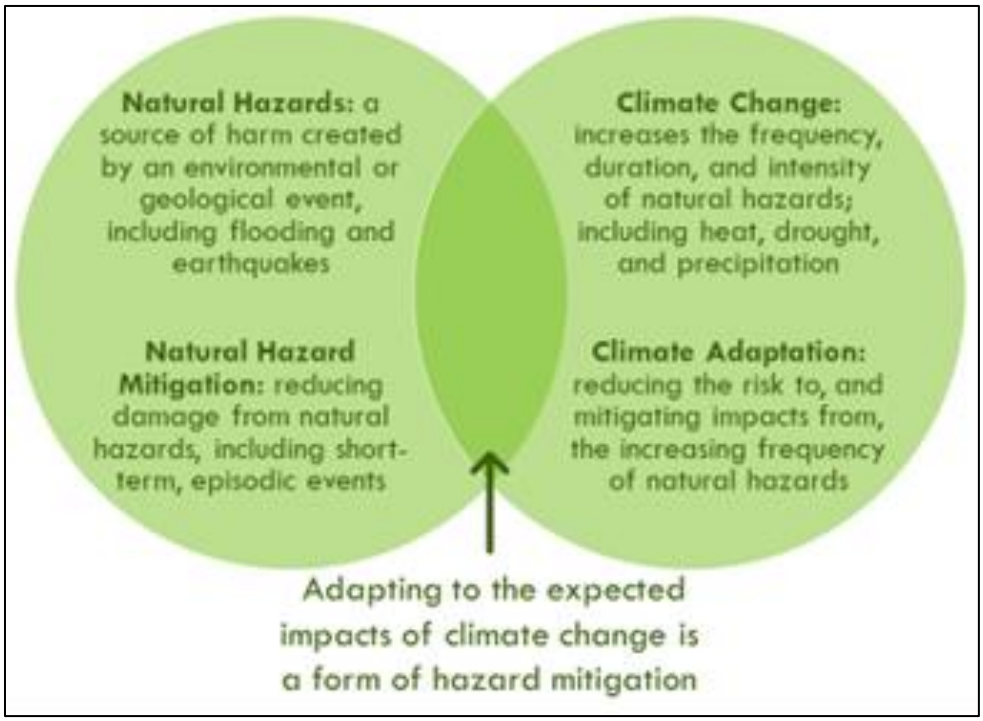


Table 2 Previous Federal Disaster Declarations

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
Hurricane Bob (August 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects)
No-Name Storm (October 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	FEMA Individual Household Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (10 projects)

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
December Blizzard (December 1992)	FEMA Public Assistance Project Grants	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk (7 projects)
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	All 14 Counties
May Windstorm (May 1996)	State Public Assistance Project Grants	Counties of Plymouth, Norfolk, Bristol (27 communities)
October Flood (October 1996)	FEMA Public Assistance Project Grants	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	FEMA Individual Household Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (36 projects)
1997	Community Development Block Grant-HUD	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
June Flood (June 1998)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (19 projects)
(1998)	Community Development Block Grant-HUD	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
March Flood (March 2001)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (16 projects)
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	All 14 Counties

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
May Rainstorm/Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide
April Nor'easter (April 15-27, 2007)	Hazard Mitigation Grant Program	Statewide
Flooding (March, 2010)	FEMA Public Assistance FEMA Individuals and Households Program SBA Loan	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Statewide
Hurricane Earl (September 2010)	FEMA Public Assistance Project Grants	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Worcester
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance	Statewide
Hurricane Sandy (October 27-30, 2012)	FEMA Public Assistance	Statewide
Severe snowstorm and Flooding (February 8-09, 2013	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Blizzard of 2015 (January 26-28, 2015)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Severe winter storm and Snowstorm (January 2018)		Essex, Middlesex, Norfolk, Suffolk, Worcester
Severe winter storm and flooding (March 2018)		Barnstable, Bristol, Essex, Nantucket, Norfolk, Plymouth
COVID-19 Pandemic (January 2020)		Statewide
Severe winter storm and snowstorm (January 2022)		Bristol, Norfolk, Plymouth, Suffolk

Source: database provided by MEMA

Since 2018, there have been 6 Massachusetts State Declared Disasters that affected Hull. Below is a list of them, mostly containing winter storms and pandemics.

Table 3. Massachusetts State Disaster Declarations since 2018

Disaster Name	Date of Event	Declared Areas
Massachusetts Severe Winter Storm and Flooding	March 2-3, 2018	Statewide
Massachusetts Severe Winter Storm and Snowstorm	March 13-14, 2018	Statewide
Massachusetts Covid-19 Pandemic	January 20, 2020 – May 11, 2023	Statewide
Massachusetts Severe Winter Storm and Snowstorm	January 28-29, 2022	Statewide
Massachusetts Hurricane Lee	September 15-17, 2023	Statewide

Source: FEMA Declared Disasters; OpenFEMA Dataset: Disaster Declarations; and FEMA Declared Disasters.

FEMA FUNDED MITIGATION PROJECTS

Since 1991 the Town of Hull has received funding from FEMA for nine mitigation projects, with two more pending in 2024, under the Hazard Mitigation Grant Program (HMGP) and the Flood Mitigation Assistance Program (FMA). In addition, the Massachusetts DEM received HMGP funding to support work at Allerton Point. These projects totaled more than $13.8 million, with $13.3 million covered by FEMA grants and $7.3 million by local and state funding. The projects are summarized in Table 4 below.

Table 4 FEMA-Funded Mitigation Projects

Year	Project Title	Scope of Work	Total Cost	Federal Funding	Local Funding
2024	BRIC Electronic Permitting Process Building Code Grant	Develop an online permitting system including floodplain overlay district bylaw integration.	$70,970	$49,500	$21,470
2024	L-PDM 2023 Nantasket Ave Seawall Project	Seawall improvement and road elevation project.	$11,682,185	$4,943,000	$6,739,185 (incl. State)
2022	HMGP WWTF Coastal Resiliency Berm Project	Whole-facility exterior flood protection project including vegetated reinforced earthen berm and gravity walls/flood barriers	$633,334	$475,000	$158,333
2019	HMGP- Water Pollution	Elevate critical electrical assets &			

	Control Facility Retrofit	equipment above 500-yr flood.			
2010	HMGP	Elevate one home, retrofit utilities for one home	$41,481	$31,111	$10,370
2009	FMA – Elevations & Retrofits	Elevate three properties, retrofit utilities at one home	$310,460	$240,889	$69,560
2007 April Nor'easter	HMGP - Elevations and Retrofits	Elevate five homes, retrofit utilities at one home.	$315,539	$236,519	$78,840
1996 October Flood	HMGP - Allerton Point Seawall Upgrade	Placement of an embedded toe and reconstruction of existing revetment.	$1,294,262	$940,360	$323,566 (DEM)
1992 December Blizzard	HMGP - Ocean Meadows – Retrofitting / Elevation	Retrofitting: relocating heating systems; elevation	$52,312	$36,982	$12,327
1991 Hurricane Bob	HMGP - Ocean Meadows – Retrofitting / Elevation	Retrofitting: relocating heating systems; elevation	$17,155	$12,128	$4,042
1991 No-Name Storm	HMGP - Treatment Plant	Purchase emergency generator for Pumping Station A	$13,649	$8,942	$2,980

Source: database provided by MEMA

COMMUNITY PROFILE

Hull is located 18 miles southeast of Boston on a long narrow peninsula projecting into Boston harbor. In 1825 a new industry was launched in Hull when Paul Warrick built the Sportsman Hotel on Nantasket Avenue, the very first hotel in the town. The magnificent beaches of the town, easy access to Boston, and sea air brought hordes of visitors. By 1840 steamers were making three trips a day between Boston and Hull. Boardinghouses and elaborate hotels catered to visitors while Hull fishermen and farmers still pulled nets and farmed in its rural acreage. When Paragon Park closed in 1985, an era ended for the town and the millions of visitors. But another era began as Hull acquired a suburban character with a growing number of year-round residents moving into town, and today there are over 11,050 residents. The town maintains a website at www.town.hull.ma.us

Some of Hull's unique characteristics to keep in mind include:

- While Hull's year-round population has grown, Hull still has a significant seasonal population. Nantasket Beach draws thousands of daily visitors during the summer season.
- Hull's status as a seaside community; economic activity includes lobstering, fishing, and several marinas.
- Hull has a relatively small commercial base, the town is reliant on residential property taxes to support municipal services.
- Hull is highly vulnerable to coastal storms and has only three evacuation routes from town.
- Hull's natural resources and beauty are highly valued by residents.

The significant demographic characteristics of the Town of Hull are summarized in Table 5. Some of these features are important to keep in mind for hazard mitigation as well as emergency preparedness and response in the Town.

Table 5. Town of Hull Characteristics

Population	
Total population	10,116
Residents under 5 years old	3%
Residents 65 years old and over	23%
Race & Ethnicity	
American Indian and Alaska Native	0%
Asian	1.5%
Black or African American	0%
White	96%
Hispanic or Latino	0%
Other Race	1.5%
Two or More Races	1%
Household Income	
Total Households	4380
Mean Household Income	$117,120
Housing units built before 1940	40%
Renter occupied housing units	20%
Languages	
Speak a language other than English at home	4%
Spanish	1%
Other Indo-European languages	3%
Asian and Pacific Island languages	0%
Other languages	0%
Speaks English less than "very well"	0%
Additional Information	
Residents with a Disability	24%
Age 65 to 74 with a disability	2%
Age 75 and over with a disability	3%
Households in Poverty	9%
Households with no vehicle	3%

Sources: US Census, 2020 Decennial Census and American Community Survey (ACS) 5-Year Estimates (2017-2021)

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. 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:

- Meetings and work with the Local Teams
- Two public meetings, advertised through email, webpage content, a flyer, press release to local media, and social media posts, with the second meeting shared on Local Access TV,
- A project website at: www.mapc.org/resource-library/hull-hmp and a dedicated email for public comments, ResilientHull@mapc.org
- Launching a public comment period at the second public meeting, and posting the draft plan to the project website to facilitate public review,
- Outreach to neighboring communities, Town boards and commissions, the local chamber of commerce and businesses, and other local or regional entities.

PLANNING PROCESS SUMMARY

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

Figure 2. 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:

    - Blue Hills Observatory
    - DCR, Community Information System, Community Overview
    - Town of Hull Zoning By-Laws
    - Town of Hull Community Development Strategy
    - Town of Hull Open Space and Recreation Plan, 2000
    - Kleinfelder Inc., Coastal Climate Change Vulnerability Assessment and Adaptation Study, 2016
    - Environment America Research and Policy Center, *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation,* July 2012
    - FEMA, Disaster Declarations for States and Counties, 2023
    - FEMA, Flood Insurance Study, Plymouth County, 2016
    - FEMA Flood Insurance Rate Maps for Plymouth County, MA, 2012
    - FEMA LOMR, Effective 12/13/17
    - FEMA, HAZUS-MH, 2023
    - FEMA, Local Mitigation Planning Policy Guide, 2022
    - Massachusetts Climate Change Assessment, 2022
    - MA Office of Coastal Zone Management, Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning, December 2013.
    - MA Office of Dam Safety, Inventory of Massachusetts Dams
    - Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018, 2023
    - Massachusetts State Hazard Mitigation Plan, 2013
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
    - New England Seismic Network, Boston College Weston Observatory
    - NOAA Centers for Environmental Information
    - Northeast States Emergency Consortium
    - Tornado History Project
    - US Census, 2020, American Community Survey
    - USDA Forest Service, Wildfire Risk to Communities
    - USGS, National Water Information System,
    - U.S. Global Change Research Program, Fourth National Climate Assessment, 2018

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. 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 Chapter VII.

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 E.

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. Chapter IX includes more detailed information on plan implementation.

See Section 7 for more information on the status of mitigation measures from the 2018 Hazard Mitigation Plan.

THE LOCAL HAZARD COMMUNITY PLANNING TEAM

MAPC worked with the local community representatives to organize a Local Hazard Mitigation Planning Team for Hull. 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.

The Local Hazard Mitigation Planning Team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC 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 Local Hazard Mitigation Planning Team membership can be found in Table 5 below.

The Hull Planning Board, the Hull Conservation Commission, and the Building Department are the primary entities responsible for regulating development in town. Feedback from the Planning Board and the Conservation Commission was assured through the participation of the Director of Community Development and Planning, the Conservation Administrator, the Building Commissioner, and the Town Manager. In addition, MAPC, the State-designated regional planning authority for Hull, works with all agencies that that regulate development in the region, including the listed municipal entities and state agencies, such as the MassDOT and the Department of Conservation and Recreation.

The Local Hazard Mitigation Planning Team met four times on the dates listed below. The agendas for these meetings are included in Appendix B.

- **June 21, 2023**: to discuss the project overview and update local hazard areas and critical facilities inventory
- **September 20, 2023**: to update hazard mitigation goals and existing mitigation measures
- **November 15, 2023**: to update the recommended mitigation strategies from the 2018 HMP and prepare for Public Meeting #1
- **December 14, 2023**: to develop new recommended mitigation measures for the 2024 plan update and prepare for Public Meeting #2

Table 6: Membership of the Hull Hazard Mitigation Team

Brianna	Bennett	Resident
Kurt	Bornheim	Harbormaster
Jennifer	Constable	Town Manager
Chris	Dilorio	Director of Community Development & Planning
John	Dunn	Police Chief
William	Frazier	Deputy Fire Chief
Chris	Gardner	Director, Dept. of Public Works
Steven	Greenburg	Hull Chamber of Commerce
Jason	Harris	Local Inspector, Building Dept.
Bartley	Kelly	Building Commissioner
Christian	Krahforst	Director, Climate Adaptation & Conservation and Hazard Mitigation Team coordinator
Ian	MacDonald	Conservation Administrator
Tom	Molinari	Assistant Director of Wastewater Operations
Matt	O'Sullivan	Associate Planner
Neil	Reilly	Deputy Police Chief
Chris	Russo	Fire Chief
Michael	Schmitt	Assistant Operations Manager, Hull Municipal Light
John	Struzziery	Director, Wastewater Operations
Joan	Taverna	Director, Board of Health
Lisa	Thornton	Director, Council on Aging
Gary	Twombly	Fire Department

PUBLIC MEETINGS

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, 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, the first during the planning process and the second when a draft plan was available for review.

The public had an opportunity to provide input to the Hull hazard mitigation planning process at a public meeting held on November 28, 2023 at the Hull High School Exhibition Room. The meeting was attended by 48 residents (see sign in sheets in Appendix C).

The draft plan update was presented at a second public meeting on April 18, 2024, also at the Hull High School Exhibition Room. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. Both meetings were publicized on the Town's website and social media, direct outreach by email, flyers, and press outreach. A Media Advisory was also sent to the local press. See public meeting notices in Appendix C.

LOCAL STAKEHOLDER INVOLVEMENT

The local Hazard Mitigation Planning Team was encouraged to reach out to local stakeholders that might have an interest in the Hazard Mitigation Plan including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following organizations and neighboring municipalities inviting them to review the Hazard Mitigation Plan and submit comments to the Town:

Town of Hingham
Town of Cohasset
Hull Nantasket Chamber of Commerce
Wellspring
U.S. Coastguard
Lifesaving Museum
Hull Redevelopment Authority
Weir River Watershed Association
Straits Pond Watershed Association

See Appendix C for public meeting notices.

The draft Hull Hazard Mitigation Plan 2024 Update was posted online for the second public meeting. Members of the public could access the draft document and submit comments or questions to the Town through a dedicated project email address ResilientHull@mapc.org

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 the annual update and 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

PLAN UPDATE PROCESS 2023-24

Major milestones in the planning process to prepare this plan update included the following:

May 24, 2023	Kick-off Meeting with MAPC and Town Staff
June 21, 2023	1st Meeting of the Hull Hazard Mitigation Team
September 20 2023	2nd Meeting of the Hull Hazard Mitigation Team
November 15, 2023	3rd Meeting of the Hull Hazard Mitigation Team
November 28, 2023	Public Meeting at Hull High School
December 14, 2023	4th Meeting of the Hull Hazard Mitigation Team
April 18, 2024	Public Meeting at Hull High School
TBD	Draft Plan Update submitted to MEMA
TBD	Notice of Approval Pending Adoption issued by FEMA
TBD	Adoption of the Plan by the Town
TBD	FEMA Formal Approval of the plan for 5 years

PLAN IMPLEMENTATION MILESTONES 2024-29

After this plan update is approved by FEMA for a five-year period, the Town should take note of the following milestones for the ongoing implementation, review, and updating of this plan:

2026	Conduct Mid-Term Plan Survey on Progress
2027	Seek FEMA grant to prepare next plan update
2028	Begin process to update the plan
2029	Submit Draft 2028 Plan Update to MEMA and FEMA
2029	FEMA approval of 2029 Plan Update

SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town 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 Hull's risk assessment, MAPC gathered the most recently available hazard and land use data and met with the Local Team to identify changes in local hazard areas and development trends. MAPC also used FEMA's damage estimation software, Hazards US (HAZUS).

The projected impacts of our warming climate on natural hazards are integrated throughout this risk assessment. Key impacts include rising temperatures, which in turn affect precipitation patterns and extreme weather. Analysis of these impacts included in this plan aligned closely with the data and assessment presented in Massachusetts' State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) and the Massachusetts' 2022 Climate Change Assessment.

> *"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)

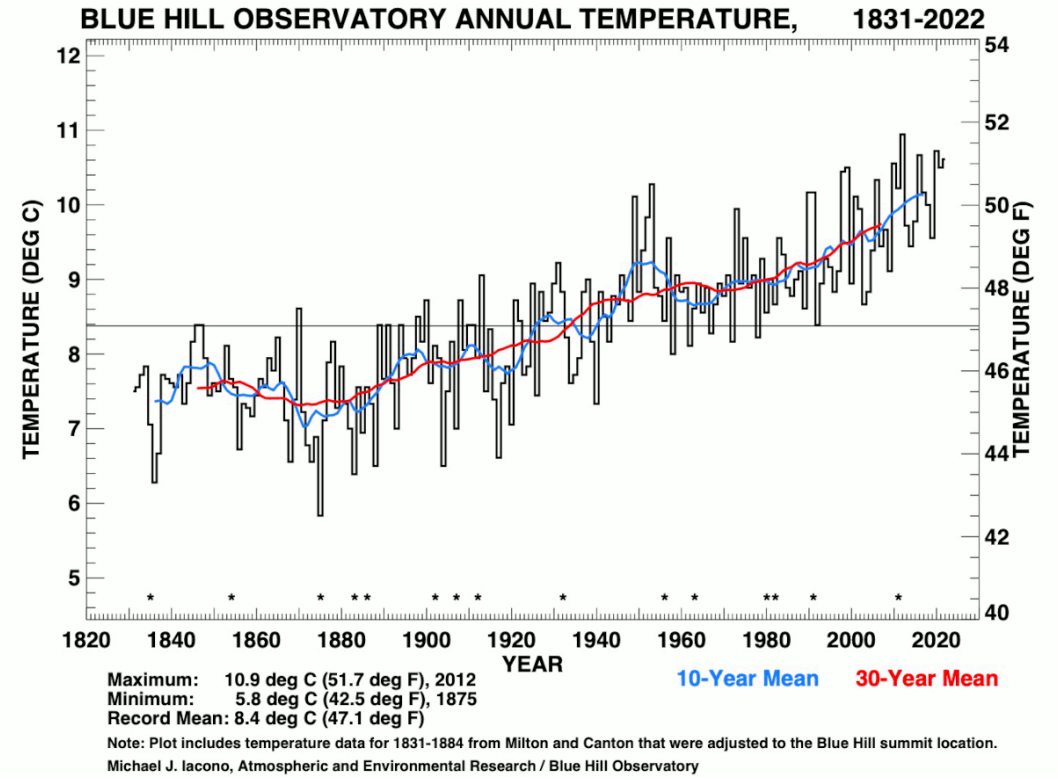
CLIMATE CHANGE OBSERVATIONS AND PROJECTIONS

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

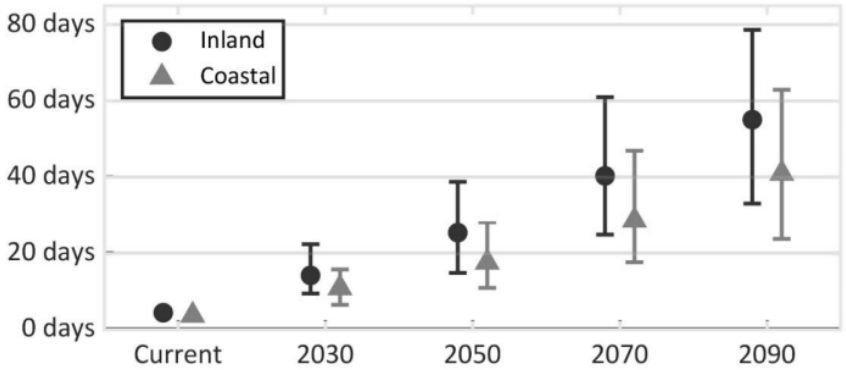
Our climate has always been regulated by gases, including carbon dioxide, methane, and nitrous oxide, which blanket the earth. These gases trap heat that would otherwise be reflected out to space; without them our planet would be too cold to support life. We refer to these gases as "greenhouse gases" (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. See Figure 3 below for more information.

Figure 3: Observed Increase in Temperature



Climate projections include an increase in average temperature and in the number of extreme heat days. Extreme cold days are projected to decrease in number. By 2030, the summer mean temperature could increase by 3.6°F from the historical period (1950-2013). By 2070, there could be 58 fewer days below freezing, which could lead to an increase in ticks. By mid-century, the State anticipates about 25 more days per year where the temperature exceeds 90°F for inland areas, and about 19 more days above 90°F for coastal areas (Commonwealth of Massachusetts, 2022).

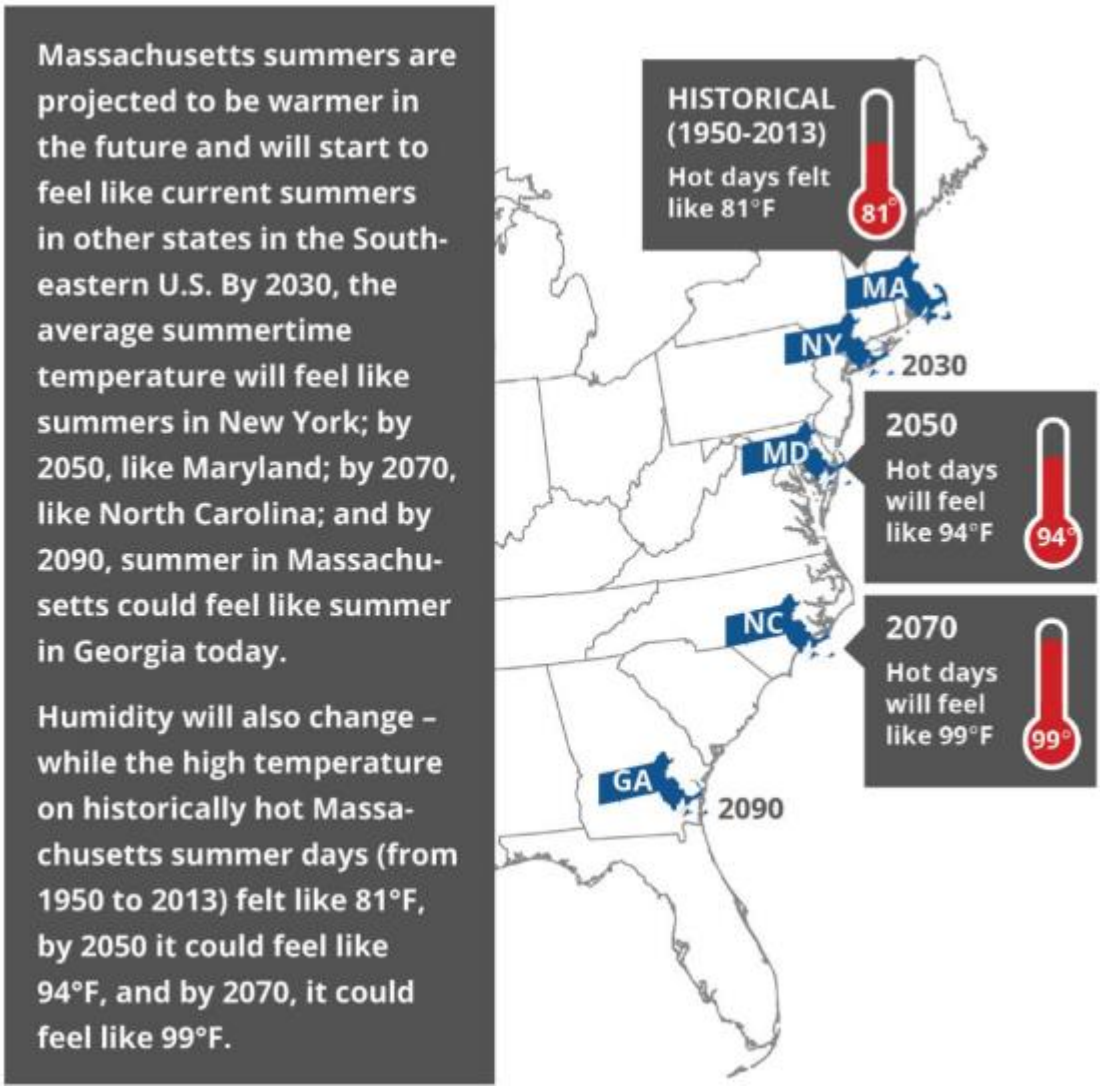
Figure 4: Change in the Annual Number of Days Over 90°F Compared to Today



Sources: 2022 MA Climate Change Assessment and Stochastic Weather Generator

These changes could result in Massachusetts summers feeling like a more southern state, as described in the infographic in Table 5 from the State's 2022 Climate Change Assessment.

Figure 5: Change in Average Summertime Temperatures for Massachusetts

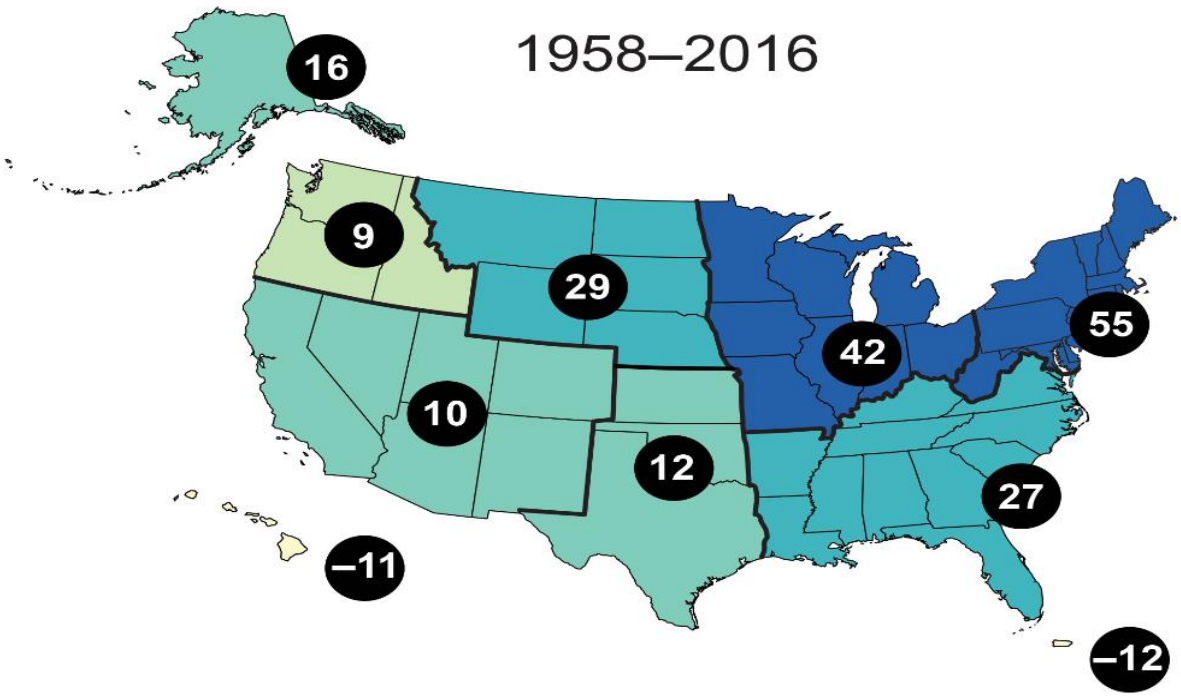


Source: 2022 MA Climate Change Assessment

PRECIPITATION PATTERNS

Annual precipitation in Massachusetts has increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA EEA, 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, as shown in Figure 6 below (US Global Change Research Program, 2018). Changes in precipitation are fueled by warming temperatures which increase evaporation and, therefore, the amount of water vapor in the air.

Figure 6: Observed Change in Total Annual Precipitation in the Heaviest 1% Events

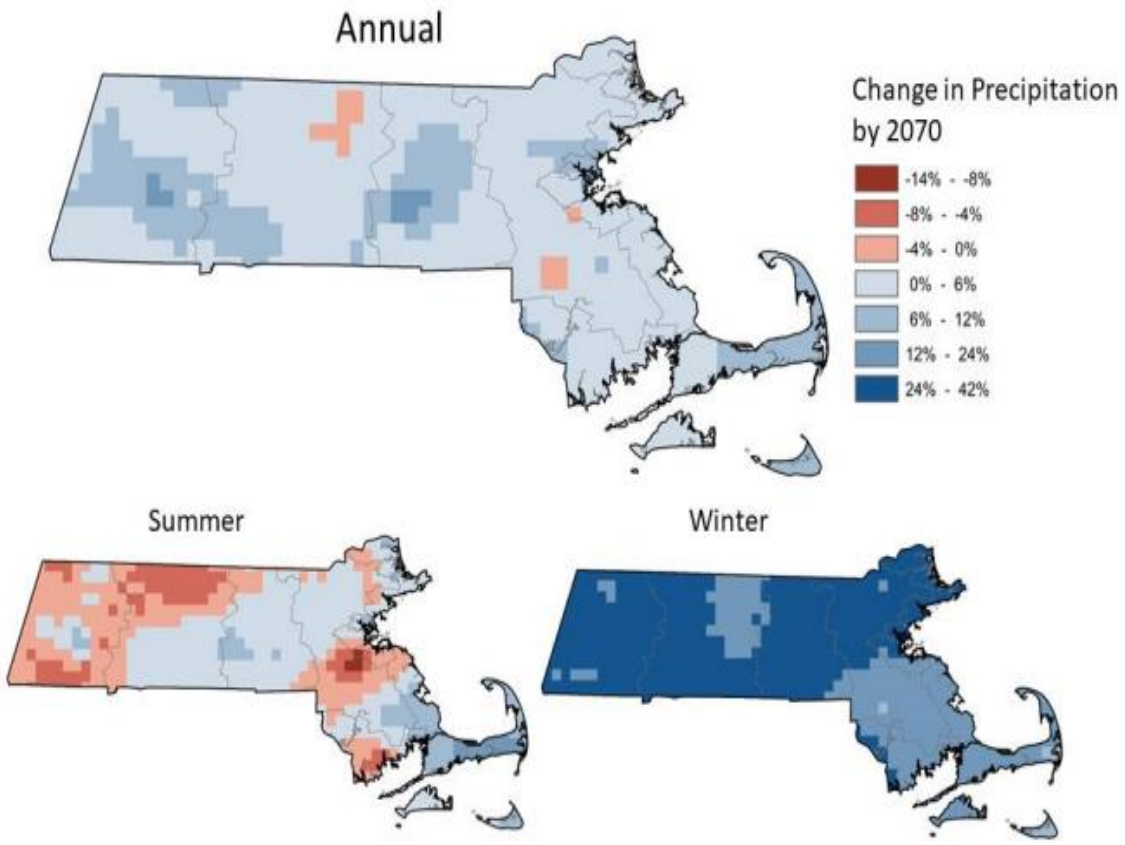


Source: Fourth National Climate Assessment, 2018
Numbers circled in black indicate % change.

Massachusetts' 2022 Climate Change Assessment anticipates that most parts of the State will see a future increase in annual total precipitation of less than 8% per year. Most of these increases are anticipated during the winter months (see Figure 7 below).

Additionally, the historic 10% annual chance daily rainfall event (2.8-4.0" of rain) could occur four times more frequently by 2090 (Commonwealth of Massachusetts, 2022).

Figure 7: Change in Annual and Seasonal Precipitation in 2070 Compared to Today



Source: 2022 MA Climate Change Assessment. Current climate is the 1986-2005 era, the projection for 2070 is for a 20-year era centered on 2070. Maps show LOCA downscaled GCM projections at the 50th percentile across 20 LOCA GCMs that overlap with the GCMs used in the Stochastic Weather Generator.

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. Massachusetts' 2022 Climate Change Assessment anticipates that these changes will vary by region. The Boston Harbor where Hull is located may experience slightly more consecutive dry days, and more days without rain per year, by 2090 (Commonwealth of Massachusetts, 2022). See Figure 8 below for more information.

Figure 8: Consecutive dry day events (number of multiple-dry-day events per year)

Panel A: Consecutive dry day events (number of multiple-dry-day events per year)

Region	Baseline	2030	2050	2070	2090
Berkshires & Hilltowns	29	29	30	30	31
Greater Connecticut River Valley	31	31	32	32	33
Central	32	32	32	33	33
Eastern Inland	32	32	32	33	33
Boston Harbor	31	31	32	32	33
North & South Shores	31	31	32	32	33
Cape, Islands, & South Coast	31	31	32	32	33
Statewide	**31**	**31**	**31**	**32**	**33**
Statewide Percent Change	**0%**	**1%**	**2%**	**4%**	**6%**

Source: Stochastic Weather Generator

Panel B: Annual number of days without rain (days per year)

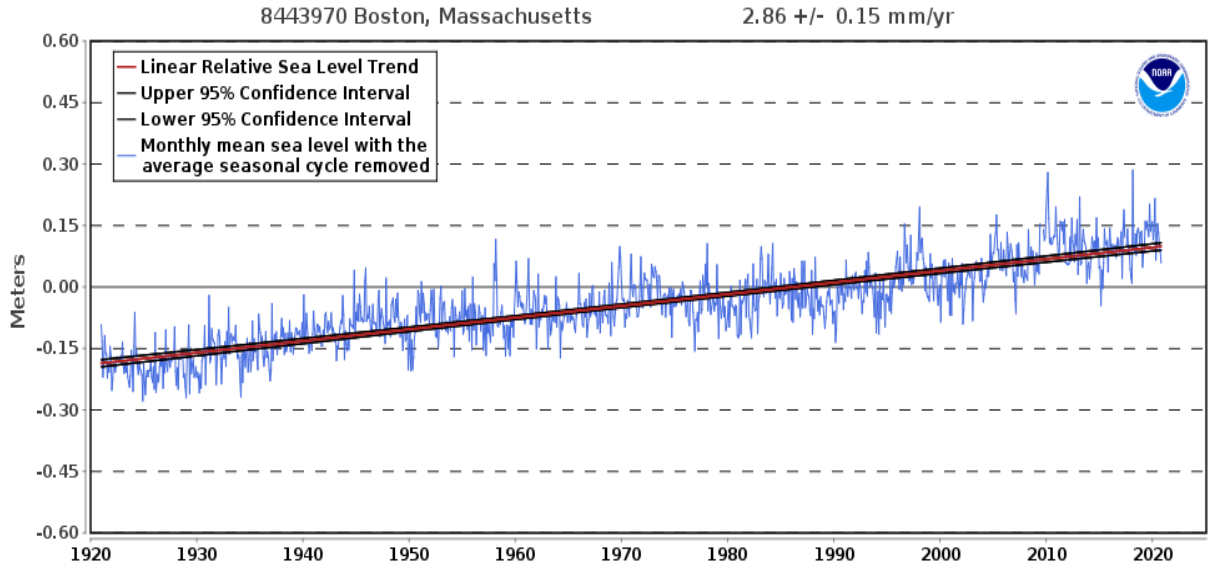
Region	Baseline	2030	2050	2070	2090
Berkshires & Hilltowns	159	161	165	167	170
Greater Connecticut River Valley	171	172	175	178	181
Central	180	182	185	188	192
Eastern Inland	186	181	185	188	193
Boston Harbor	192	185	192	194	198
North & South Shores	184	182	187	190	195
Cape, Islands, & South Coast	186	182	187	191	194
Statewide	**176**	**175**	**179**	**182**	**187**
Statewide Percent Change	**0%**	**-1%**	**2%**	**3%**	**6%**

Source: 2022 MA Climate Change Assessment. The Town of Hull is located in the Boston Harbor Region.

SEA LEVEL RISE

High-level information on sea level rise is discussed here as the town as well as the regional economy of the Boston Metro area may be impacted by sea level rise in the future. Warming temperatures contribute to sea level rise in three 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. NOAA's records from the Boston Tide Station show nearly one foot of sea level rise over the past century. See Figure 9 below for more information.

Figure 9: Observed Increase in Sea Level Rise



Source: NOAA

The sea level rise information in Massachusetts' 2022 Climate Change Assessment considers sea-level changes, land-level changes, and other regional facts that can impact the rate of change. The report includes the following approximate sea level rise projections for the State:

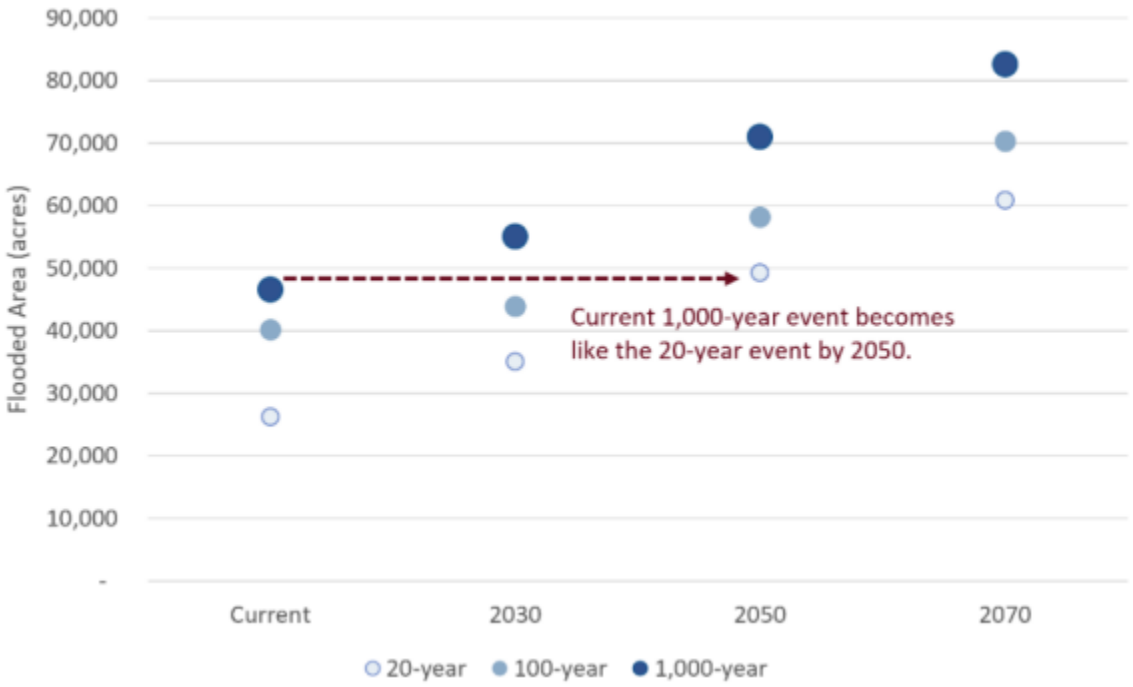
- **Northern Massachusetts:** 21 inches by 2050, and 43 inches by 2070
- **Southern Massachusetts:** 23 inches by 2050 and 45 inches by 2070

The 2022 Climate Change Assessment also quantified the developed land area flooded for events including:

- the 20-year (5% annual probability)
- 100-year (1% probability)
- 1000-year (0.1% probability) events

This approach found that the area flooded by the current 1000-year event is comparable to the area of a 20-year event by 2050. Even more area could be impacted by the annual probability event by 2070. See Figure 10 below for more information.

Figure 10: Total Flooded Area of the Commonwealth for Selected Events



Source: 2022 MA Climate Change Assessment

CLIMATE CHANGE AND HAZARD MITIGATION

Following the outline of the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), this local hazard mitigation plan organizes consideration of natural hazards based on their relationship to projected climate changes.

The table below, which is originally from the 2018 SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

Table 7: Climate Change & 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, increased potential for loss of life, 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 of wetlands
	Coastal Erosion	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, increase in vector-borne illnesses (West Nile, Zika, EEE), ecosystem stress, energy brownouts from higher energy demands, more intense heat waves, public health impacts from high heat exposure and poor outdoor air quality, increased potential for loss of life, 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		
	Tornadoes		
	Other Severe Weather (Strong Wind & Thunderstorms)		

OVERVIEW OF HAZARDS AND IMPACTS

In order to update Hull'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. The Resilient MA Plan, the SHMCAP (2018) and the State Hazard Mitigation Plan (2013) are key planning documents that examine natural hazards that have the potential to impact the Commonwealth. The 2013 State HMP set the stage by defining considerations such as frequency and severity and summarizing the frequency and severity of hazards of greatest concern. The 2018 SHMCAP used similar definitions for hazard considerations and expanded on this research by including additional climate projections. Because the 2013 State HMP includes definitions that were not specified in the SHMCAP, both resources are referred to in this report. MAPC also used FEMA's damage estimation software, HAZUS (described below).

Table 8 below summarizes the hazard risks for Hull. This evaluation takes into account the frequency and severity of each hazard for Massachusetts and Hull, based on available data, including:

- **State-level data**, including the Resilient MA Plan, the 2022 Climate Change Assessment, and 2018 SHMCAP.
- **County-level data** from NOAA's National Climatic Data Center and Storm Events Database for Plymouth County (where Hull is located)
- **Local-level information** including input from the Local Team, the hazard mapping included in Appendix A, and the HAZUS results.

The statewide hazard risk assessment is based on the definitions for hazard frequency and severity listed below. The statewide assessment was modified to reflect local conditions in Hull using the same criteria.

Definitions of Hazard Frequency and Severity

Frequency

Very low: Very unlikely; minimal examples of historical occurrences.
Low: Likely to occur at least once by the end of the century; some examples of historical occurrences; anticipated every 100 years.
Medium: Likely to occur at least once every 50 years (two or more occurrences in the next century)
High: Almost certain to occur at least once a year.
Very High: Almost certain to occur multiple times a year.

Severity

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

Table 8 - Hazard Risks Summary for MA and Hull

Hazard	Frequency		Severity	
	Massachusetts	Hull	Massachusetts	Hull
Flooding from Precipitation	Very High	High	Serious	Serious
Dam failures	Very Low	Very Low	Extensive	Minor
Coastal Erosion	Very High	Very High	Serious-Extensive	Extensive
Coastal Flooding	Very High	Very High	Serious-Extensive	Extensive
Tsunami	Very Low	Very Low	Extensive-Catastrophic	Extensive
Hurricane/Tropical Storm	Medium	Medium	Serious - Catastrophic	Extensive
Tornadoes	High	Low	Serious - Extensive	Serious
Other Severe Weather (Wind/Thunderstorms)	Very High	High	Minor - Extensive	Minor-Serious
Severe Winter/Nor'easter	High	High	Minor - Extensive	Extensive
Winter-Ice Storms	Medium	Medium	Minor - Extensive	Minor
Earthquakes	Medium	Medium	Serious - Catastrophic	Serious
Landslides	High	Very Low	Minor - Extensive	Minor
Wildfire/Brushfires	Very High	Medium	Minor - Extensive	Minor
Extreme Temperatures	Very High	Very High	Minor -Serious	Minor
Drought	Medium	Medium	Minor - Serious	Minor

Sources: *Resilient MA Plan (Frequency), State Hazard Mitigation Plan 2013 (Severity), HAZUS, Local information.*

FLOODING HAZARDS

Flooding was the most prevalent natural hazard identified by local officials in Hull. The Town is subject to two kinds of flooding; *coastal flooding* (discussed further below), where wind and tide leads to flooding along the shore and tidal waterways, and *inland or stormwater flooding, discussed in this section,* 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. These two types of flooding are often combined as inland flooding is prevented from draining by the push of wind and tide driven water.

Flooding is generally caused by severe rainstorms, hurricanes, nor'easters, and thunderstorms. Severe rainstorms can occur year-round. Hurricanes are most common in the summer and early fall while Nor'easters are most common in winter. Spring snowmelt may exacerbate flooding during storm events. Large rainstorms can occur year-round. 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.

REGIONALLY SIGNIFICANT FLOODS

There have been a number of major floods that have affected the Metro Boston region over the last fifty years. Significant historic flood events have included those listed below (NOAA, 2024)

- The Blizzard of 1978
- January 1979
- April 1987
- October 1991
- December 1992
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- December 2010
- March 2013
- January 2018
- March 2018
- June 2020

OVERVIEW OF TOWN-WIDE FLOODING -

The frequency and locations of flood hazard events in Hull can be estimated based on the reported loss occurrences for repetitive loss properties and from local knowledge captured through discussion with local staff and the public during identification of local flood hazard areas. Based on these factors flooding occurs most often along the ocean shoreline, where even a relatively small storm can lead to very high tides and overwash of seawalls and dunes, and in a number of low-lying neighborhoods throughout the town. Reported losses on repetitive loss properties indicate that a flood event resulting in property damage occurs on average a little more frequently than once a year, though there have been stretches of time over the last 30 years of up to a couple years during which flooding of this extent did not occur. In particular, winter storms in 1978, 1979, 1982, 1991, 1992, 2001, 2003 (twice), 2005, 2006, and 2007, 2010, and 2013 all led to extensive flood insurance claims in Hull's low lying, flood prone areas.

INLAND/STORMWATER FLOODING

Given Hull's largely peninsular geography, riverine flooding is less of a prominent issue compared to the hazards presented by coastal flood events. The Weir River and its tributaries, located at the southern end of the Town, is the only real river system. Flooding is relatively limited in this area and active land conservation and wetland protection measures in this area have limited the exposure of homes and businesses to this type of flooding.

The type of inland flooding that is a greater issue for the Town is flooding driven by inadequate storm water drainage. Particularly an issue in those parts of the Town with greater levels of imperviousness, this flooding occurs in areas where the storm drain pipes are inadequately sized compared to the level of storm water run-off. Exceptionally high tides can also effectively block the storm drain systems, given Hull's generally low-lying geography.

The best available local data on previous flooding events in Hull is from NOAA's National Centers for Environmental Information Storm Events Database, which provides county-level records of natural hazards (see Table 9). Plymouth County, which includes the Town of Hull, experienced 57 flood events from 2005 –2023. No deaths or injuries were reported and the total reported property damage in the county was $24.3 million dollars.

Table 9: Plymouth County Flood Events, 2005-2023

Date	Deaths	Injuries	Property Damage ($)
3/28/2005	0	0	0
10/15/2005	0	0	350,000
10/15/2005	0	0	200,000
10/15/2005	0	0	50,000
10/15/2005	0	0	100,000
10/15/2005	0	0	140,000
10/25/2005	0	0	35,000
12/9/2005	0	0	40,000
5/13/2006	0	0	500,000
5/13/2006	0	0	0
6/7/2006	0	0	30,000
6/23/2006	0	0	2,000
8/20/2006	0	0	5,000
10/28/2006	0	0	10,000
3/2/2007	0	0	10,000
3/17/2007	0	0	8,000
4/15/2007	0	0	25,000
2/13/2008	0	0	0
3/8/2008	0	0	5,000
3/8/2008	0	0	0
9/27/2008	0	0	50,000
5/24/2009	0	0	0
8/29/2009	0	0	0
3/14/2010	0	0	16,150,000
3/29/2010	0	0	8,070,000
4/1/2010	0	0	0
7/13/2011	0	0	5,000
8/10/2012	0	0	30,000
5/11/2013	0	0	0
5/11/2013	0	0	0
6/7/2013	0	0	0
9/3/2013	0	0	0
3/30/2014	0	0	0
10/22/2014	0	0	0
11/17/2014	0	0	0
05/31/2015	0	0	0
07/28/2015	0	0	15,000
09/10/2015	0	0	0
10/29/2015	0	0	0
05/30/2016	0	0	0

Date	Deaths	Injuries	Property Damage ($)
04/01/2017	0	0	5,000
04/06/2017	0	0	5,000
6/24/2017	0	0	1K
10/25/2017	0	0	0
10/29/2017	0	0	0
1/12/2018	0	0	0
11/3/2018	0	0	1K
4/15/2019	0	0	0
7/12/2019	0	0	0
7/22/2019	0	0	0
9/2/2019	0	0	2K
7/12/2021	0	0	0
9/2/2021	0	0	2000
11/12/2021	0	0	5000
8/5/2022	0	0	4000
8/18/2023	0	0	0
9/10/2023	0	0	0
Total	**0**	**0**	**$25,851,000**

Source: NOAA, National Centers for Environmental Information

The most severe recent flooding In Eastern Massachusetts occurred during the major storms of March 2010, when a total of 17.7 inches of rainfall was recorded by the Blue Hills Observatory from three storms over 19 days from March 13 to 31. accumulation was officially recorded by the National Weather Service (NWS). The weather pattern that caused these floods consisted of early springtime prevailing westerly winds that moved three successive storms, combined with tropical moisture from the Gulf of Mexico, across New England. Torrential rainfall caused March 2010 to be the wettest month on record. The March 2010 rainstorms fit the profile of a type of severe precipitation event expected to increase in frequency as the climate warms. That is, significant precipitation, falling in late winter as rain rather than snow, on frozen ground, and while vegetation is still dormant.

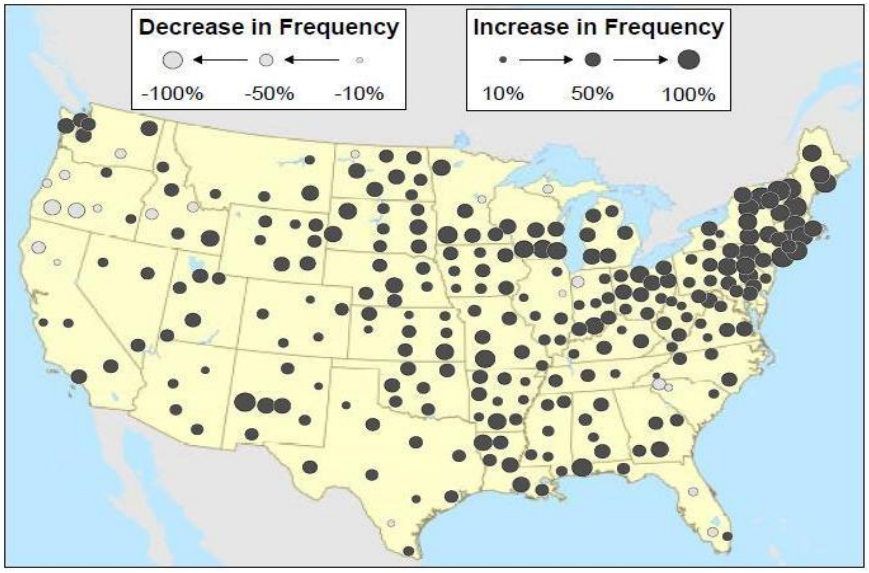
Damages from flooding from storms of March 2010 in Plymouth County totaled $24.2 million. Notably, that represents 93% of total flood damages for the 18 year period from 2005 to 2023, which totaled $25.8 million. Those storms were a federally declared disaster, making federal assistance available to residents who did not carry flood insurance. That resulted in 37 disaster claims in the Town of Hull, totaling $57,171.39.

The HAZUS analysis estimates damages in Hull from a 100-year flood at $266.8 million and $676.4 million from a 500-year flood.

FLOODING AND CLIMATE CHANGE

Hull's average annual precipitation is 42 inches. While total annual precipitation has not changed significantly, according to the 2012 report *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation from 1948 to 2011,* intense rainstorms and snowstorms have become more frequent and more severe over the last half century in the northeastern United States. Extreme downpours are now happening 30 percent more often nationwide than in 1948 (see Figure 11). In other words, large rain or snow storms that happened once every 12 months, on average, in the middle of the 20th century, now happen every nine months.

Figure 11 Changes in Frequency of Extreme Downpours, 1948 – 2011



Source: *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation,* Environment America Research and Policy Center, July 2012

Not only are these intense storm events more frequent, they are also more severe; the largest annual storms now produce 10 percent more precipitation, on average, than in 1948. In particular, the report finds that New England has experienced the greatest change with intense rain and snow storms occurring 85 percent more often than in 1948.

Data from the 2022 MA Climate Change Assessment related to changes in precipitation patterns is included in an earlier section of this chapter. Those projections suggest that future rain events will be increasingly intense and lengthy, which could lead to increased inland and stormwater flooding.

Precipitation frequency estimates, which are used to derive stormwater design standards, were published in 196l 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. Communities should consider future rainfall rates when designing infrastructure.

For example, communities could consider using NOAA Atlas 14 rainfall rates with an additional allowance to account for projected rainfall during the life of projects permitted today when sizing stormwater infrastructure. DEP takes a similar approach to describe current (not future) rainfall rates, called "NOAA14+". Mystic River Watershed Association (MyRWA) communities propose "NOAA14++", which they say reflects 2070 projections. The NOAA 14+ number is calculated by multiplying the NOAA 14 precipitation frequency estimate upper confidence interval by 0.9 (i.e., current but extreme precipitation events reflect 90% of upper confidence intervals). The NOAA 14++ number is the upper confidence interval. A comparison of these numbers is summarized in the table below (NOAA, 2023).

Table 10: Rainfall rates for the 10-year 24-hour storm

NOAA 14	NOAA 14+	NOAA 14++
5.27 inches	5.90 **inches**	6.56 **inches**

The 2022 MA Climate Change Assessment also highlights the following flooding climate impacts:

- By 2050, the 1 percent annual chance river flood could be two times more likely to occur
- By 2090, the historical 10 percent annual chance daily rainfall event (2.8 to 4 inches) could occur four times more frequently
- Damage could occur to inland buildings from heavy rainfall and overwhelmed drainage systems
- Damage could occur to transit service due to flooding
- There could be a reduction in the availability of affordably priced housing from direct damage including from flooding (Commonwealth of Massachusetts, 2022)

COASTAL FLOODING

Coastal flooding is 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. Hull has extensive exposure to coastal flooding and flooding along large stretches of its coastline can be a relatively frequent occurrence. The greatest amount of coastal storm related flooding is along the eastern coastline, which faces the greatest exposure to wind driven waves. 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. Projections of future sea level rise identify locations that will be subject to flooding in future years. While those areas do expand with increasing sea level, the more significant impact will be frequent and deeper flooding in the locations already subject to coastal flooding.

Map 10 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.

The best available local data for previous coastal flooding occurrences is for Plymouth County through the NOAA National Centers for Environmental Information. Plymouth County, which includes the Town of Hull, experienced 42 coastal flood events from 2011 through 2023 (see Table 11). No deaths and two injuries were reported and the total reported property damage in the county was $12.83 million dollars. Measures of the severity of coastal flooding include water level elevation and duration of the event. The National Weather Service issues minor, moderate, and major coastal flood warnings.

Table 11: Plymouth County Coastal Flood Events, 2011-2023

Date	Deaths	Injuries	Property Damage ($)
10/30/2011	0	0	10,000
11/23/2011	0	0	0
6/3/2012	0	1	35,000
6/4/2012	0	0	0
6/4/2012	0	0	40,000
10/29/2012	0	0	645,000
10/29/2012	0	0	322,000
12/27/2012	0	0	0
12/27/2012	0	0	0
2/9/2013	0	0	9,200,000
3/7/2013	0	0	500,000
12/15/2013	0	0	0
1/2/2014	0	0	0
1/2/2014	0	0	0
1/3/2014	0	0	0
3/26/2014	0	0	0
10/22/2014	0	0	75,000
10/23/2014	0	0	0
11/2/2014	0	0	0
1/27/2015	0	1	1,500,000
2/15/2015	0	0	0
10/2/2015	0	0	0
1/23/2016	0	0	0
1/24/2016	0	0	3,000
2/8/2016	0	0	0
1/4/2018	0	0	500,000
1/30/2018	0	0	0
3/2/2018	0	0	0
3/8/2018	0	0	0
10/27/2018	0	0	0
11/25/2018	0	0	0
1/20/2019	0	0	0
4/3/2020	0	0	2,000

Date	Deaths	Injuries	Property Damage ($)
9/22/2020	0	0	0
12/17/2020	0	0	0
2/2/2021	0	0	0
10/27/2021	0	0	0
1/17/2022	0	0	0
1/29/2022	0	0	0
12/23/2022	0	0	2,000
12/23/2022	0	0	5,000
1/23/2023	0	0	0
Total	**0**	**2**	**$12,839,000**

Source: NOAA, National Centers for Environmental Information

On January 4, 2018 Hull experienced significant flooding due to a nor'easter. The storm coincided with astronomical high tides and resulted in a surge, recorded at the Boston tide station, of 15.16 – higher than the highest surge from the Blizzard of 78. As a result the Town additional flooding areas that hadn't previously been identified (see Flood Hazard Areas below).

POTENTIAL FLOOD HAZARD AREAS

Information on potential flood hazard areas was taken from several sources. The first was the National Flood Insurance Rate Maps. The FIRM flood zones are shown on Map 3 in Appendix A and their definitions are listed below.

Flood Insurance Rate Map Zone Definitions

Zone AO (1% chance zone) Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.

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

Zones X500 (.2% annual chance) **-** Zone X500 is the flood insurance rate zone that correspond to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone.

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

The second was from a 2017 analysis of Hull's repetitive loss properties developed by the Town as part of its compliance with FEMA's Community Rating System program (see Appendix D). Finally, information on locally identified areas subject to flooding was provided by the Hull Hazard Mitigation Team. These are shown in Table 12.

All of these local flooding areas do not necessarily coincide with the flood zones from the FIRM maps. Some may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The Hull Hazard Mitigation Team reviewed the sites identified in the 2018 plan and provided the following updates and additional sites for this 2024 updated plan . The numbers correspond to the numbers on Map 8, "Local Hazard Areas," which is shown in Appendix A.

Table 12: Hull Locally Identified Flood Hazard Areas

Name/Description	Revisions/updates for 2024
1) **Atlantic Avenue** – Overwash of the sea wall leads to flooding, especially during Nor'easters.	Mitigation will be seawall/revetment 2 feet additional height
2) **Atlantic Avenue @ Cohasset Border** – Overwash leads to flooding.	None
3) **Nantasket Beach (DCR**), Hull Shore Drive/Extension – Waves during storm events top the sea wall in this area.	None
4) **Hampton Circle** – Floods in the low area between Hampton and Sagamore Hills.	Town has a planning grant for preliminary design; applied for an MVP Action Grant
5) **Beach Avenue to Nantasket Avenue**, (Phipps to A Streets) – Coastal flooding overtops or erodes the sand dunes. Flooding is compounded by lack of adequate drainage.	Parking lot at 140 Beach Avenue was closed; a dune was added.
6) **Sunset/Caddish Avenue, Bayside** – Coastal flooding overtops seawalls and revetments.	None
7) **Alphabet Streets, Oceanside** – Coastal flooding overtops the sand dunes.	Town to continue planting dune grasses, drainage improvements from A to L Street.
8) **Stoney Beach**– Coastal flooding overtops seawalls and revetments. Flooding is compounded by lack of adequate drainage.	$11 million grant for seawall replacement at Fitzpatrick Way and Nantasket Street, design work by the state, work to start in December 2024.
9) **Ocean Avenue Marsh**– Coastal flooding overtops seawalls and revetments. Flooding is compounded by lack of adequate drainage.	Maintenance dredging was conducted.
10) **Channel Street – Sea wall**– Coastal flooding overtops seawalls. Flooding is compounded by lack of adequate drainage.	None
11) **Point Allerton** - Coastal flooding overtops the revetment.	Seawall is state owned; there has been no action on this.

Name/Description	Revisions/updates for 2024
12) **James Avenue–** Coastal flooding overtops seawalls and revetments.	Seawall was repointed.
13) **DPW Building** – adjacent to Weir River storm surge overtops the bank	None
14) **Gun Rock Beach/Atlantic Avenue** - Coastal flooding overtops seawalls and revetments.	The retaining wall was replaced and elevated 2 feet.
15) **Dighton Street** adjacent to Hull Bay	Seawall was repointed.
23) **Gun Rock/Stony Beach Road** - Coastal flooding overtops seawalls and revetments	None
24) **Boathouse**	Add site to flood hazard area)
25) **Lifesaving Museum**	Add site to flood hazard area)
27) **Paragon Carousel**	Add site to flood hazard area)
28) **Central Avenue** – flooding from rain events is exacerbated by poor drainage	Pumps were replaced at D Street stormwater station; new valves at H Street.
29) **Edgewater Road** – flooded between 6th and 11th Streets in the January 2018 storm	Outfall pipe was extended bay side.
30) **Bay Street** – flooded along the southern section in the January 2018 storm	None
31) **Nantasket Road** – flooded between 11th Street and Clifton Avenue in the January 2018 storm	None
32). **Hull Light** – concrete storage building	Add to plan for 2024
33). **GW Blvd.** – Generator staging area	Add to plan for 2024

REPETITIVE LOSS PROERTIES

As defined by the National Flood Insurance Program (NFIP), a Repetitive Loss property is any property for which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978. A Severe Repetitive Loss property is a property for which four or more claims of $5,000 each have been paid, with a cumulative amount exceeding $20,000; or for which at least two payments were made with a cumulative amount exceeding the value of the property.

There are 261 Repetitive Loss properties and 34 Severe Repetitive Loss (SLR) properties in Hull. Table 13A summarizes the number and type of repetitive loss properties by building type. Single

Family residences are by far the largest category with 228 Repetitive Loss properties and 28 Severe Repetitive Loss properties, representing 87% of the combined loss categories.

The Repetitive Loss properties had a total of 920 losses and the SLR properties had 228 losses between 1978 and 2023. A total of $10.4 million in building damage damages has been paid for Repetitive Loss properties, and $4.45 million was paid for SLR properties in the same period. Table 13B summarizes the number of losses and total claims associated with these properties.

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

Table 13A Summary of Repetitive Loss Properties in Hull

Repetitive Loss Category	Number of Properties	Single Family	Two-Four Family	Non Residential	Other Residential	Other Non Residential
Repetitive Loss	261	228	16	1	9	7
Severe Repetitive Loss	34	28	1	1	4	0
Total	**295**	**256**	**17**	**2**	**13**	**7**

Source: MEMA, FEMA Repetitive Loss data

Table 13B Summary of Repetitive Losses and Claims in Hull

Repetitive Loss Category	Number of Properties	Number of Losses	Total Building Payments	Total Contents Payments
Repetitive Loss	261	920	$ $10,425,087	$ $1,108,804
Severe Repetitive Loss	34	228	$ $4,564,979	$ $410,305
Total	**295**	**1148**	**$ $14,990,066**	**$ $1,519,109**

Source: MEMA, FEMA Repetitive Loss data

Based on the record of previous occurrences flooding events in Hull are a Very High frequency event as defined by the Resilient MA Plan. This hazard is almost certain to occur multiple times a year.

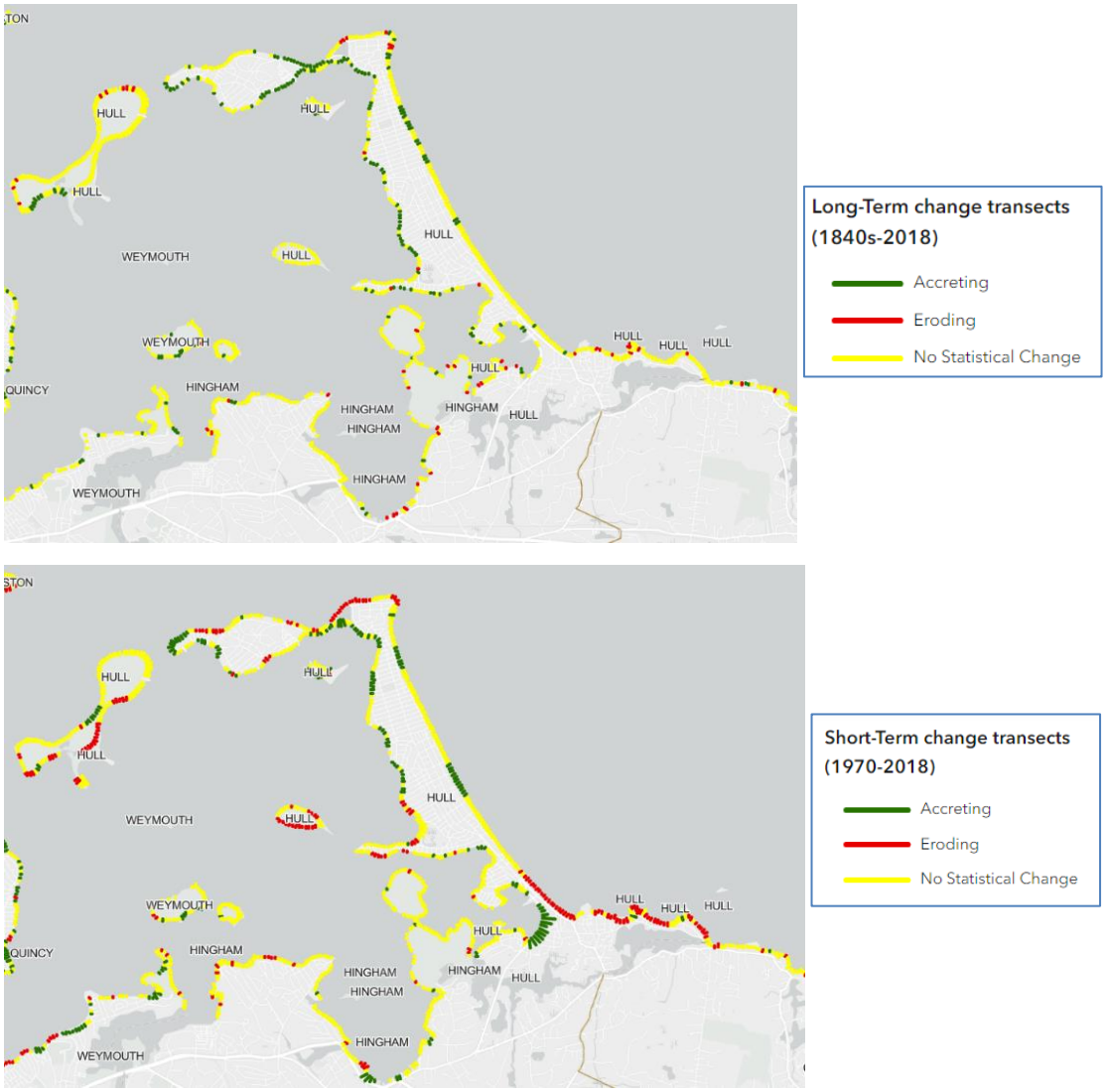
COASTAL EROSION AND SEA WALL FAILURE

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 (MA CZM) in cooperation with the U. S. Geological Survey (USGS) provides shoreline change data for the Massachusetts coast. The most recently available data provide long-term (1800's – 2014) and short-term (1970-2014) data. The analysis for Hull shows moderate long-term erosion and more significant short-term erosion (see Figure 12).

Figure 12: Short- and Long-Term Coastal Erosion in Hull



Source: MA Coastal Zone Management, Coastal Erosion Viewer

Average Shoreline Change Rates by Shoreline Type.

The Massachusetts Coastal Erosion Commission published an assessment of coastal erosion statewide in 2015. For this project, a shoreline characterization project was implemented to describe and categorize the land uses and natural resources potentially at risk from coastal erosion. The results of the characterization provide a baseline from which to monitor and identify landscape-level trends and patterns for evaluating adaptation and hazard mitigation strategies for a particular location or region.

In the report, the Commission assesses the status and trends of coastal erosion by examining the information and results of the Massachusetts Shoreline Change Project and then providing a summary assessment of past shoreline change and rates. Launched in 1989, the Shoreline Change Project develops and analyzes data from historical and modern sources, mapping the local high water line and developing shoreline change rates and statistics over both a long-term ~150 year period (i.e., from the mid-1800s to 2009) and a short-term ~30 year period (from 1970-2009) The information provided by the Shoreline Change Project is useful insight into the historical migration of Massachusetts shorelines and erosional hot spots.

The results from the shoreline characterization were used to analyze shoreline change rates for Hull. This was done to demonstrate the long-term and short-term erosion or accretion trends for seven shoreline types (see Table 14). The shoreline types with the greatest short-term erosion rates are Beach with Bank (-2.67 feet/year), Beach (-0.67 feet/year), and Salt Marsh (0.35 feet/year). By contrast, Beach with Dune had an accretion rate of +1.13 feet/year.

Table 14 - Average Shoreline Change Rates by Shoreline Type

Town	Shoreline Type	Long-Term Rate		Short-Term Rate	
		Mean (ft/yr)	Std Dev (ft/yr)	Mean (ft/yr)	Std Dev (ft/yr)
Hull	Beach	-0.12	0.39	-0.67	2.21
	Beach w/ Dune	0.08	0.38	1.13	1.15
	Beach w/ Bank	0.03	0.30	-2.62	2.67
	Beach w/ Structure	-0.05	0.33	0.08	1.32
	Bank	0.39	0.87	-0.04	1.43
	Salt Marsh	0.07	0.36	-0.35	1.68
	Structure	0.38	0.86	0.02	1.10

Source: Report of the Mass. Coastal Erosion Commission, 2015

To augment the information derived from the Shoreline Change Project, coastline and storm damage reports collected by the Massachusetts Rapid Response Coastal Storm Damage Assessment Team were reviewed to identify several "hot spot" locations where the combination of erosion, storm surge, flooding, and waves have caused significant damage to buildings and/or infrastructure during coastal storm events over the past five years Table 15 lists locations where the combination of erosion, storm surge, flooding, and waves have caused damage to buildings and/or infrastructure during coastal storm events over the past five years on the South Shore. This includes two sites in Hull, Nantasket Beach and Crecent Beach.

Table 15. South Shore Coastal Erosion "Hot Spot" Areas

Hull	Nantasket Beach
Hull	Crescent Beach
Scituate	Glades
Scituate	Oceanside Drive
Scituate	Lighthouse Point
Scituate	Peggotty Beach
Scituate	Humarock Beach (northern half)
Marshfield	Fieldstone to Brant Rock
Marshfield	Bay Ave.

Source: Report of the Mass. Coastal Erosion Commission, 2015

TSUNAMIS

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. While all of the coast of Massachusetts could be subject to a tsunami, 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. Collapse of glaciers resulting from our warming climate could cause landslides that could generate tsunamis more powerful than those caused by earthquakes.

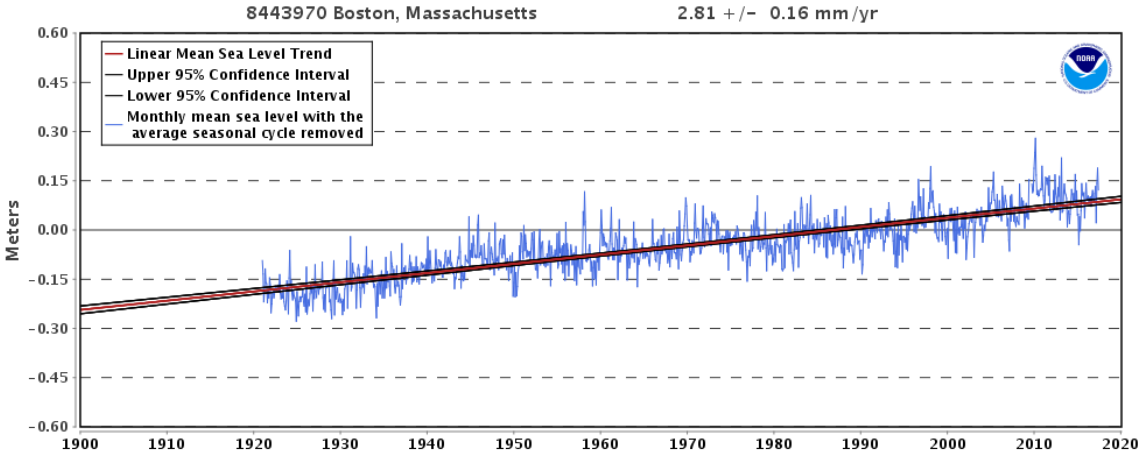
The severity of a tsunami is related to its wave height at the shore, and the extent of runup. Areas most at risk would be the locations that currently experience flooding during storm tides. Hull would likely be more impacted than other coastal communities as it is directly exposed to open ocean.

CLIMATE CHANGE IMPACTS: SEA LEVEL RISE

Of all the impacts of climate change, Hull is most susceptible to the impacts of sea level rise, as it will magnify the flooding associated with coastal storms. As shown by records from the Boston Tide Station (see Figure 13) seas have risen the equivalent of 11 inches over 100 years, based on data from 1921 to 2016.

The Massachusetts Office of Coastal Zone Management (CZM) adjusted global predictions for future sea level rise, taking into account local subsidence (see Figure 14). The range of projections for the future is quite wide, particularly approaching the end of this century. The High scenario includes ocean warming and a calculation of maximum glacier and ice sheet melt. The Intermediate High scenario averages higher predictions but includes lesser ice sheet melting. The Intermediate Low considers lower sea level rise scenarios and limited ice melt. The Historic Trend reflects a continuation of the current rate of sea level rise.

Figure 13 Boston Sea Level Rise from 1921 to 2016

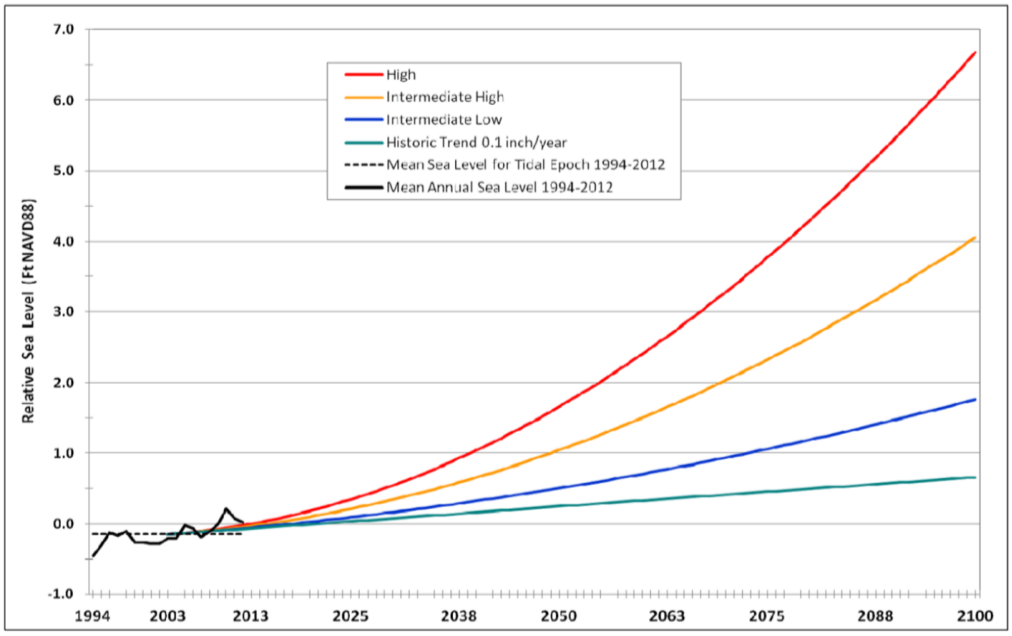


Source: NOAA

The CZM estimate for the Boston Harbor does not take into account more recent research that suggests the Boston Harbor is included in a region that may experience greater than average sea level rise. CZM cautions that the Historic and Intermediate Low scenarios may "considerably underestimate actual sea level rise", particularly for time horizons beyond 25 years.

The Town of Hull has devoted considerable resources to assessing and preparing for the impacts of future sea level rise. With grant support from the Massachusetts Office of Coastal Zone Management, working with Kleinfelder, Inc., Hull completed a "Coastal Climate Change Vulnerability Assessment and Adaptation Study" in 2016. Many of its recommendations have been incorporated into this Hazard Mitigation plan.

Figure 14 Projected Sea Level Rise for Greater Boston Harbor

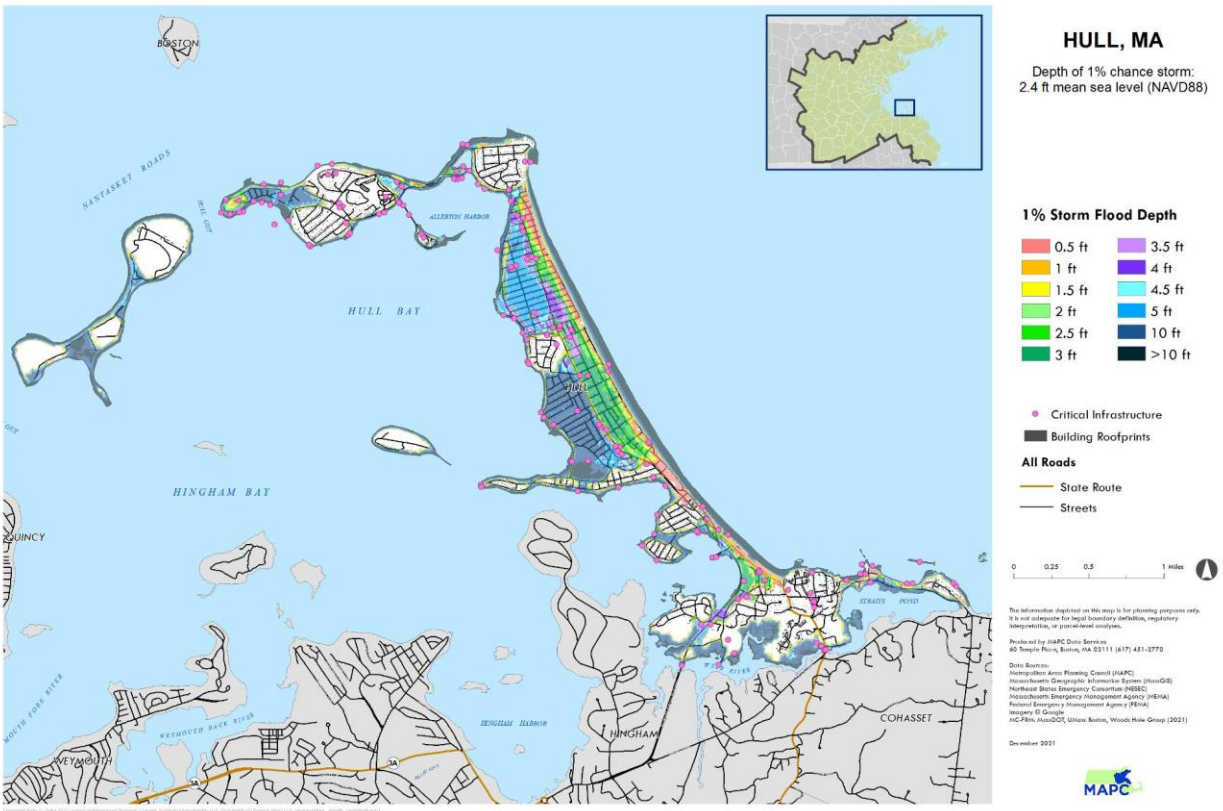


Source: Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning, Massachusetts Office of Coastal Zone Management, December 2013.

Sea Level Rise Impacts on Hull

To assess the impacts of sea level rise on Hull, in 2022 a climate resilience project was conducted by MAPC for the Town. The project was conducted by Ann Herbst, Principal Environmental Planner at MAPC and former Conservation Agent for the Town of Hull. The project included a technical memo, "Massachusetts Coast Flood Risk Model, Hull Impact Analysis" which used the Massachusetts Coastal Flood Risk Model (MC-FRM) prepared by Woods Hole Group to analyze the impacts of future Sea Level Rise scenarios on the Town of Hull. The analysis focused on the "High" SLR scenario which projects increases of 1.2 feet in 2030., 2.4 feet in 2050, and 4.2 feet by 2070. Under these three SLR scenarios, maps were produced showing the annual chance of flooding and the depth of flooding for a 1% chance storm. The analysis also identified critical infrastructure that would be impacted in of the three future decades by 100% chance, 10% chance and 1% chance storm events. Figure 15 shows the SLR scenario map for 2050 based on 2.4 feet of Sea Level Rise. The project also produced a Story Map, "Preparing for Climate Change"

Figure 15 Depth of Flooding with 2.4 Feet of Sea Level Rise and 1% Chance Storm



Source: Massachusetts Coast Flood Risk Model, Hull Impact Analysis, MAPC, 2022

The MAPC technical assistance project also included preparation of a Story Map, "Preparing for Sea Level Rise." https://storymaps.arcgis.com/stories/a89fd86d80a1407186ed16ee02f782e5

DAM HAZARDS

Dam failure can arise from two types of situations. Dams can fail because of structural problems independent of any storm event. Dam failure can follow an earthquake by causing structural damage. Dams can 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 area in the path of the dam's floodwaters. An issue for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight.

The Massachusetts Department of Conservation and Recreation (DCR) Office of Dam Safety has three hazard classifications for dams:

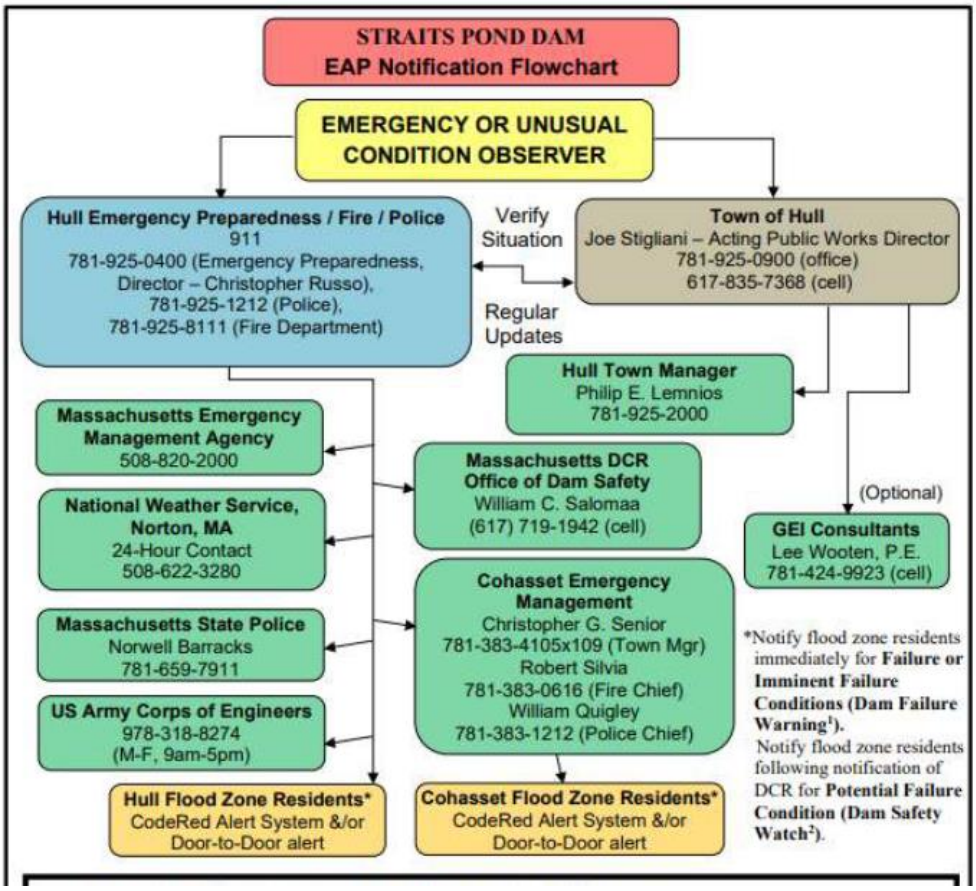
High Hazard:	Dams located where failure or mis-operation will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).
Significant Hazard:	Dams located where failure or mis-operation may cause loss of life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

In general, DCR requires that dams that are rated as low hazard be inspected every ten years while dams that are rated as significant hazards must be inspected every five years.

Dam failure is a highly infrequent occurrence but a severe incident could result in loss of lives and significant property damage. Since 1984, three dams have failed in or very near to Massachusetts, one of which resulted in a death. There have been no recorded dam breaches in Hull or nearby communities.

DCR's statewide dam inventory lists one dam in Hull, which is ranked as a significant hazard. The Straits Pond Dam in fact refers to the tide gate of the same name, which was recently replaced and is alarmed and monitored frequently. This structure is listed by DCR as a Significant Hazard.

Figure 16 Straits Pond Dam Notification Flowchart



Source: Straits Pond Dam Emergency Action Plan

HURRICANES AND TROPICAL CYCLONES

Wind-related hazards include hurricanes, tropical storms, and tornadoes as well as high winds during Nor'easters and thunderstorms. Information on wind related hazards can be found on Map 5 in Appendix B, which indicates that the 100-year wind speed in Hull is 110 miles per hour.

A hurricane is a violent wind and rainstorm with wind speeds of 74-200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits the land. The Town's entire area is vulnerable to hurricanes. Hurricanes occur between June and November. A tropical storm has similar characteristics, but wind speeds are between 38 and 74 miles per hour.

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. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm.

As shown in Map 5 in Appendix A, a tropical storm tracked through Hull near Pemberton Point in 1923. In addition, Hull experiences the impacts of hurricanes and tropical storms regardless of whether the storm track passes directly through the Town, and numerous hurricanes have affected the communities of eastern Massachusetts (see Table 16).

Table 16: Hurricane Records for Massachusetts, 1938 - 2023

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

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. The following gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

Scale No. (Category)	Winds(mph) Storm	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 Hull. Potential hurricane damages to Hull have been estimated using HAZUS-MH. Total damages are estimated at $30.8 million for a100-year frequency hurricane and $151.1 million for a 500-year frequency hurricane. Other potential impacts such as debris and evacuation needs are detailed in Table 23.

Based on records of previous occurrences, hurricanes in Hull are a Medium frequency event as defined by the Resilient MA Plan. This hazard occurs from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

Hurricanes and Climate Change

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

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 Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 01, 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 in Table 17.

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).

The most recent significant tornado events in Massachusetts were in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in 4 deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16 and 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 uninhabitable.

There has been one recorded tornado within the limits of the Town of Hull on October 30, 1970. Since 1958 there have been 10 additional tornadoes in surrounding Plymouth County recorded by the Tornado History Project. One of these was an F2 tornado, and four were F1 tornados. The 10 tornadoes resulted in a total of one fatality and two injuries and $119 thousand to $1.15 million in damages, as summarized in Table18.

Table 17 Enhanced Fujita Scale

Scale	Wind speed mph	Wind speed km/h	Relative frequency	Potential damage	
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

Table 18 - Tornado Records for Plymouth County

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
9/7/1958	0	1	1	10	0.1	$500-$5000
7/4/1964	1	0	0	10	2.3	$50K-$500K
6/9/1965	0	0	0	10	0.1	<$50
11/18/1967	2	0	0	17	.1	$50-$500
8/9/1968	1	0	0	100	1	$500-$5000
9/16/1986	1	0	0	50	.1	$50K-$500K
7/10/1989	1	0	1	23	.1	$5K-$50K
7/10/1989	0	0	0	23	.1	$5K-$50K
8/20/1997	0	0	0	10	0.1	$5K-$50K
7/24/2012	0	0	0	15	.03	$3K

Source: The Tornado History Project

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.

Although tornadoes are a potential town-wide hazard in Hull, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Hull would greatly depend on the track of the tornado. Generally, the more densely developed areas would likely be subject to more damage in the event of a tornado.

Based on the record of previous occurrences since 1950, Tornado events in Hull are a Low frequency event as defined by the Resilient MA Plan. This hazard is likely to occur at least once by the end of the century; with some examples of historical occurrences.

SEVERE WINTER STORMS

Winter storms, including nor'easters, 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 strongest among these are typically nor'easters.

NOR'EASTERS

A northeast coastal storm, known as a nor'easter, is typically a large counter-clockwise 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 20 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rains or snows, depending on temperatures.

Previous occurrences of nor'easters include the storm events included in Table 19. 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.

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, large nor'easters in 2015 and 2018 caused significant damage across the coast.

Hull is vulnerable to both the wind and precipitation that accompanies 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. Due to its location on the coast, the entire Town of Hull could be at risk from the wind, rain or snow impacts from a nor'easter, depending on the track and radius of the storm.

Table 19: Nor'easter Events for Massachusetts, 1978 - 2021

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

Based on the record of previous occurrences, nor'easters in Hull are high frequency events as defined by the Resilient MA Plan. This hazard is almost certain to occur at least once a year.

BLIZZARDS & HEAVY SNOW

Winter storms are a combination hazard because they often involve wind, ice, and heavy snow fall. The National Weather Service defines "heavy snow fall" as an event generating at least four inches of snowfall within a 12-hour period (NOAA, 2009). Blizzards and winter storms are often associated with a nor'easter event (see nor'easters section above).

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 conditions 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 storm, 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 shown in Table 20.

Table 20: 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: 2018 SHMCAP

The best available data on previous occurrences and impacts of heavy snow events in Hull is available for Plymouth County from the NOAA National Centers for Environmental Information (NCEI). From 2005 to 2023, Plymouth County experienced nearly 31 days with heavy snowfall events, resulting in no injuries or deaths, and property damage of $108,000, as shown in Table 21.

Table 21 - Heavy Snow events in Plymouth County 2005 –2023

DATE	DEATHS	INJURIES	PROPERTY DAMAGE
2/24/2005	0	0	0
12/13/2007	0	0	0
12/16/2007	0	0	0
12/19/2008	0	0	3,000
12/31/2008	0	0	0
1/18/2009	0	0	0
1/19/2009	0	0	0
2/3/2009	0	0	0
3/2/2009	0	0	0
12/19/2009	0	0	0
12/20/2010	0	0	0
1/26/2011	0	0	0
1/21/2012	0	0	0
2/8/2013	0	0	0
3/7/2013	0	0	0
1/2/2014	0	0	0
1/21/2014	0	0	0
2/5/2014	0	0	0
2/15/2014	0	0	5,000

2/2/2015	0	0	0
2/8/2015	0	0	0
3/5/2015	0	0	0
2/5/2016	0	0	100,000
4/4/2016	0	0	0
12/19/2019	0	0	0
12/16/2020	0	0	0
2/7/2021	0	0	0
1/7/22	0	0	0
1/28/22	0	0	0
2/13/22	0	0	0
2/25/22	0	0	0
Total	**0**	**0**	**$108,000**

Source: NOAA, National Centers for Environmental Information

Another indication of previous severe winter events is the list of Presidentially-declared disasters for blizzards and snowstorms. There have been 14 in Massachusetts since 1978, as shown in Table 22. The most significant single winter storm was the "Blizzard of 1978," which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. The record snowfall of January 2015 resulted from a series of storms over that month. The most recent significant winter event was Winter Storm Kenan (January 29, 2022), which resulted in 30.9" of snow in Massachusetts (Stucker, 2022).

Table 22: Winter-Related Federal Disaster Declarations, 1978-2023

Disaster Name	Date of Event
Coastal Storms, Flood, Ice & Snow	February 1978
Winter Coastal Storm	December 1992
Blizzard	March 1993
Blizzard	January 1996
Snowstorm	March 2001
Snowstorm	February 2003
Snowstorm	December 2003
Snowstorm	January 2005
Severe Winter Storm, Snowstorm	January 2011
Severe Winter Storm, Snowstorm, Flooding	February 2013
Severe winter storm, snowstorm, flooding	January 2015
Severe winter storm and Snowstorm	March 2018
Severe winter storm and flooding	March 2018
Severe winter storm and snowstorm	January 2022

Sources: OpenFEMA Dataset: Disaster Declarations and FEMA Declared Disasters

Winter storms are a community-wide hazard in Hull. Map 6 in Appendix A illustrates the average annual average snowfall in Hull, which is between 36 to 48 inches.

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.

A number of public safety issues can arise during snowstorms. Impassible streets are a challenge for emergency vehicles and affect residents and employers. 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.

Blizzards are considered high frequency events based on past occurrences, as defined by the Resilient MA Plan. This hazard is almost certain to occur at least once a year.

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.

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 (a description of hail is included in a subsequent report section).

The best available data on previous ice storm events are recorded at the county level through NOAA's National Centers for Environmental Information (NCEI) Storm Events Database. Plymouth County, which includes the Town of Hull, had no ice storms or sleet events recorded since 1950. There have been 12 hail events, which had no deaths, injuries, or damages reported.

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

causing power outages and blocking roadways. The impacts of winter storms may also include roof collapses and property damage and injuries related to the weight of snow and ice.

In Hull, ice storms are considered to be very low frequency events based on past occurrences, as defined by the Resilient MA Plan. This hazard is very unlikely to occur as there have been no examples of historical occurrences.

OTHER SEVERE WEATHER

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, and 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 Hull is for Plymouth County through the NOAA National Centers for Environmental Information (NCDC). Between the years 2011 and 2023 NCEI records show 36 thunderstorm events in Plymouth County (Table 23). These storms resulted in a total of $367,700 in property damages. There were no injuries or deaths reported.

Table 23 Plymouth County Thunderstorm Events, 2011-2023

DATE	DEATHS	INJURIES	PROPERTY DAMAGE
8/4/2015	0	0	40,000
2/25/2016	0	0	50,000
7/17/2016	0	0	30,000
7/18/2016	0	0	53,000
7/22/2016	0	0	5,000
7/23/2016	0	0	19,000
9/11/2016	0	0	1,000
6/13/2017	0	0	2,000
7/6/2018	0	0	1,000
7/17/2018	0	0	10,000
4/15/2019	0	0	4,000
6/29/2019	0	0	3,000
7/17/2019	0	0	4,000
7/31/2019	0	0	0
8/8/2019	0	0	300

8/19/2019	0	0	300
6/6/2020	0	0	3,000
6/28/2020	0	0	9,200
7/23/2020	0	0	500
8/22/2020	0	0	95,300
10/7/2020	0	0	0
6/22/2021	0	0	500
6/30/2021	0	0	5,600
7/7/2021	0	0	1,000
7/23/2021	0	0	300
7/27/2021	0	0	500
11/13/2021	0	0	1500
7/14/2022	0	0	900
8/9/2022	0	0	2100
8/26/2022	0	0	5000
6/14/2023	0	0	2600
7/29/2023	0	0	9600
8/8/2023	0	0	3000
8/13/2023	0	0	1000
8/18/2023	0	0	2000
TOTAL	**0**	**0**	**367,200**

Source: NOAA, National Climatic Data Center

Severe thunderstorms are a town-wide hazard for Hull. 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 previous occurrences, severe thunderstorms in Hull are very high frequency events as defined by the Resilient MA Plan. This hazard is almost certain to occur multiple times a year.

Thunderstorms and Climate Change

As noted previously, the intensity of rainfall events has increased significantly, and those trends are expected to continue. Neither the SHMCAP, nor the 2022 Massachusetts Climate Change Assessment, specifically address whether climate will affect the intensity or frequency of thunderstorms.

WILDFIRE/BRUSHFIRE

A brush fire is an uncontrolled fire occurring in a forested or grassland area. In the Boston Metro region these fires rarely grow to the size of a wildfire as seen more typically in the western U.S.

As their name implies, these fires typically burn no more than the underbrush of a forested area. There are three different classes of wild fires:

- 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.

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.

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.

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. 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. The most common cause of wildfires is the careless disposal of smoking materials and untended campfires.

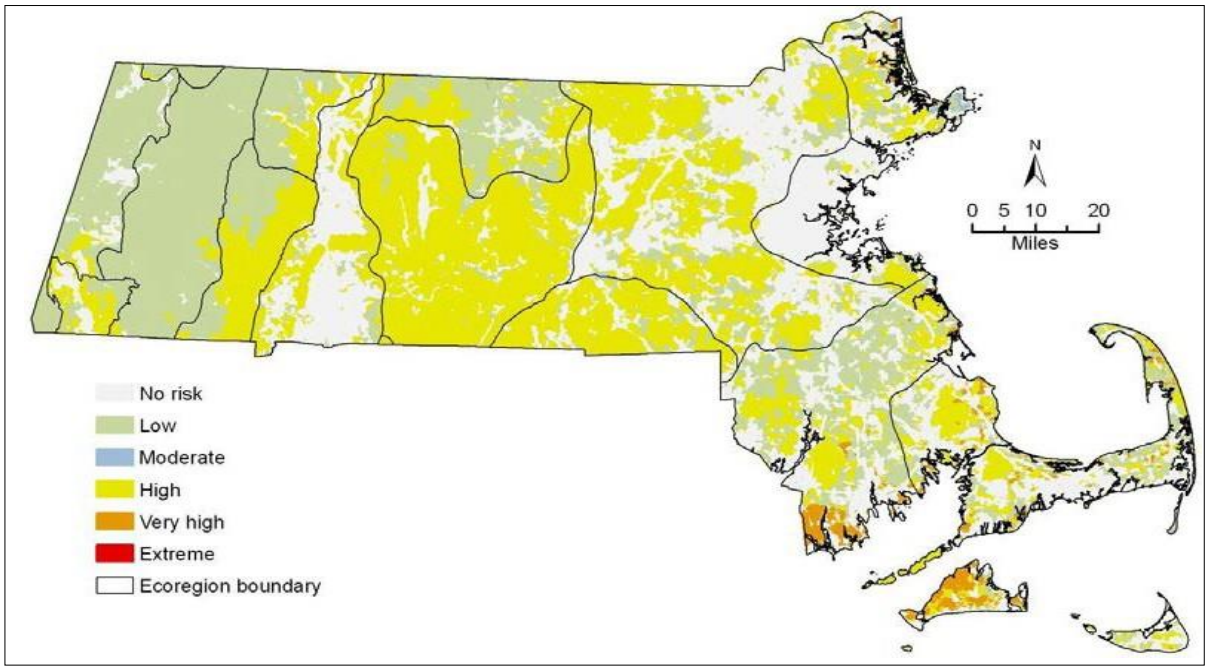
The National Wildfire Coordinating Group (NWCG) classifies the severity of wildfires based on their acreage as follows:

- Class A - one-fourth acre or less;
- Class B - more than one-fourth acre, but less than 10 acres;
- Class C - 10 acres or more, but less than 100 acres;
- Class D - 100 acres or more, but less than 300 acres;
- Class E - 300 acres or more, but less than 1,000 acres;
- Class F - 1,000 acres or more, but less than 5,000 acres;
- Class G - 5,000 acres or more (NWCG, 2023).

Potential Wildfire Hazard Areas

The 2018 SHMCAP includes a map that depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 24). The wildland-urban interface reflects communities where housing and vegetation intermingle, and fire can spread from structures to vegetated areas. Hull is not in a high-risk area.

Figure 17: Wildfire Risk Areas in Massachusetts



Source: 2018 SHMCAP

The Hull Fire Department has rarely had to respond to brush fires. There was one brushfire on Straits Pond Island in recent history. It was not extensive and no restoration was required. The f areas of town listed in Table 24 were identified as having the potential for brush fires based either on higher concentration of brush or forest, or large stands of phragmites. The numbers correspond to the numbers on Map 8, "Hazard Areas" in Appendix A.

Table 24: Brushfire Hazard Areas

Name/Description	Revisions/updates or deletions for 2024
16) Ocean Avenue Marsh	Keep in 2024 Plan.
17) Fort Revere	Keep in 2024 Plan.
18) WBZ	Keep in 2024 Plan.
19) Straits Pond Island	Keep in 2024 Plan.
20) Garden Road	Keep in 2024 Plan.
21) Landfill	Keep in 2024 Plan.
22) Weir River Woods	Keep in 2024 Plan.
26) Fort Revere	Add to brushfire hazard area

Wildfires can present a hazard where there is the potential for them 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 wild fire destroys the ground cover, then erosion becomes one of several potential problems.

Potential vulnerabilities to wildfires include damage to structures and other improvements and impacts on natural resources such as town conservation land. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases.

Potential damages from wildfires in Hull would depend on the extent and type of land affected. There could be the need for post-fire revegetation to restore a burned property, which could cost from a few thousand dollars to tens of thousands for an extensive area. However, there are no data on actual wildfire damages in Hull.

Based on past occurrences and the Massachusetts Hazard Mitigation Plan 2013, brushfires are of Medium frequency, events that occur from once in 5 years to once in 50 years (2% to 20% probability per year).

WILDFIRE AND CLIMATE CHANGE

As the climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation dries out and becomes more flammable. Increasing drought and increasing damage to trees from pests, can also lead to greater fire risk. The 2022 Massachusetts Climate Assessment cites anticipated forest health degradation from increasing wildfire frequency.

EXTREME TEMPERATURES

AVERAGE AND EXTREME TEMPERATURES

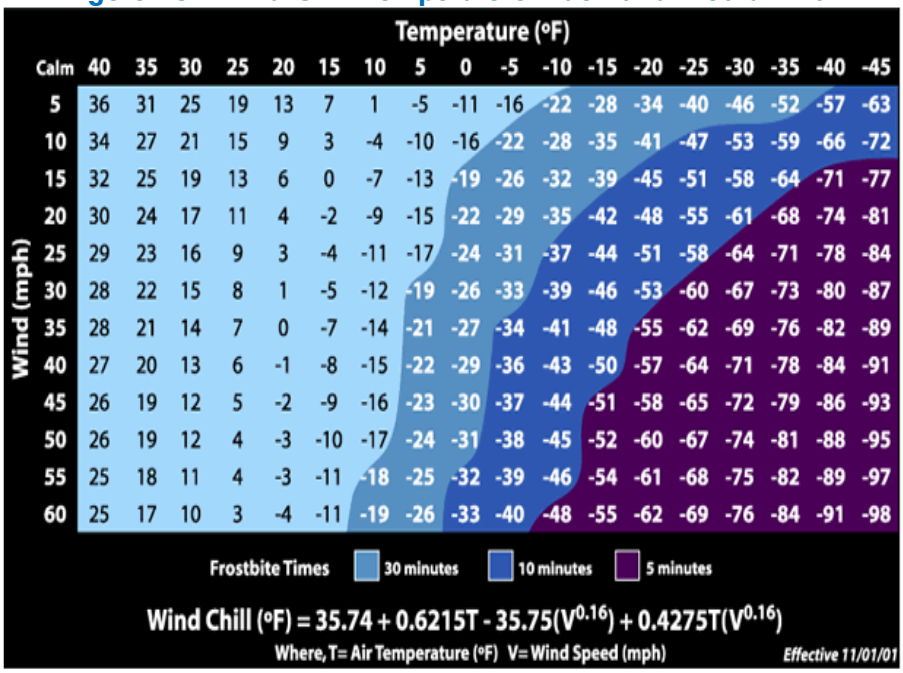
Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time when there is a prolonged period of excessively hot or cold weather.

Hull 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, which are far outside of the normal seasonal ranges for Massachusetts. The average temperatures for Massachusetts are: winter (Dec-Feb) Average = 31.8°F and summer (Jun-Aug) Average = 71°F. Extreme temperatures are a town-wide hazard.

EXTREME COLD

Extreme cold is relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. 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 18. A Wind Chill warning is issued when the Wind Chill Index is forecast to fall below -25 degrees F for at least 3 hours.

Figure 18 - Wind Chill Temperature Index and Frostbit Risk



Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. The greatest vulnerability to the Town would be a power outage during a winter storm, which could temporarily leave many residents without heat. In Hull, 23% of residents are 65 years old (US Census Bureau, 2021). Extreme cold is a town-wide hazard in Hull.

The best available local data on past occurrences of extreme cold vents are for Plymouth County, through the NOAA National Centers for Environmental Information (NCEI). There are two extreme cold events on record which caused no deaths, injuries, or property damage. (see Table 25).

Table 25 – Plymouth County Extreme Cold and Wind Chill Occurrences

Date	Deaths	Injuries	Damage
2/16/2015	0	0	0
2/14/2016	0	0	0

Source: NOAA, National Climatic Data Center

EXTREME HEAT

While a heat wave for Massachusetts is defined as three or more consecutive days above 90°F, another measure used for identifying extreme heat events is through a Heat Advisory from the NWS. These advisories are issued when the heat index (Figure 19) is forecast to exceed 100 Degrees, Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above105 degree F.

Figure 19 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 data on past occurrences of extreme heat events is from NOAA's National Centers for Environmental Information (NCEI) for Plymouth County, which includes Hull. The NCEI records indicate that there was one recorded excessive heat event, with no deaths or injuries, and no property damage resulting from excessive heat (see Table 26).

Table 26 – Plymouth County Extreme Heat Occurrences

Date	Deaths	Injuries	Damage
7/6/2010	0	0	0

Source: NOAA, National Climatic Data Center

Extreme heat poses a potentially greater risk to the elderly, children, and people with certain medical conditions, such as heart disease. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather.
Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions; in Hull,23% 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. Areas with less shade and darker 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 9 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. There are a few hot spots spread across parts of Hull.

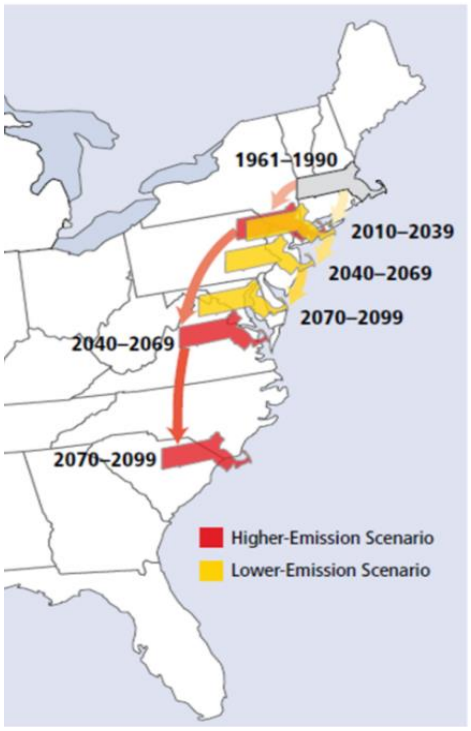
Hot summer days can worsen air pollution. With increased extreme heat, urban areas are likely to experience more days that fail to meet air quality standards. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage.

Extreme Heat and Climate Change

The 2022 MA Climate Change Assessment includes projections of climate-driven future increases in average temperature and in the number of extreme heat days. Over time our climate could become more similar to areas well to the south of New England (Figure 22). The assessment also highlights the following climate impacts related to temperatures:

- Warmer temperatures and more frequent heat waves are connected to impaired human health, increased droughts, reduced agriculture yields, species range shifts, and damaged infrastructure.
- By 2030, the summer mean temperature could increase by 3.6°F from the historical period (1950-2013), worsening stress on electric transmission and utility distribution infrastructure.
- By 2070, there could be 58 fewer days below freezing, increasing the chance of ticks overwintering and reducing winter recreation opportunities.
- Increase in vector borne diseases and bacterial infections, including West Nile Virus and Lyme disease due to more favorable conditions for ticks and mosquitoes.
- Damage to electric transmission and utility distribution infrastructure associated with heat stress
- Damage to rails and loss of rail/ transit service, including flooding and track buckling during high heat events.
- Reduced ability to work, particularly for outdoor workers during extreme heat, as well as commute delays due to damaged infrastructure.
- Freshwater ecosystem degradation due to warming waters.
- Forest health degradation from warming

Figure 29: Temperature Scenarios



Source: Union of Concerned Scientists

temperatures and increasing pest occurrence

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). Other Impacts on natural resources include a longer growing season and northern migration of plants and animals, including invasive species.

Extreme temperature events are classified as very high frequency events as defined by the Resilient MA Plan. Extreme temperature events are almost certain to occur multiple times a year.

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.

In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960's, a cool drought occurred because dry air from the north caused lower temperatures in the spring and summer of 1962-65. The northerly winds drove frontal systems to sea along the Southeast Coast and prevented the Northeastern States from receiving moisture (U.S. Geological Survey). This is considered the drought of record in Massachusetts.

Average annual precipitation in Massachusetts is 44 inches per year, with approximately 3 to 4 inch average amounts for each month of the year. Regional monthly precipitation ranges from zero to 17 inches. Statewide annual precipitation ranges from 30 to 61 inches. Thus, in the driest calendar year (1965), the statewide precipitation total of 30 inches was 68 percent of average.

Although Massachusetts is relatively small, it has a number of distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive. The DCR precipitation index divides the state into six regions: Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape and Islands. Hull is located in the Northeast Region. In Hull drought is a potential town-wide hazard.

The Massachusetts Drought Management Plan was revised in 2018 to change the state's classification of droughts by establishing four levels to characterize drought severity beyond normal conditions:

- Level 0-Normal Conditions (no drought)
- Level 1-Mild Drought (formerly Advisory)
- Level 2-Significant Drought (formerly Watch)
- Level 3-Critical Drought (formerly Warning)
- Level 4-Emergency Drought (formerly Emergency)

The Massachusetts drought levels are shown in comparison to the U.S. Drought Monitor levels in Table 27. The two sets of drought indices are similar, but Massachusetts combines the USDM's level D2 and D3 into one category, Critical Droughts.

Table 27: US Drought Monitor Compared to MA Statewide Drought Levels

USDM Names	Recurrence	Percentile Ranges	MA DMP Levels	MA Percentile Ranges	MA DMP Names
D0: Abnormally Dry	once per 3 to 5 years	21 to 30	1	>20 and ≤30%	Mild Drought
D1: Moderate	once per 5 to 10 years	11 to 20	2	>10 and ≤20%	Significant Drought
D2: Severe Drought	once per 10 to 20 years	6 to 10	3	>2 and ≤10%	Critical Drought
D3: Extreme Drought	once per 20 to 50 years	3 to 5			
D4: Exceptional Drought	once per 50 to 100 years	0 to 2	4	≤2%	Emergency

Source: Massachusetts Drought Management Plan, 2019

These levels are based on conditions of natural resources and provide information on the current status of water resources. As dry conditions can have a range of different impacts, a number of drought indices are available to assess these impacts. Massachusetts uses a multi-index system that takes advantage of several of these indices to determine the severity of a given drought or extended period of dry conditions. Drought level is determined monthly based on the number of indices which have reached a given drought level. Drought levels are declared on a regional basis for each of seven regions in Massachusetts. County by county or watershed-specific determinations may also be made. A determination of drought level is based on seven indices:

1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index: (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire potential assessment.
4. Precipitation Index is a comparison of measured precipitation amounts to historic normal precipitation.
5. The Groundwater Level Index is based on the number of consecutive month's groundwater levels are below normal (lowest 25% of period of record).
6. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record).
7. The Reservoir Index is based on the water levels of small, medium and large index reservoirs across the state, relative to normal conditions for each month.

Table 28 shows the range of values for each of the indices associated with the drought levels. Because drought tends to be a regional natural hazard, this plan references state data as the best available data for previous drought occurrences.

Determinations regarding the end of a drought or reduction of a drought level focus on precipitation and groundwater levels. These factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture, and forest fire potential.

Table 28: Indices Values Corresponding to Drought Index Severity Levels

Index Severity Level	Standardized Precipitation Index	Streamflow	Lakes and Impoundments	Groundwater	Keetch-Byram Drought Index	Crop Moisture Index
0	>30th percentile				< 200	> -1.0
1	≤30 and >20				200-400	≤-1.0 and > -2.0
2	≤20 and >10				400-600	≤-2.0 and < -3.0
3	≤10 and >2				600-700	≤ -3.0 and > -4.0
4	≤2				700-800	≤-4.0

Source: Massachusetts Drought Management Plan, 2019

The drought levels provide a framework from which to take actions to assess, communicate, and respond to drought conditions. Drought levels are used to coordinate both state agency and local response to drought situations. Water restrictions might be appropriate at the significant drought stage, depending on the capacity of each individual water supply system. A critical drought level indicates a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is one in which mandatory water restrictions or use of emergency supplies is necessary.

Previous Occurrences

Because drought tends to be a regional natural hazard, the best available date on previous drought occurrences is state-wide data, summarized below.

The Executive Office of Energy and Environment's Drought Management Task Force also provides information on historic drought status for each drought level in Massachusetts. That information is summarized below.

Mild Drought/Advisory	2001, 2002, 2007, 2014, 2016, 2017, 2020, 2021, 2022
Significant Drought/Watch	2002, 2016, 2017, 2020, 2021, 2022
Critical Drought/Warning	2016, 2017, 2020, 2022
Emergency Drought/Emergency	None

A summary of Massachusetts long term historic drought events from 1879 to 2019 is shown in Table 29. This table was prepared for the 2019 Massachusetts Drought Management Plan, so it does not include the more recent droughts of 2020 (Level 3) and 2021(Level 2).

Table 29 - Chronology of major droughts in Massachusetts since 1879

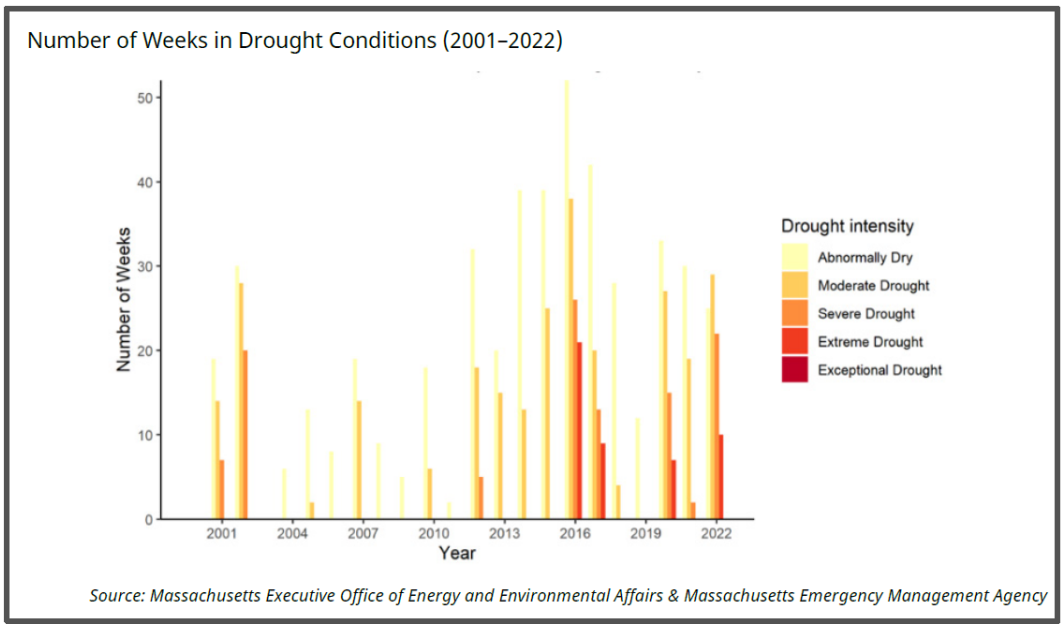
Date	Area affected	Recurrence interval (years)	Remarks	Reference
1879-83	–	–	Kinnison 1931 referenced these periods as two of three worst droughts on record in 1931, the third being the then current drought of 1929-1932.	Kinnison 1931
1908-12	–	–		
1929-32	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.	USGS 1989
1939-44	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.	USGS 1989
1957-59	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.	USGS 1989
1961-69	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.	USGS 1989
1980-83	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.	USGS 1989
1985-88	Housatonic River Basin	25	Duration and severity as yet unknown. Streamflow showed mixed trends elsewhere.	USGS 1989
1995	–	–	Based on statewide average precipitation	DMP 2013
1998-1999	–	–	Based on statewide average precipitation	DMP 2013
Dec 2001 - Jan 2003	Statewide	–	Level 2 drought (out of 4 levels) was reached statewide for several months	DCR 2017
Oct 2007 - Mar 2008	Statewide except West and Cape & Islands regions	-	Level 1 drought (out of 4 levels)	DCR 2017
Aug 2010 - Nov 2010	Connecticut River Valley, Central and Northeast regions	–	Level 1 drought (out of 4 levels)	DCR 2017
Oct 2014 - Nov 2014	Southeast and Cape & Islands regions	–	Level 1 drought (out of 4 levels)	DCR 2017
Jul 2016 - Apr 2017	Statewide	–	Level 3 drought (out of 4 levels)	DCR 2017

Source: Massachusetts Drought Management Plan, 2019

Figure 21 shows the frequency and extent of drought events in Massachusetts since the year 2001. The graphic clearly shows an increase in severe drought events in the most recent years of this 21 year period. In just the last seven years there have been four droughts at the extreme level in Massachusetts, in 2016, 2017. 2020, and 2022.

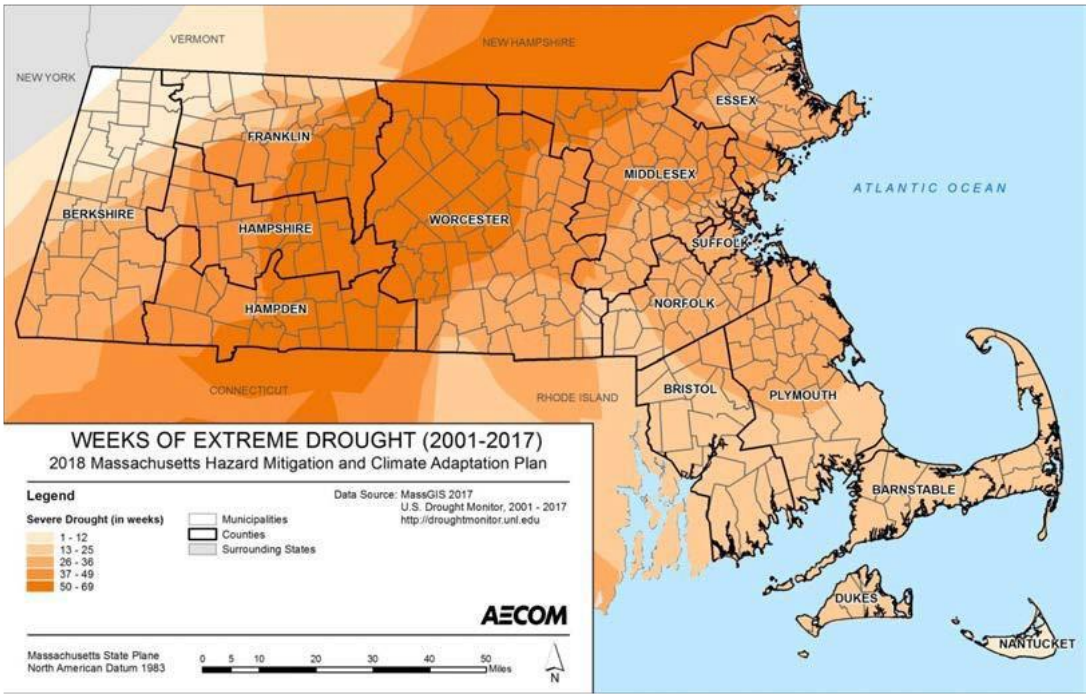
As shown in Figure 22, the geographic extent of droughts from 2001 to 2017 varied greatly in different parts of the state. Hull experienced between 26 and 36 weeks of severe drought between 2001 and 2017.

Figure 21: Weeks of Extreme Drought (2001-2017)



Source: Massachusetts Executive Office of Energy and Environmental Affairs & Massachusetts Emergency Management Agency

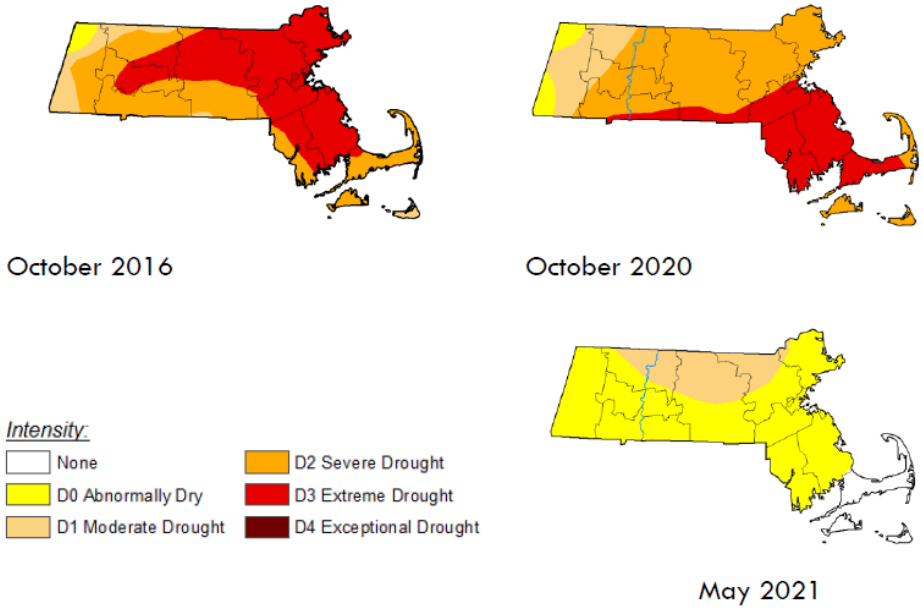
Figure 22: Map of Weeks of Extreme Drought (2001-2017)



Source: SHMCAP 2018

Figure 23 shows the geographic extent of each of the droughts in 2016, 2020, and 2021. The drought of 2016 was the worst one since 1985, with more than half of the state reaching the Extreme Drought stage for several months. This was followed by another drought four years later in 2020, which was most severe in Southeastern Massachusetts. Finally, in the early spring of 2021 a third, milder, drought was declared. By the summer of 2021 conditions in the northeast region improved.

Figure 23: Recent Massachusetts Drought Events (2016-2021)



Source: US Drought Monitor, 2016-2021

Potential Drought Vulnerability

The most significant potential impact of drought on any community is on the public water supply, which may have to impose restrictions on water use in the event of extended abnormally low precipitation. The Town of Hull's water system is supplied by the Weir River Water System, which is operated by the Town of Hingham. The water supply sources include a combination of surface water from Accord Pond and groundwater wells. During a drought the water supplier imposes demand management measures that include varying levels of restrictions on "non-essential water use," primarily outdoor water use for watering lawns and irrigating landscaping. Even during previous droughts the system has always been able to supply water to meet essential water uses as well as firefighting needs.

Considering longer-term changes such as increased water demand due to growth and development as well as the impacts of climate change, the town of Hingham and several neighboring towns are conducting an evaluation of supplementing local water sources with a connection to the Massachusetts Water Resources Authority (MWRA). This is still in the early exploratory stage, but if a connection to MWRA is found to be feasible, it could improve the resilience of the water supply of both Hingham and Hull in the face of climate change in the future.

There are also other potential impacts of drought beyond limits on public water supply. Droughts stress vegetation, everything from landscaping to parks and playing fields, to urban trees. A severe or prolonged drought can significantly increase the risk of brushfires, which in some cases could threaten nearby structures or infrastructure. Smoke from wildfires also poses a public health threat due to degraded air quality, which can have more severe impacts on vulnerable populations.

Should there be a drought severe enough to impact the ability of the Weir River Water System to supply normal amounts of water, the most widespread impact would likely be a more stringent curtailment or elimination of non-essential outdoor water use. Potential financial damages to the Town could include the loss of landscaped properties such as parks and playing fields, though no existing cost estimates for such losses are available as this impact has not previously occurred. Similar losses could be incurred by private property owners. An extremely severe drought could have economic impacts if essential water use for businesses, and residences had to be restricted. However, there is no precedent for a drought of this severity in Massachusetts.

Probability of Future Occurrence

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. See Table 30 for more information.

Table 30: Frequency of Massachusetts Drought Levels

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

Source: 2018 SHMCAP

Droughts And Climate Change

Droughts are projected to increase in frequency and intensity in the summer and fall as weather patterns change. Factors contributing to this include increasing evaporation as a result of warmer weather, earlier snow melt, and more extreme weather patterns. Information from the 2022 Massachusetts Climate Change Assessment related to drought is included in the "Climate Change Observations and Projections" section of this report. Additionally, the 2022 Assessment highlights the following drought-related impacts:

- Freshwater ecosystem degradation due to drought and other impacts
- Increased contaminant concentrations in freshwater during drought conditions
- Loss of tree cover due to drought and other impacts

Based on the history of past occurrences, the Resilient MA Plan classified drought as a medium frequency event, likely to occur at least once every 50 years (two or more occurrences in the next century).

EARTHQUAKES

Damage in an earthquake stems 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 in Table 31.

Table 31 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

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2007, 355 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, 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, and a 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historical records of some of the more significant earthquakes in the region are shown in Table 32.

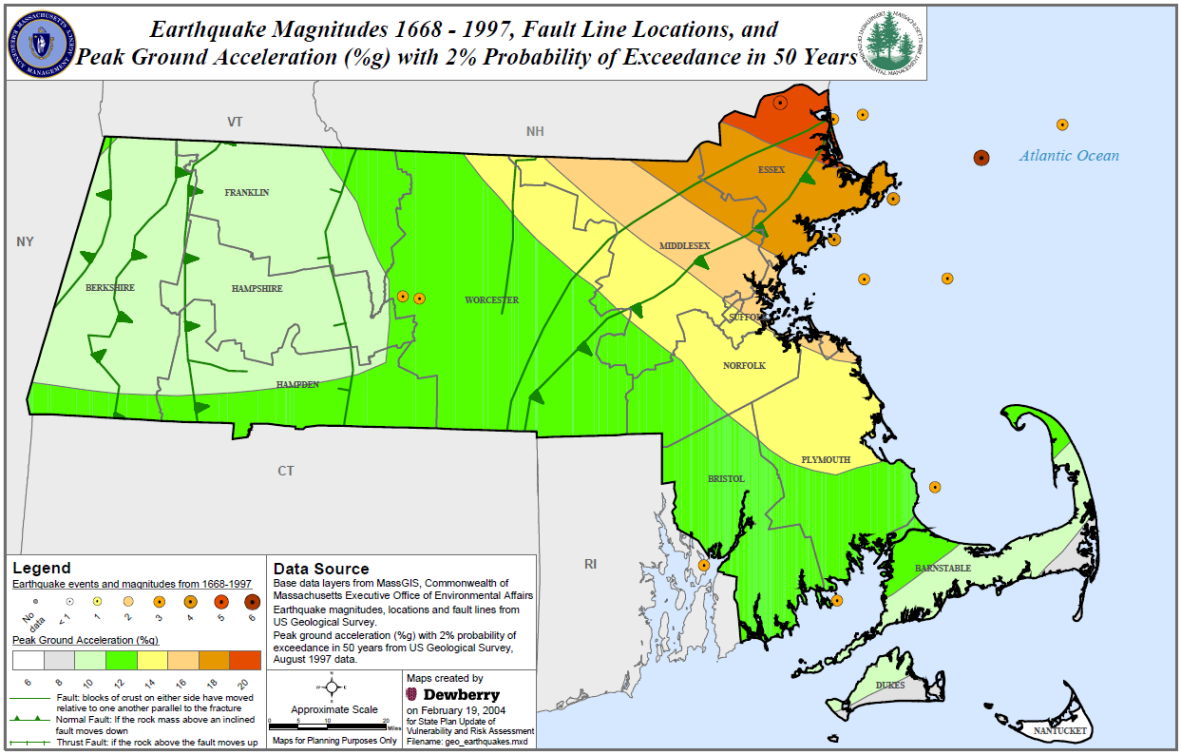
Table 32 Historic Earthquakes, 1727-2012

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA – Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA – Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA – Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA – Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA – Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA – Brewster	8/8/1847	4.2
MA – Boxford	5/12/1880	NA
MA – Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
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 (1 g). The range of peak ground acceleration in Massachusetts is from 10g to 20g, with a 2% probability of exceedance in 50 years, as shown in Figure 25. Hull is in the middle part of the range for Massachusetts making it a relatively moderate 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.

Figure 24: Massachusetts Earthquake Probability Map



Source: 2018 SHMCAP

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. Most older buildings and infrastructure were constructed without specific earthquake resistant design features.

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.

Earthquakes are a potential town-wide hazard in Hull, The Town has many older buildings that pre-date current building code which could be vulnerable in the event of a severe earthquake. Potential earthquake damages to Hull have been estimated using HAZUS-MH. Total building damages are estimated at $249.7 million for a 5.0 magnitude earthquake and $1.64 billion for a 7.0 magnitude earthquake. Other potential impacts such as sheltering and debris generation are detailed in Table 39.

There are several ways the probability of future occurrences has been estimated. According to the Boston College Weston Observatory, in most parts of New England, there is a one in ten chance that a potentially damaging earthquake will occur in a 50 year time period. The Resilient MA Plan classifies earthquakes as medium frequency events. This hazard is likely to occur once every 50 years (two or more occurrences in the next century).

LANDSLIDES

According to the USGS, "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; earthquakes create stresses that make weak slopes fail; and excess weight from accumulation of rain or snow, and stockpiling of rock or ore, from waste piles, or from man-made structures.

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. The lack of vegetation and root structure that stabilizes soil can destabilize hilly terrain.

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 the destructiveness. Table 33 summarizes the estimated intensity for a range of landslides. For a given landslide volume, fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

Table 33 Landslice Severity Categories

Estimated Volume	Expected Landslide Velocity		
(m^3)	Fast moving landslide (Rock fall)	Rapid moving landslide (Debris flow)	Slow moving landslide (Slide)
<0.001	Slight intensity		
<0.5	Medium intensity		
>0.5	High intensity		
<500	High intensity	Slight intensity	
500-10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,000		Very high intensity	High intensity
>>500,000			Very high intensity

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

The SHMCAP, utilized 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 in the state. 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.

All of Hull is classified as having a low risk for landslides (see Map 4, Appendix A). The Town does not have records of any damages caused by landslides in Hull. Should a landslide occur in the future, the type and degree of impacts would be highly localized, and the town's vulnerabilities could include damage to structures, damage to transportation and other infrastructure, and localized road closures. Potential damages would depend on the extent of impact, based on how many properties were affected. However, there are no data available on landslide damages in Hull, as there are no records of any damages caused by landslides in the town. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Hull.

Although the Resilient MA Plan classifies landslides as high likelihood events statewide, based on past occurrences and topographic conditions in Hull, landslides are very low frequency events in the town. This hazard is very unlikely to occur and there are minimal examples of historical occurrences.

Climate Change and Landslides

Changes in precipitation may increase the chance of landslides, as extreme rain events could result in more frequent saturated soils which are conducive to landslides. Drought may also increase the likelihood of landslides if loss of vegetation decreases soil stability.

LAND USE AND DEVELOPMENT TRENDS

EXISTING LAND USE

The most recent land use statistics available from the state are from aerial photography done in 2017. Table 19 shows the acreage and percentage of land in 23 categories. Because Hull has extensive shoreline, Saltwater Beach is calculated as 45.4% of total land use. If the five residential categories are aggregated, residential uses make up 31% of the area of the town (567 acres). Commercial and industrial combined make up 1.4% of the town, or 33 acres. Recreation, and urban public, and comprise a total of 2.4%, or 46.2 acres. This does not include Hull's significant beaches which comprise the largest land use category as noted above.

Table 34 – Hull Land Use, 2027

Land Use Type	Acres	Percent
Forest	217.0	11.4%
Saltwater Wetlands	100.8	5.3%
Non-Forested Wetlands	8.3	.44%
Forested Wetland	.8	.04%
Mining	4.4	.23%
Open & Urban Open Land	29.2	1.53%
Participation and Spectator Recreation	13.1	0.69%
Water-based Recreation	10.4	0.54%
Saltwater Beach	865.4	45.4%
Marina	3.9	.2%
Multi-family Residential	80.8	4.23%
High Density Residential	201.6	10.6%
Medium Density Residential	272.8	14.3%
Low Density Residential	7.8	.4%
Very Low Density Residential	3.8	.19%
Commercial	22.9	1.2%
Industrial	3.2	.18%
Transportation	.5	.03%
Waste Disposal	5.2	0.3%
Water	2.5	0.1%
Brushland/Successional	5.8	0.3%
Urban Public	33.1	1.7%
Cemetery	13.4	0.7%
Total Acres	**1,906.7**	**100.0%**

For more information on how the land use statistics were developed and the definitions of the categories, please go to http://www.mass.gov/mgis/lus.htm.

Economic Elements

Hull has two primary commercial areas. The first is centered around the Department of Conservation and Recreation (DCR) Nantasket Beach Reservation. It includes a number of businesses related to the recreation and tourism at Nantasket Beach, historic buildings owned by

DCR, docks for a portion of Hulls commercial fishing fleet, and open land targeted for development. The second is the Kenberma Business Block in the vicinity of Kenberma Street and Nantasket Avenue. This area includes the local supermarket, hardware store, pharmacy, and numerous other local businesses. Both areas are susceptible to damage from coastal storms; the Nantasket Beach area is flooded more often than the Kenberma district.

Historic, Cultural, and Natural Resource Areas

The Local Committee identified four sites of cultural importance to the Town, the Boathouse, the Lifesaving Museum, Paragon Carousel, and Fort Revere. For this plan update these sites have been added to the inventory of Critical Facilities. Several Town buildings were also noted to be of historic value including the library and Town Hall.

DEVELOPMENT TRENDS

The entire peninsula occupied by the Town of Hull is built out with a relatively high density of homes. Historically, much of Hull's development has been driven by beach oriented development along the coast. Anticipated new development is primarily limited to the occasional single residential lot redevelopment, with the exception of potential redevelopment in the Nantasket Beach area, Waveland area and Nantasket Avenue from R Street to Fitzpatrick Way. Extensive wetlands and floodplains limit the land available for development.

Development trends throughout the metropolitan region are tracked by 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. The database includes just one completed development in the Town of Hull since 2012. It also include two potential new developments including Nantasket Beachfront Condominiums, and redevelopment of Coast Guard housing.

The database also includes housing units and commercial space. See Table 35 below.

Table 35 Summary of Hull Developments 2015-2023

DEVELOPMENTS COMPLETED 2007-2015	HOUSING UNITS	COMMERCIAL (SQ FEET)	PROJECT TYPE
The Estuary	11	0	Residential condominiums
SUBTOTAL	11	0	
PLANNED			
Coastguard Housing	8		Residential – existing units were auctioned
Nantasket Beachfront Condominiums	66		Residential and retail new development
Total	74		

POTENTIAL FUTURE DEVELOPMENT

MAPC consulted with town planning staff to determine areas that may be developed in the future, based on the Town's comprehensive planning efforts and current trends and projects. These areas are described below. In order to characterize any change in the town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the FEMA Flood Insurance Rate Map. The analysis shows that all three sites are located in flood zones. Two of those parcels have more than 90% of land in the flood zone, the fourth parcel has 35% of land located in a flood zone. Due to their location in the flood hazard area, all of these developments must meet the requirements of Hull's Floodplain Overlay Zoning bylaw.

With regard to other hazard categories, all of the developments are in the areas defined as "Low Landslide Incidence." Other hazards are also within the same category throughout the town. For snowfall, all of Hull is in the zone of 36 to 48 inches average annual snowfall. With respect to wind, there is no variation across the town; the hazard map depicts the entire town of Hull with a 100-year wind speed of 110 miles per hour. (See hazard maps in Appendix A).

Nantasket Focus Area (A)
Future residential and retail development
Worrick Estates (B)
Possible future redevelopment location
Waveland Area (C)
Targeted for redevelopment

Table 36 shows the relationship of these parcels to three of the mapped hazards. This information is provided so that planners can ensure that development proposals comply with flood plain zoning and that careful attention is paid to drainage issues.

Table 36 - Relationship of Potential Development to Hazard Areas

Parcel	Flood Zone	Brush Fire Risk
Nantasket Focus Area (A)	23% AE, 30% AO, 41% VE	No
Worrick Estates (B)	35% AE	Yes
Waveland Area (C)	87% AE, 7% VE	No

CRITICAL FACILITIES

Critical Facilities include sites that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 149 facilities identified in Hull. These are listed in Table 37 and are shown on the maps in Appendix A.

Explanation of Columns in Table 37

Column 1: ID #: The first column 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 fifth 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 AE (1% annual chance) **-** Zones AE is the flood insurance rate zone that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
Zone AO (1% chance zone) Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.
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 Flood Area: The locally identified areas of flooding were identified by Town staff as areas where flooding occurs. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, "Hazard Areas".
Column 6: Brushfire Risk: The fourth column indicates whether the site falls within an area identified by municipal staff as posing a brushfire risk.
Column 7: Hurricane Surge Category: The seventh column indicates whether or not the site is located within a hurricane surge area and the category of hurricane estimated to be necessary to cause inundation of the area. The following explanation of hurricane surge areas was taken from the US Army Corps of Engineers web site:

> "Hurricane storm surge is an abnormal rise in sea level accompanying a hurricane or other intense storm. Along a coastline a hurricane will cause waves on top of the surge. Hurricane Surge is estimated with the use of a computer model called SLOSH. SLOSH stands for Sea Lake and Overland Surge from Hurricanes. The SLOSH models are created and run by the National Hurricane Center. The SLOSH model results are merged with ground elevation data to determine areas that will be subject to flooding from various categories of hurricanes. Hurricane categories are defined by the Saffir-Simpson Scale." See http://www.sam.usace.army.mil/hesdata/General/hestasks.htm

According to the Saffir-Simpson Scale, the least damaging storm is a Category 1 (winds of 74-95 miles per hour) and the most damaging storm is a Category 5 (winds greater than 155 miles per hour).

Table 37 Relationship of Critical Infrastructure to Hazard Area

ID	NAME	TYPE	FEMA Flood Zone	Locally Identified Flood Area	Locally Identified Brushfire Risk	Hurricane Surge Areas
1	Lillian M Jacobs School	School	No	No	No	0
2	Hull Sewer Plant	Waste Water Treatment / Above Ground Diesel Tank	AE	Stoney Beach	No	2
3	Gould Hall	Religious Facility	No	No	Fort Revere	0
4	Hull High School	School	No	Channel Street	No	2
5	Hull Memorial School	School / Shelter	AE	Central Ave	No	2
6	Hull Fire – A St.	Fire Department	AE	No	No	2
7	Hull Police	Police Department	No	No	No	0
8	Hull Medical Facility	Medical Facility	AE	No	No	3
10	Hull Fire – Green Hill	Fire Department	No	No	No	0
11	Atlantic Avenue Senior Housing	Elderly/Disabled Housing	No	No	No	0
12	Hull Town Hall	Town Hall	No	No	No	0
13	Hull Fire - Village	Fire Department	No	No	No	4
15	Station 9, Pemberton	Waste Water Pump Station	VE	Channel Street	No	1
16	Pemberton Pier	Commuter Boat Float	VE	Channel Street	No	1
17	Life Saving Boat House	Educational Facility	AE	Channel Street	No	2
18	Pt. Allerton Coast Guard Station and Boat House	Coast Guard Station	VE	No	No	2
20	Station 6	Waste Water Pump Station	AE	No	No	2
21	Stormwater Pump Station, D Street	Storm Water Pump Station	VE	Sunset/Caddish Avenue	No	1
22	Sunset Bay Marina	Marina	No	No	No	2
25	Anne Scully's Senior Center	Elderly Center	AE	Beach Avenue to Nantasket Avenue	No	2
27	Town Hall Fuel Depot	Fuel Depot	No	No	No	0
28	Municipal Light Dept.	Electric Company Headquarters.	No	No	No	2
29	Knights of Columbus	Meeting Place	No	Beach Avenue to Nantasket Avenue	No	2
30	DPW Facility and Salt Shed	DPW Facility / Salt Storage	AE	DPW Building	No	2
32	Public Safety Dispatch Center	Dispatch Center (Secondary)	No	No	No	0
33	Waste Water Pump Station A, Valley Beach Road	Waste Water Pump Station	VE	No	No	0
34	Waste Water Pump Station 1, Atlantic Ave.	Waste Water Pump Station	AE	No	No	2
35	Waste Water Pump Station 3, G.W. Blvd.	Waste Water Pump Station	AE	No	No	3

ID	NAME	TYPE	FEMA Flood Zone	Locally Identified Flood Area	Locally Identified Brushfire Risk	Hurricane Surge Areas
36	Wastewater Pump Station 4, Marginal Ave.	Waste Water Pump Station	AE	Hampton Circle	No	2
37	Wastewater Pump Station 5, Draper Ave.	Waste Water Pump Station	AE	No	No	1
38	Storm Water Pump Station, Newport & Draper Ave.	Storm Water Pump Station	AE	No	No	1
39	Nantasket Pier,	Pier	AE	No	No	1
40	Hull Landfill	Landfill, closure mid-stage	No	No	Landfill	0
41	~~Town~~ National Grid Power Line	Power Line	AE	No	No	0
42	Spinnaker Island Bridge (private)	Bridge	VE	No	No	0
43	Drinking Water Booster Pump	Water Booster	No	No	No	3
44	West Corner Bridge and culvert	Bridge/culvert	AE	DPW Building	No	0
46	Hull Public Library	Library	No	James Avenue	No	4
47	Borland Bridge, G.W. Blvd.	Bridge	AE	No	No	0
48	MLK Bridge, Fitzpatrick Way	Bridge	AE	No	No	1
49	Windemeer Pier	Pier	VE	No	No	0
50	Hull Yacht Club	Marina	VE	No	No	0
51	Hull Salt Water Club	Marina	VE	No	No	0
52	Newport Road Dike	Dike	AE	No	WBZ	3
53	WBZ TV Towers	Communication Towers	AE	No	WBZ	1
54	Nantasket Beach Reservation Seawall	Seawall	VE	No	No	1
55	Summit Hill Seawall	Seawall	VE	No	No	1
56	Crescent/Gunrock Beach Seawall	Seawall	VE	No	No	1
57	Gunrock Beach Breakwater	Breakwater	VE	No	No	0
58	Beach Avenue Barrier Dunes	Dune	VE	Beach Avenue to Nantasket Avenue	No	2
59	Allerton Hill Bluff	Bluff	VE	No	No	4
60	Point Allerton Seawall	Seawall	VE	Stoney Beach	No	1
61	Stoney Beach/Fort Hill Riprap Seawall	Seawall	VE	No	No	0
62	Channel Street Seawall	Seawall	VE	No	No	0
63	Windmill Point Breakwater Riprap	Seawall	VE	Channel Street	No	0
64	Main Street Seawall	Seawall	VE	No	No	0
65	Hull Hill Seawall, Highland Avenue	Seawall	VE	No	No	1

ID	NAME	TYPE	FEMA Flood Zone	Locally Identified Flood Area	Locally Identified Brushfire Risk	Hurricane Surge Areas
66	James Avenue Landing Seawall Riprap	Seawall	VE	James Avenue	No	1
67	Spring Street Seawall	Seawall	VE	No	No	0
68	Caddish/Sunset Ave Seawall	Seawall	VE	No	No	0
69	Strawberry Hill Seawall	Seawall	VE	No	No	1
70	Newport Road Seawall	Seawall	VE	No	No	1
71	Sunset Point Seawall	Seawall	VE	No	No	1
72	Hampton Circle Seawall	Seawall	AE	No	No	1
73	Bay Street Seawall	Seawall	AE	Bay Street	No	0
74	Fitzpatrick Way Lagoon Seawall	Seawall	AE	No	No	0
75	Sunset Marina at V Street	Marina	VE	Sunset/Caddish Avenue	No	1
76	Montessori School	Preschool	AO	Alphabet Streets, Oceanside	No	2
77	North River Bus Company	Bus Garage	AE	Beach Avenue to Nantasket Avenue	No	2
78	Hadassah Way Temple Complex	Religious Facility	AE	Beach Avenue to Nantasket Avenue	No	2
80	Boy Scout Building	Municipal Building	No	No	No	2
81	Hull Public Housing, C and D Streets	Public Housing	AE	Central Ave	No	2
82	Hull Lifesaving Museum	Museum	AE	Stoney Beach	No	2
83	Nantasket Pharmacy	Pharmacy	No	Beach Avenue to Nantasket Avenue	No	2
84	Village Market, Kenburma St.	Food	No	No	No	2
85	US Post Office	Post Office	AE	No	No	2
86	Cumberland Farms, Monument Street	Food	No	No	No	3
87	Seven-Eleven	Food	AE	Beach Avenue to Nantasket Avenue	No	2
88	Daley and Wanzer Moving & Storage	Moving/storage	AO	No	No	2
89	Cumberland Farms, R Street	Food	AE	No	No	2
90	Allerton Post Office, R Street	Post Office	AE	No	No	2
91	Well Spring, T Street	Food Pantry	AO	Alphabet Streets, Oceanside	No	2
92	Hull Cemetery	Cemetery	No	No	No	0
93	Pemberton Boat Ramp	Boat Ramp	VE	Channel Street	No	1

ID	NAME	TYPE	FEMA Flood Zone	Locally Identified Flood Area	Locally Identified Brushfire Risk	Hurricane Surge Areas
94	A Street Boat Ramp	Boat Ramp	VE	Sunset/Caddish Avenue	No	1
95	8th Street Boat Ramp	Boat Ramp	AE	Edgewater Rd.	No	1
96	Gunrock Boat Ramp	Boat Ramp	VE	Gun Rock Beach	No	1
97	Roller Hockey Park Heliport	Heliport	AE	No	No	2
98	Burgin's Parking Lot Heliport	Heliport	AO	No	No	3
99	Kenberma Play Ground Heliport	Heliport	AE	No	No	2
100	L Street Playground Heliport	Heliport	AE	No	No	2
101	Mariners Park Heliport	Heliport	VE	No	No	2
102	Jacobs School Heliport	Heliport	No	No	No	0
103	Dust Bowl Heliport	Heliport	AE	No	No	1
104	Main Street Beach	Beach	VE	No	No	0
a	Channel Street Beach	Beach	VE	No	No	1
106	Stoney Beach North	Beach	VE	No	No	1
107	Point Allerton Beach	Beach	VE	Stoney Beach	No	1
108	Allerton Hill Bluff Beach	Beach	VE	No	No	0
109	Nantasket Beach	Beach	VE	No	No	1
110	Gunrock Beach	Beach	VE	Gun Rock Beach	No	1
111	Stoney Beach South	Beach	VE	Gun Rock Beach	No	1
112	Crescent Beach	Beach	VE	No	No	0
113	Crescent beach Breakwater	Breakwater	VE	No	No	2
114	Crescent beach Seawall	Seawall	VE	Atlantic Ave	No	1
115	Summit Ave Beach	Beach	VE	No	No	1
116	Bay Street Beach	Beach	AE	Bay Street	No	1
117	Hampton Circle Beach	Beach	AE	No	No	1
118	Bay Street Beach 2	Beach	AE	No	No	1
119	Topics Beach	Beach	AE	No	No	1
120	Edgewater Beach	Beach	AE	No	No	1
121	Sunset Point Beach	Beach	VE	No	No	1
122	New Port Road Beach	Beach	VE	No	No	1
123	Strawberry Hill Beach	Beach	VE	No	No	0
124	Caddish Ave Beach	Beach	VE	Sunset/Caddish Avenue	No	1
125	Spring Street Beach	Beach	VE	No	No	1
126	Fitzpatrick Way Beach	Beach	VE	No	No	1
127	Fitzpatrick Way Seawall	Seawall	VE	No	No	1
128	James Ave Beach	Beach	VE	James Avenue	No	1
129	Hull Hill Beach	Beach	VE	No	No	1
130	Spinnaker Water Pump	Water Pump (private)	No	No	No	0

ID	NAME	TYPE	FEMA Flood Zone	Locally Identified Flood Area	Locally Identified Brushfire Risk	Hurricane Surge Areas
131	Hull Wind Mill 2	Turbine	AE	No	Landfill	2
132	Communications Shed / Dump Access Road	Communications Building Town fiber and Verizon	AE	No	No	2
133	Communications Tower, Prospect Ave.	Communications Tower	No	No	No	0
134	Verizon Communications Tower	Communications Tower	AO	Nantasket Beach (DCR)	No	2
135	Water Pipe - ~~6"~~ 8' Main, Spinnaker	Water Pipe	VE	No	No	0
136	~~Gas Line~~ Major Utilities, West Corner	Gas/Water/Sewer Line	No	DPW Building	No	3
137	3 Water Tanks in Bunker	Water Tank	No	No	No	0
138	St. Nicholas United Methodist	~~Church~~ Religious Facility	No	No	Fort Revere	0
139	Harbormaster's Office, Nantasket Pier	Town Facility	AE	No	No	1
140	Nantasket Beach Resort	Hotel	VE	No	No	1
141	Nantasket Hotel	Hotel	No	No	No	0
142	Emergency Operations Center (Middle School)	Town Facility	AE	No	No	1
143	DCR HQ., Fuel Station, Barracks	State Facility	AO	Nantasket Beach (DCR)	No	3
144	Bermaken,102 Revere Street	Rooming House	VE	Beach Avenue to Nantasket Avenue	No	3
145	Nantasket Lodging, 475 Nantasket Ave.	Rooming House	No	No	No	2
146	Nantasket Beach Lodging, 12 Park Ave.	Rooming House	AO	Nantasket Beach (DCR)	No	3
147	Neighborhood Housing, 24 Park Ave.	Rooming House	AO	Nantasket Beach (DCR)	No	2
148	Sandpiper,165 Nantasket Ave	Rooming House	AO	Nantasket Beach (DCR)	No	3
149	Spinnaker Island Beach	Beach	VE	No	No	1

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. The methodology used for hurricanes and earthquakes was the HAZUS-MH software. The methodology for flooding was developed specifically to address the issue in many of the communities where flooding was not solely related to location within a floodplain.

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 http://www.fema.gov/plan/prevent/hazus/index.shtm

> "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 Hull, 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-MH 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 100-year and 500-year return frequency 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. The results are summarized in Table 38 and in Figures 25 and 26.

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 38 - Estimated Damages from Hurricanes

Vulnerabilities	100 Year	500 Year
Building Characteristics		
Estimated total number of buildings	4,721	
Estimated total building replacement value	$2,042,475,000	
Building Damages		
# of buildings sustaining no damage	3,995	2,329
# of buildings sustaining minor damage	626	1,283
# of buildings sustaining moderate damage	91	343
# of buildings sustaining severe damage	5	58
# of buildings destroyed	4	59
Population Needs		
# of households displaced	1	38
# of people seeking public shelter	0	4
Debris		
Total debris generated (tons)	3,001	10,898
Building debris generated (tons)	2,361	1,488
Tree debris generated (tons)	640	9,387
# of truckloads to clear building debris	94	63
Value of Damages		
Total property damage (buildings and content)	$28,310,410	$135,146,980
Total losses due to business interruption	$2,499,240	$15,966,650
Total All Losses	$30,809,650	$151,113,630$

Figure 25 - Estimated Damages from 100- and 500-Year Hurricanes

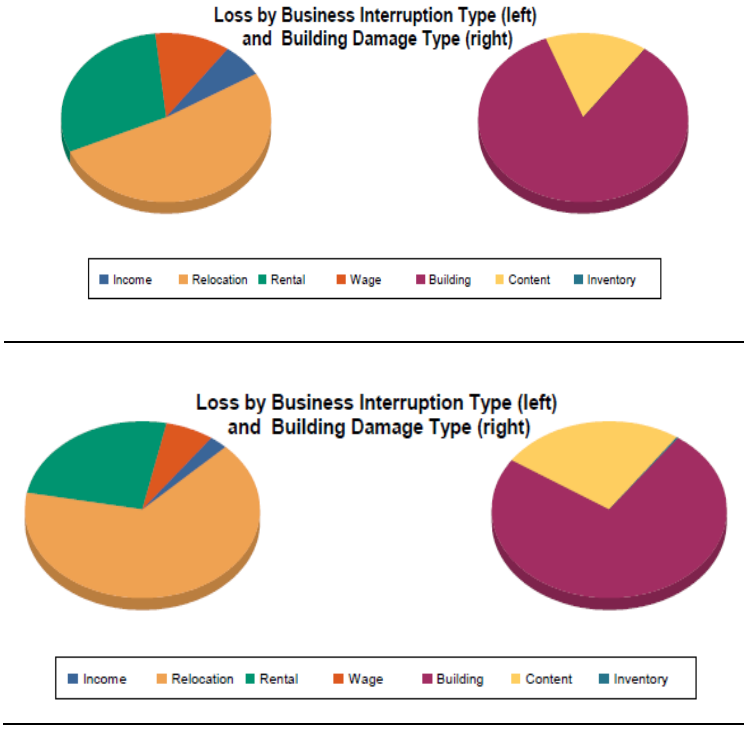
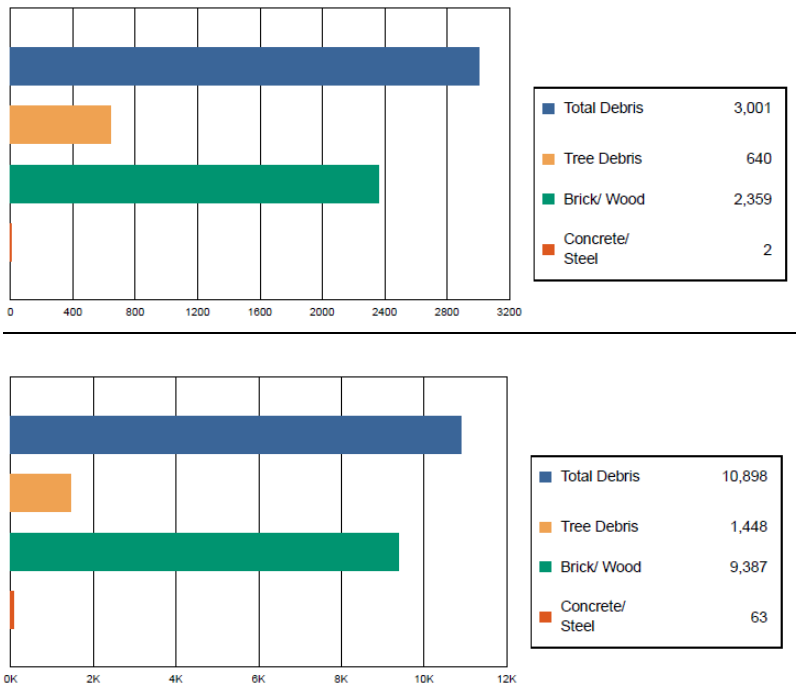


Figure 26 - Estimated Debris Generation from 100- and 500-Year Hurricanes



ESTIMATED DAMAGES FROM EARTHQUAKES

The HAZUS-MH 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 event occurred in 1963. The results are summarized in Table 39 and in Figures 27 and 28.

Table 39 - Estimated Damages from Earthquakes

Vulnerabilities	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	4,721	
Estimated total building replacement value	$2,042,475,000	
Building Damages		
# of buildings sustaining no damage	2,371	100
# of buildings sustaining slight damage	1,391	486
# of buildings sustaining moderate damage	724	1,374
# of buildings sustaining extensive damage	189	1,215
# of buildings completely damaged	46	1,547
Population Needs		
# of households displaced	262	2.219
# of people seeking public shelter	82	817
Debris Generation		
Building debris generated (tons)	34,000	280,000
# of truckloads to clear debris (@ 25 tons/truck)	1,360	11,200
Value of Damages		
Total property damage	$214,973,900,	$1,444,613,300
Total losses due to business interruption	$34,715,200	$200,709,200
Total All Losses	$249.690,000	$1,645,320,000

Figure 27 - Estimated Damages from Magnitude 5 and 7 Earthquakes

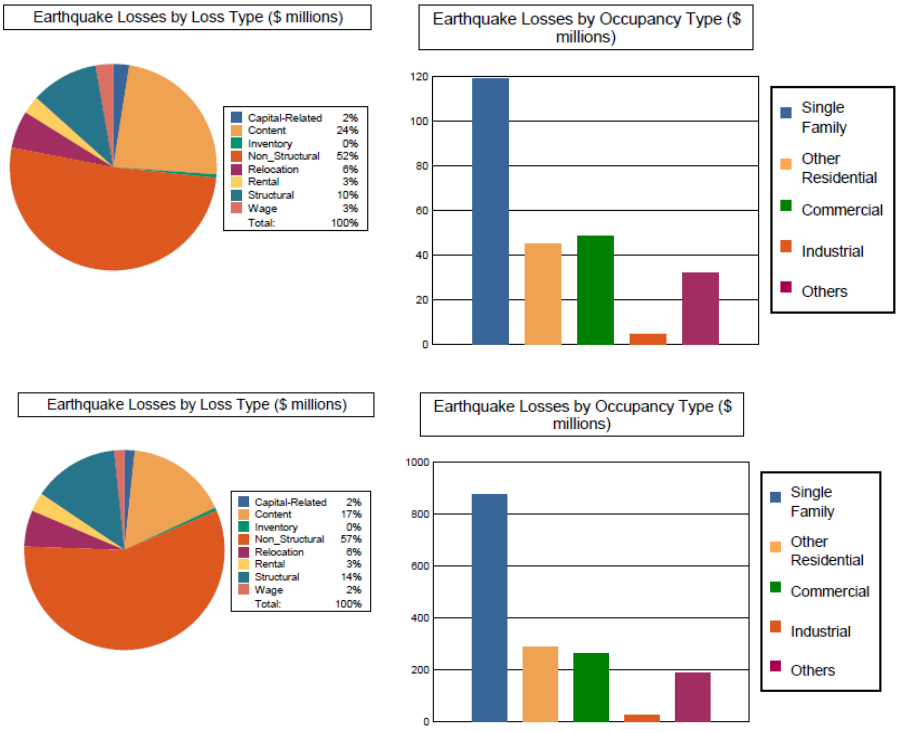
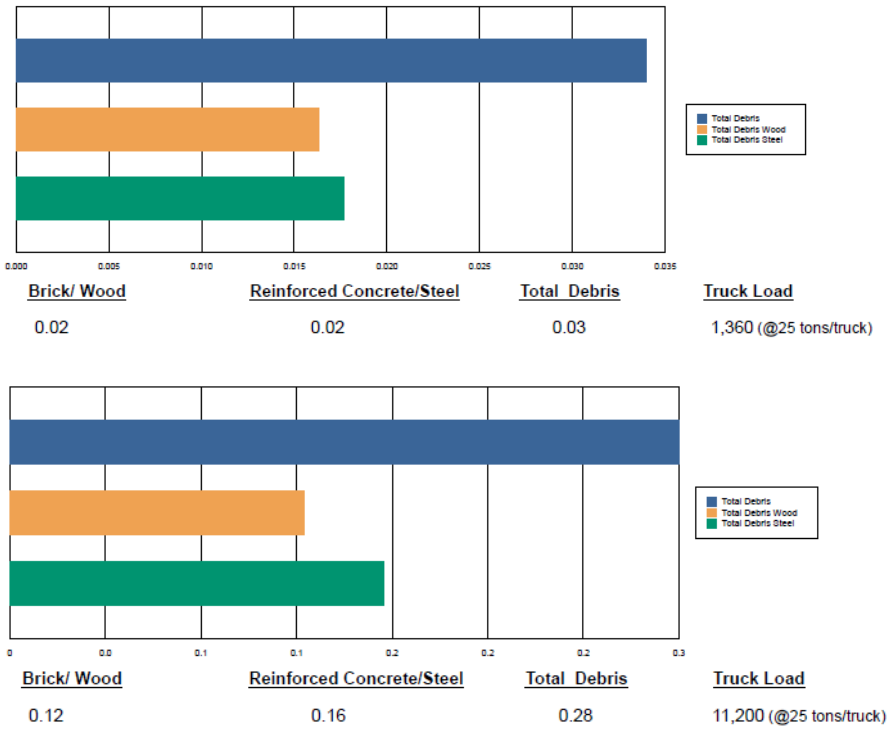


Figure 28 – Estimated Debris Generation from Magnitude 5 and 7 Earthquakes



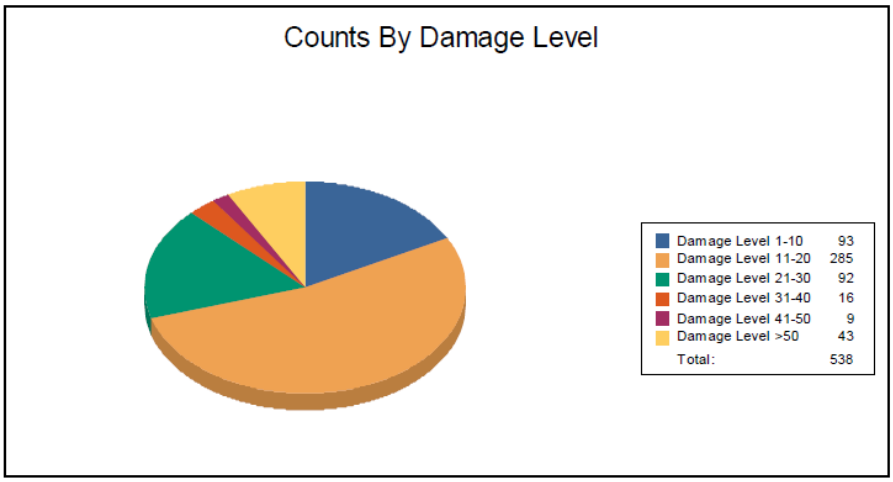
ESTIMATED DAMAGES FROM FLOODING

The HAZUS-MH flood risk module was used to estimate damages to the municipality at the 100 and 500 return periods. These return periods correspond to flooding events that have a 1% and a 0.2% likelihood of occurring in any given year. The results are summarized in Table 40 and in Figure 29.

Table 40 - Estimated Damages from Flooding

Vulnerabilities	100 Year	500 Year
Building Characteristics		
Estimated total number of buildings	4,721	
Estimated total building replacement value	$2,042,475,000	
Building Damages		
# of buildings sustaining no damage	4,183	3,705
# of buildings sustaining slight damage (<20%)	378	610
# of buildings sustaining moderate damage (21-50%)	117	277
# of buildings sustaining substantial damage (>50%)	43	118
Population Needs		
# of households displaced	1,270	1,778
# of people seeking public shelter	115	138
Value of Damages		
Total property damage (buildings and content)	$218,610,000	$423,030,000
Total losses due to business interruption	$148,260,000	$253,250,000
Total All Losses	$266,860,000	$676,290,000

Figure 29: Expected Building Damage, 100-year Flood



SECTION 5: HAZARD MITIGATION GOALS

The Hull Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2018 Hazard Mitigation Plan. All of the goals were found to continue to be reflective of the Town's priorities and concerns relative to natural hazard mitigation. The Team added one new goal, addressing priority populations (#10). All of the goals are considered critical for the Town and they are not listed in order of importance.

Goal 1: Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.

Goal 2: Identify and seek funding for measures to mitigate or eliminate each known significant hazard area.

Goal 3: Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

Goal 4: Prevent and reduce the damage to public infrastructure and natural resources resulting from all hazards.

Goal 5: Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

Goal 6: Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

Goal 7: Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

Goal 8: Take maximum advantage of resources from FEMA, MEMA, and MA Energy and Environmental Affairs to educate Town staff and the public about natural hazard risks and mitigation strategies.

Goal 9: Consider the potential impacts of climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning and other town plans, policies, and programs

Goal 10: Address the needs of priority populations such as seniors, low income, renters throughout hazard mitigation planning, including public outreach, analysis of impacts, and development and implementation of mitigation strategies.

SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Hull are a combination of zoning, land use, and environmental regulations, public education, infrastructure maintenance and infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems, or seawall/revetment/dune repairs, while large scale capacity problems may require pipe replacement, invert elevation modifications, or large scale seawall/revetment improvements and replacements. 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 2007 Plan, are listed by hazard type here and are summarized in Table 26 below. Many upgrades to existing measures are noted in the following sections.

Flooding – Existing Town-Wide Mitigation

Hull employs a number of practices to help minimize potential flooding and impacts from flooding, and to maintain existing drainage infrastructure. Existing town-wide mitigation measures include the following:

National Flood Insurance Program (NFIP) – Hull participates in the NFIP with 1,637policies in force as of the May 1, 2023. FEMA maintains a database on flood insurance policies and claims., which was provided to MAPC by the DCR Flood Management Program. The following information is provided for the Town of Hull:

Flood insurance policies in force (as of October 31, 2017)	1,637
Coverage amount of flood insurance policies	$405,598,000
Premiums paid	$3,321,838
Total paid losses	2,430
Total payments (Total amount paid on losses)	$17,868,120.07
Substantial Damage claims since 1978	112

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 floodplain and building requirements.

CRS Program Participation – The Town of Hull participates in the Community Rating System (CRS) program, gaining a reduction in flood insurance rates for property owners in the Town in exchange for mitigation actions taken to reduce the Town's potential vulnerability to flooding. The program functions on a rating system, with an individual community's rating being based on the number of points they receive, with points allocated for each flood mitigation measure enacted. The Town of Hull currently has a rating of Class 7 with 1301 points, resulting in a 10% reduction in flood insurance rates in the Town.

Public Works Operations/Maintenance Activities – The Public Works Department 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* – Conducted annually, more frequently in environmentally sensitive areas and business districts.
- *Catch basin cleaning* – Conducted annually, more frequently in low lying areas.
- *Roadway treatments* – Mixture of sand and salt.
- *Other* – Continued repair and rehabilitation of check valves and back-flow preventers.

Stormwater Drainage System – Hull has an extensive stormwater drainage system that features a lagoon system with pumps as well as check valves and back-flow preventers.

Hull Community Development Plan, 2004 – The Community Development Plan includes an analysis of challenges and opportunities in the Town and proposes a vision for the Town's future and a general strategy for achieving it. The plan focuses on the potential for development in the Nantasket Beach area.

Conservation/Recreation Open Space Plan – The 2000 Open Space and Recreation Plan identifies current open space areas, as well as properties that could be acquired for open space, which serve a number of different purposes including mitigation of flooding and storm damage.

Weir River Estuary Land Protection Plan – The 2006 Weir River Estuary Land Protection Plan, covering an area that includes portions of Hull, Hingham, and Cohasset includes land protection goals for shoreline lands and wetlands that could also serve as flood and storm damage mitigation. The efforts to date have protected 368 acres of estuary land and there are approximately 150 acres of key parcels that have been identified as a priority for protection.

Harbor Management Plan - The Harbor Management Plan addresses the need for maintenance and repair of foreshore structures that prevent against flooding.

Floodplain Zoning District – Zoning is intended to protect the public health and safety through the regulation of land use. The Hull Zoning Bylaw includes a Floodplain District (Section 37and 42). The purposes of this district are to protect the public health, safety and general welfare, to protect human life and property from the hazards of periodic flooding, to preserve the natural flood control characteristics, and the flood storage capacity of the floodplains. The Floodplain District is an overlay district, defined by the 100-year floodplain as designated by FEMA. Within the District, all development must conform with the requirements of the State Building Code pertaining to the flood resistant construction and meet requirements related to anchorage, flood design considerations for enclosed spaces below base flood elevation, and water resistant construction. In High Hazard Zones (V Zones), buildings must be elevated two feet above base flood elevation, spaces below flood elevation levels should be free of obstruction or have "break-away walls", and be anchored to pilings.

Site Plan Review – The Hull Zoning Bylaw includes Site Plan Review Design Guidelines (Section 40) with provisions that relate to improving stormwater management.

1. Protection and enhancement of important existing site features
2. Protection of adjoining premises against detrimental uses by provision of surface water drainage, sound, sight and wind barriers and preservation of views, light and air quality.
3. Convenience and safety of vehicular and pedestrian movement within the site, the location of driveway openings in relation to traffic or to adjacent streets.
4. Adequacy of the arrangement of parking and loading spaces.
5. Adequacy of the methods of disposal of refuse and other wastes.
6. Relationship of buildings, structures and open space to the natural landscape and existing buildings and structures.
7. Prevention of pollution, soil erosion, increased runoff and flooding.

Subdivision Control – "Town of Hull, Rules and Regulations Governing the Subdivision of Land" was adopted in 1988 to regulate land subdivision in the Town. These regulations include provisions that serve to address stormwater run-off associated flooding and land development within the floodplain.

Cluster Zoning - Section 43 Flexible Plan Development allows for cluster zoning. Properties of at least ten acres may receive a density bonus if a minimum of 25% of the property is preserved as open space, including passive or active recreation areas. Open space areas could be designated for the protection of natural drainage areas and streams.

Wetlands Protection Act – Hull enforces the State Wetlands Protection Act through the permitting authority of the Conservation Commission. Enforcement of the Act serves to protect the Town's shores, ponds, rivers, and wetlands for, among other reasons, flood control, erosion and sedimentation control, and storm damage prevention.

Resource Area Setbacks – Section 31-3.e and f of the Zoning Bylaw require building setbacks from sea walls and cliffs. Specifically, these sections require that no building be constructed within ten feet of a publicly owned seawall and that no structure be built closer than twenty five feet from the top edge of a cliff that is greater than twenty feet in height unless said cliff is certified as stable by a registered geologist or registered engineer.

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.

Identification of Repetitive Loss Areas – The Town has identified and mapped areas where there are significant concentrations of repetitive loss properties.

Elevating Repetitive Loss Properties - The Town has received two FEMA Hazard Mitigation Grants for a total of more than $600,000 to elevate homes, or utilities within homes, for ten residential

properties. The ten property owners are proceeding with their projects. The Town has applied for an additional FEMA Hazard Mitigation elevation grant for two homeowners.

Freeboard Incentive - For residential and commercial building elevation, or new construction projects, building department permit fees are reduced by $500 if an elevation certificate is provided to verify the building is elevated a minimum of two feet above the highest federal or state requirement for the flood zone.

Tide-Gates – The Town has three major tide-gates used to control incoming tide levels. The tide-gate at Strait Pond was recently repaired and modernized.

Seawalls, Jetties, and Dikes - There are 22.6 miles of coastal frontage in Hull, 5.9 miles of this coastal frontage is publicly owned. Hull has a significant number of seawalls and armoring treatments on this frontage. The town has a Seawall Maintenance and Monitoring plan to ensure Town seawalls are inspected on a regular basis, and corrective action taken when required. Recent work includes emergency repairs to the James Street seawall. In February 2006 the Town updated a comprehensive study of these facilities to determine which ones were in need of repair or replacement and what the likely impacts of a seawall failure would be. The Town completed an inventory, condition and ownership study for all in-town seawalls in the fall of 1996. A US Army Corp of Engineers (USACOE) feasibility study to mitigate flooding of north Nantasket Beach was completed in February 1996. The Town appropriates funding annually to support seawall maintenance and repair and actively inspects and monitors their condition.

Beach and Dune Protection - The Town plants beach grass each spring. In March 2010, as in the previous several years, the Town planted 15,000 beach grass plants. The Town has continued to repair breaches in the dune and improve sand fencing to protect the dune from damage.

Existing Dam Failure Mitigation Measure

The tidegate at Straits Pond is classified by DCR as a dam. The town maintains the tidegate and has an alarm system to provide notice of any operational issues. The tidegate was recently repaired and modernized.

Existing Wind Hazard Mitigation Measures

Communication Tower Zoning Regulations – Regulations of communication towers were created to (a) protect the general public from hazards associated with wireless communication facilities; (b) minimize visual impacts from wireless communication facilities on districts in Hull and to preserve scenic views to and from roadways, open space, recreation areas, and waterways; (c) allow the provisions of necessary wireless communication services and (d) promote shared use of facilities to minimize the need for additional facilities. The zoning ordinance contains regulations that limit tower height and ensure that design and construction is done safely. A special permit from the Board of Appeals is required in order to construct a communications tower and it must meet the following conditions:

- Towers must be 500' from buildings
- Towers cannot be more than 50' above natural grade
- Allowed on public lands or commercial recreation by special permit
- Only mono-poles are allowed
- Not closer than 2 miles to nearest wireless facility
- No lighting allowed

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 Light Department conducts tree trimming in coordination with the Department of Public Works.

Existing Winter Hazard Mitigation Measures

Snow disposal –The town conducts general snow removal operations with its own equipment.

Existing Brush Fire Hazard Mitigation Measures

Burn Permits – The Town fire department requires a written permit for outdoor burning, which includes explanation of the related regulations and precautions for the permit-holder to take. The permit-holder must call the fire department on the proposed burn day to confirm weather conditions are suitable for outdoor burning.

Subdivision/Development Review – The Fire Department participates in the review of new subdivisions and development projects.

Existing Geologic Hazard Mitigation Measures

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.

Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to a Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which

are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.

Existing Multi-hazard Mitigation Measures

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.

Communications Equipment – Hull has full coverage of the Town with emergency services radio. The Town is addressing compatibility issues that will allow for regional dispatch during emergency events. Incident command units are available through Plymouth County and MEMA.

Emergency Power Generators – The Town maintains emergency power generators in several important public facilities and emergency shelters.

Massachusetts State Building Code – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads.

Regional and Local Emergency Management Planning Committees – Locally, the Town engages department heads in emergency management planning. On a regional level, the Town participates in regional emergency management groups, including emergency management cooperation across five neighboring communities and the Massachusetts Emergency Preparedness Region 4b, a health emergency preparation group operating across a large part of the metropolitan region and organized by Cambridge Health Alliance.

Public Information & Outreach – The Town provides information to residents and business owners relating to a range of potential natural hazards, most especially with regard to flooding, hurricanes, and northeasters. The Town maintains a section of its webpage devoted specifically to flooding issue awareness: http://www.town.hull.ma.us/Public_Documents/HullMA_conservation/flood In addition, the Town has comprehensive flood information and mitigation materials in the town library and sends an annual mailing with flood information to all residents in a flood zone.

Existing mitigation measures from the 2018 plan with 2024 updates are summarized in Table 26 below.

Table 41 Hull Existing Mitigation Measures

Mitigation Measure	Area Covered	Effectiveness / Enforcement	Updates since 2018 Plan?	Improvements Needed?
FLOOD RELATED HAZARDS				
Participation in the National Flood Insurance Program (NFIP)	Areas identified on the FIRM maps.	There are 2,094 policies in force.	FIRM Maps are being updated	Adopt final FIRM maps
CRS Program Participation	Town-wide	Class 8	Class 7 CRS	Evaluate performance; consider seeking more CRS points
Public Works Operations/Maintenance	Town-wide	Effective	Grant obtained to evaluate Light Plant/DPW needs	Relate to Master Plan, needs more funding
Stormwater Drainage System	Town-wide	Somewhat Effective	MS4 Adaptation planning at the neighborhood scale and higher. (Example, Hampton Circle).	Upgrade and improve drainage system as funding allows.
Master Plan, 2004	Town-wide	Effective	Master Plan under development, including Comprehensive Development Plan	Complete an d adopt new plan
Open Space Plan	Town-wide	Effective	Updated 2022	None
Weir River Estuary Land Protection Plan	Weir River	Effective		Needs Updating
Harbor Management Plan	Harbor Area	Effective	None	Was done in 1996, needs to be updated

Mitigation Measure	Area Covered	Effectiveness / Enforcement	Updates since 2018 Plan?	Improvements Needed?
Zoning – Floodplain District	Town-wide	Effective	Floodplain District Bylaw to be updated to MEMA's Model Bylaw	Adopt final revised Floodplain District bylaw at Town Meeting
Site Plan Review	Town-wide	Effective	None	None
Subdivision Control Law	Town-wide	Effective	None	None
Cluster Zoning	Town-wide	Effective	None	None
Wetlands Protection Act	Resource Areas	Effective	Bylaw articles are being developed, including fee structure	Adopt amended articles
Resource Area Setbacks	Town coastlines	Effective	None	None
DCR Dam Safety Regulations	Dams	Effective	DCR Report on Straits Pond Tide Gate	Town needs to respond to DCR report
Identification of Repetitive Loss Areas	Town-wide	Effective	None	Keep up to date
Elevating Repetitive Loss Properties, d	Repetitive Loss Properties	Grants complete	3 applications to FEMA increased the Town's capacity for hone elevation grants	Continue to implement and expand the program
Freeboard Incentive	Flood Zones	Effective	None	Need to revisit fees. Amend ZBA height

Mitigation Measure	Area Covered	Effectiveness / Enforcement	Updates since 2018 Plan?	Improvements Needed?
				requirement to accommodate building elevations
Flood Control Pump Stations	Town-wide	Effective	Upgrade of D Street pump completed. Pump Station 4 was replaced; obtained funding for Pump Station 9	Working on pumps for Brockton St. lagoon
Tide Gates	Town-wide	Effective	Straits Pond Tide gates were repaired and modernized	Review and improve protocols for communication and operation during flooding events Continue to inspect, maintain and repair as necessary.
Seawalls, Jetties, and Dikes	Coastline	Effective		Continue to inspect, maintain, and improve
Beach Dune Protection	Coastline	Effective	Restored dune at A Street access; Town & DCR explored beach nourishment	Continue to inspect, maintain, and improve
NEW 2024 – Two-way Road Plan completed, to provide two ways out of Town	Town-wide evacuation		Design of road is underway	Construct the project

Mitigation Measure	Area Covered	Effectiveness / Enforcement	Updates since 2018 Plan?	Improvements Needed?
WIND HAZARDS				
Communication Tower Zoning Regulations	Town-wide	Effective	None	Communications to be installed on new water tower
The Massachusetts State Building Code	Town-wide	Effective for most situations except severe storms	None	None
Tree trimming program	Town-wide	Effective	None	Enhanced tree trimming program
WINTER HAZARDS				
Snow Disposal Site	Town-wide	Effective	None	None
GEOLOGIC HAZARDS				
Massachusetts State Building Code	Town-wide	Effective	None	None
BRUSHFIRE HAZARDS				
Burn Permit	Town-wide	Effective	None	None
Development Review	Town-wide	Effective	None	None
MULTI-HAZARDS				
Comprehensive Emergency Management Plan (CEMP)	Town-wide	Emphasis is on emergency response.	None	CEMP needs to be updated
Communications Equipment	Town-wide	Effective	Fiber Overlay Channel; Enhanced 911.	None

Mitigation Measure	Area Covered	Effectiveness / Enforcement	Updates since 2018 Plan?	Improvements Needed?
Massachusetts State Building Code	Town-wide	Effective for new construction.	None	None
Emergency Power Generators	Town-wide	Effective.	Upgraded 100 KW generator at Town Hall and Fire Station. Portable generator for Tide Gates; Town leases 6 generators 12MW (added one).	None
Participation in the Regional and Local Emergency Planning Committees	Town-wide	Forums for cooperation on natural and manmade disasters.	None	None
Public Information & Outreach	Town-wide	Effective	Communications software platform to be enhanced; social media capacity	Possible new position for managing public communication
NEW 2024 - Electric Storage and charging systems; new development parking with EV charging				

Mitigation Capabilities and Local Capacity for Improvements

Under the Massachusetts system of "Home Rule," the Town of Hull is authorized to adopt and from time to time amend a number of local bylaws and regulations that support the town's capabilities to mitigate natural hazards. These include Zoning Bylaws, Subdivision and Site Plan Review Regulations, Wetlands Bylaws, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Bylaws may be amended each year at the annual Town Meeting 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 Hull has recognized several existing mitigation measures that require implementation or improvements, and has the capacity based on these Home Rule powers within its local boards and departments to address these.

Several departments including Planning, Public Works, Light, and Sewer will address the many planned infrastructure projects. New strategies including paving reduction and drought resistant planting will be stewarded by the Conservation Commission. Many projects, including public education, encouragement of building elevation, open space planning, and incorporating climate issues into capital and other planning documents will be jointly pursued by departments and town leadership.

SECTION 7: MITIGATION MEASURES FROM THE 2018 PLAN

Implementation Progress on the Previous Plan

The Hazard Mitigation Planning Committee meets annually every September to review and update these mitigation measures. During this 2024 Plan update process, the Hull Hazard Mitigation Team reviewed the mitigation measures identified in the 2018 Hull Hazard Mitigation Plan and determined whether each measure had been completed, partially completed or not completed.

Of those measures that have not been completed or partially completed, the Hazard Mitigation Team evaluated whether the measure should be deleted or carried forward into this updated 2024 Hazard Mitigation Plan.

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 secure funding or otherwise take action on the measure. Table 42 summarizes the status of mitigation measures.

Table 42 Status of Mitigation Measures from the 2018 Plan

Mitigation Measure	Priority in 2018 Plan	CURRENT STATUS 1. Completed 2. Partially Completed 3. Not Completed	2023 PLAN UPDATE 1. Retain in 2023 Plan? 2. Revise for 2023? 3. Changed Priority for 2023? 4. Delete in 2023 Plan?
FLOODNG MITIGATION			
1) Bay Avenue East Project	High	**Partially completed**	**Revise in 2024 Plan** Outlet pipes need to be redone, and add flapper valves **(Combine with #4)**
2) Relocate Weir River Water Pipes	High	**Completed**	**Delete** Completed
3) Encourage Building Elevation – Freeboard	High	**Partially Completed**	**Retain in 2024 Plan** Develop a Community Elevation Program

4) Stormwater Drainage System Improvements (Beach Avenue drains, others as needed)	High	• **Partially completed:** A to L Streets
		• **Partially Complete:** Bay Avenue East Project – Outlet pipes need to be redone, and add flapper valves
		• **Partially Completed:** Beach Ave (~50% done): replaced one catch basin; others have gas & water lines; -need to add catch basins
		• **Partially Completed:** Lagoon Pump on order for Draper and Newport
		• **New:** Cobble nourishment P & Q Streets (Town has funding for design)
		• **New:** Caddish Ave. & Q Street:
		  ○ 80-foot outfall pipe
		  ○ Flapper Valve
		  ○ Elevate roadway
		• **New:** Samoset and Manomet ($500K available)
		New: Assessing Hampton Circle
		• **New:** Elevate Main Street by the dustbowl
			Revise in 2024 Plan
			Revise as noted --updates for current project status shown

Mitigation Measure	Priority in 2018 Plan	**CURRENT STATUS** **1. Completed** **2. Partially Completed** **3. Not Completed**	**2023 PLAN UPDATE** **1. Retain in 2023 Plan?** **2. Revise for 2023?** **3. Changed Priority for 2023?** **4. Delete in 2023 Plan?**
5) Stormwater drainage improvements at Phipps Street & Samoset Avenue *(New, not in 2018 Plan)*	N/A 2018 Plan		**Add to 2024 Plan**
6) Install/Repair Check Valves and Back-Flow Preventers as needed	Medium	**Not Completed**	**Retain in 2024 Plan**
7) Upgrade D St. pump, consider relocation/elevation Install a Marginal Road Pump Station	High	**Completed:** D Street pump; **Revise** to install Marginal Road Pump Station	**Revise in 2024 Plan** Add Marginal Road Pump Station
8) Repair Nantasket Seawall – install revetment (DCR Project)	High	**Partially Complete:** DCR built a berm at bathhouse	**Retain in 2024 Plan:** Extend Seawall northward from Hull Shore Drive Extension
9) Repair of Town Seawalls, Dikes, and Jetties – Complete Crescent Beach. Caddish Avenue and other work as needed	High	**Partially complete:** Crescent Beach seawall not built to spec (litigation pending) Caddish Avenue, A Street to XYZ Street	**Retain in 2024 Plan** Revise as noted. Town and DCR to develop alternatives for Shoreline Protection from DCR to bathhouse
10) Dune Repair and Protection	High	**Partially complete**	**Retain in 2024 Plan** Update for current project status
11) A Street Fire Station Flood Protection – install hurricane doors	Medium	**Not Completed**	**Retain in 2024 Plan**
12) Paving Reduction Program	Medium	**Completed**	**Delete** Completed
13) Open Space Plan Update	Medium	**Completed 2022**	**Delete** Completed

Mitigation Measure	Priority in 2018 Plan	**CURRENT STATUS** **1. Completed** **2. Partially Completed** **3. Not Completed**	**2023 PLAN UPDATE** **1. Retain in 2023 Plan?** **2. Revise for 2023?** **3. Changed Priority for 2023?** **4. Delete in 2023 Plan?**
14) GIS Floodplain Mapping –update as needed	High	**Partially Completed**	**Retain in 2024 Plan** Update for new Flood Insurance Rate Maps 2024/25
15) Pursue public ownership of beach lots to protect Nantasket Beach dune	High	**Partially Completed** Did 133 Beach Ave property	**Retain in 2024 Plan**
16) Point Allerton Seawall improvements (DCR) *(New, not in 2018 Plan)*	N/A 2018 Plan	**Not Completed**	**Add to 2024 Plan**
WIND MITIGATION			
17) Protect Electric Lines – continue project to Pemberton Point.	High	**Partially Completed** In progress, part of seawall project	**Retain in 2024 Plan**
BRUSHFIRE MITIGATION			
18) Arrange mutual aid with Plymouth County for brushfire truck	Medium	**Completed**	**Delete** Completed
WINTER MITIGATION			
19) Evaluate public buildings for ability to withstand snow loads; retrofit to greatest degree feasible.	Medium	**Completed 2022**	**Delete** Completed
EARTHQUAKE MITIGATION			
20) Conduct Public building seismic assessments	Medium	**Completed 2022**	**Delete** Completed

Mitigation Measure	Priority in 2018 Plan	**CURRENT STATUS** **1. Completed** **2. Partially Completed** **3. Not Completed**	**2023 PLAN UPDATE** **1. Retain in 2023 Plan?** **2. Revise for 2023?** **3. Changed Priority for 2023?** **4. Delete in 2023 Plan?**
DAM MITIGATION			
21) Install alarm system for Straits Pond tidegate	High	**Partially Completed** Needs to be revisited – disconnected; needs new electronics	**Revise in 2024 Plan** Revise as noted and develop a procedure for communication and operation during flooding
EXTREME TEMPERATURE MITIGATION			
22) Consider establishment of a cooling center for extreme heat days	Low	**Not Completed**	**Retain in 2024 Plan** Consider Memorial School
23) Tree Planting Program *(New, not in 2018 Plan)*	N/A 2018 Plan High 2024 Plan	**Partially Completed**	**Retain in 2024 Plan**
DROUGHT MITIGATION			
24) Encourage drought resistant landscaping	Medium	**Retain in 2024 Plan** Conservation Commission	**Retain in 2024 Plan**
MULTI-HAZARD MITIGATION			
25) Public Education	High	**Partially Completed:** Social media-Fire Dept; Emergency Management talks at Senior Center; Education on Sea Level Rise at Middle School with NE Aquarium	**Retain in 2024 Plan** Revise as noted
26) Rehabilitate Village Fire Station B	High	**Partially Completed:** Planning done, initial steps to prepare building	**Retain in 2024 Plan** Revise as noted

Mitigation Measure	Priority in 2018 Plan	CURRENT STATUS 1. Completed 2. Partially Completed 3. Not Completed	2023 PLAN UPDATE 1. Retain in 2023 Plan? 2. Revise for 2023? 3. Changed Priority for 2023? 4. Delete in 2023 Plan?
27) Evaluate options for alternative electrical transmission feed to Hull *(New, not in 2018 Plan)*	N/A 2018 Plan	**Not Completed**	**Add to 2024 Plan**
CLIMATE RESILIENCE/ADAPTATION			
28) Relocate light plant garages to higher elevation	High	**Not Completed**	**Retain in 2024 Plan**
29) Investigate battery storage and other grid resilience	~~High~~ Medium	**Not Completed**	**Retain in 2024 Plan** Revise as noted
30) Develop evacuation plan considering sea level rise	~~High~~ Medium	**Partially Completed:** Installed signs for Hurricane evacuation; coordinate with Hingham and Cohasset	**Retain in 2024 Plan** Revise as noted
31) Elevate electricity and HVAC at sewer plant	High	**Partially Completed:** HVAC done; partially completed electricals	**Retain in 2024 Plan** Revise as noted
32) Encourage beach nourishment on Nantasket Beach (DCR)	High	**Not Completed**	**Retain in 2024 Plan**
33) Explore Offshore borrow sites to provide materials for beach nourishment *(New, not in 2018 Plan)*	N/A 2018 Plan High 2024 Plan	**Not Completed**	**Add to 2024 Plan**
34) Consider future climate impacts in all capital planning, as well as master plans, open space plans, etc.	~~Medium~~ High	**Not Completed**	**Retain in 2024 Plan**
35) Consider plan to protect DPW barn from future flooding	~~Medium~~ High	**Partially Completed:** Town has secured funds to elevate the DPW Barn and the Light Plant	**Retain in 2024 Plan** Revise as noted

Mitigation Measure	Priority in 2018 Plan	**CURRENT STATUS** **1. Completed** **2. Partially Completed** **3. Not Completed**	**2023 PLAN UPDATE** **1. Retain in 2023 Plan?** **2. Revise for 2023?** **3. Changed Priority for 2023?** **4. Delete in 2023 Plan?**
36) Promote bicycle/pedestrian transportation to reduce auto use	High	**Partially Completed:** Some bicycle lane barrier have been installed	**Retain in 2024 Plan**
37) Pursue opportunities to extend and expand Nantasket Beach dune	High	**Partially Completed:**	**Retain in 2024 Plan**
38) Incorporate recommendations from the Coastal Climate Change Vulnerability Assessment and Adaptation Study	High	**Partially Completed:**	**Retain in 2024 Plan**
39) Evaluate options to protect sewer plant from future flooding risk	High	**Partially Completed:** Working on design of berm; seeking funding	**Retain in 2024 Plan** Revise as noted
40) Develop formalized property owner flood protection and flood insurance education program	High	**Partially Completed:** Needs to be advanced	**Retain in 2024 Plan**
41) Install flood proofing (such as doors) at the Memorial School and Senior Center	High	**Not Completed**	**Retain in 2024 Plan** Revise as noted
42) Research ownership and status of WBZ dike tidegate to determine repair options	High	**Partially Completed:** Ownership established; need to install automated tide gate (**Note:** FEMA Communications Bunker located in this area)	**Retain in 2024 Plan**
43) Install cameras in shoreline areas to monitor storm conditions	High	**Partially Completed:** Town has grant from EOPS, working on a Memorandum of Understanding	**Retain in 2024 Plan**
44) Conduct drone surveys to facilitate documentation of pre and post storm shoreline conditions.	High	**Partially Completed:** The Town conducted two surveys of dunes in the last three years	**Retain in 2024 Plan** Revise as noted

As indicated in Table 42, Hull made considerable progress implementing mitigation measures identified in the 2018 Hazard Mitigation Plan. Completed structural projects include:

9. Relocate Weir River Water Pipes
10. D Street Pumping station
11. Caddish Avenue, A Street to XYZ Street
12. Paving reduction program
13. Open Space Plan update
14. Mutual aid agreement with Plymouth County for brushfire truck
15. Evaluate public buildings for ability to withstand snow loads; \
16. Public building seismic assessment

Numerous projects have been started by the Town and are in progress or partially completed. Given the cost and complexity of many mitigation projects, it can often take several years for a project to be completed from start to finish. Partially completed projects include:

25. A to L Streets drainage improvement
26. Bay Avenue East Project
27. Beach Ave drainage improvement
28. Lagoon Pump for Draper and Newport
29. Encourage Building Elevation – Freeboard
30. Repair Nantasket Seawalls (DCR project)
31. Repair of Town Seawalls, Dikes, and Jetties
32. GIS Floodplain mapping
33. Pursue public ownership of beach lots to protect Nantasket Beach dune
34. Protect electric lines, complete to Pemberton Point
35. Install alarm system for Straits Pond tidegate
36. Encourage drought resistant landscaping
37. Rehabilitate Village Fire Station B
38. Develop evacuation plan considering sea level rise
39. Elevate electricity and gas at sewer plan
40. Consider plan to protect DPW barn from future flooding
41. Promote bicycle/pedestrian transportation to reduce auto use
42. Pursue opportunities to extend and expand Nantasket Beach dune
43. Implement the Coastal Climate Change Vulnerability Assessment and Adaptation Study
44. Evaluate options to protect sewer plant from future flooding risk
45. Develop property owner flood protection and flood insurance education program
46. Research ownership and status of WBZ dike tidegate to determine repair options
47. Install cameras in shoreline areas to monitor storm conditions
48. Conduct drone surveys to document pre and post storm shoreline conditions

Overall, 24 mitigation measures from the 2018 plan will be continued in the plan update. They will retain the same priority in this 2018 update. A number of these are ongoing projects such as stormwater or drainage upgrades, public education, and floodplain management. Eight projects that were not completed will be carried forward into the 2024 updated plan. No measures have been deleted from the 2018 plan for this plan update.

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

Hazard Mitigation 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.
  (Source: *FEMA Local Multi-Hazard Mitigation Planning Guidance*)

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 many communities, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the Town of Hull, the Department of Conservation and Recreation (DCR), and Massachusetts Department of Transportation (MDOT). The planning, construction, operations, 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 numerous competing priorities. In the sections that follow, the plan includes recommendations for activities where cooperation with these other agencies may be necessary. Implementation of these recommendations will require that all parties work together to develop solutions.

Overview of Regional Facilities within Hull

Major facilities owned, operated and maintained by federal, state, regional or private entities in Hull include: Routes 228 (Mass DOT); local bus service and commuter boat to Boston (MBTA); the Nantasket Beach Reservation (DCR); and the Coast Guard Station Pt. Allerton (U.S. Coast Guard).

Inter-Community Considerations

Shoreline Environment – The coastal shoreline of the South Shore area is a dynamic environment where forces of erosion and deposition of sand are constantly at work changing the beach profile. This process disregards municipal boundaries as sand and other materials are moved along the coast. Shoreline protection measures such as sea walls, jetties, and others have an impact on this process with the potential of building up sand in some areas while stripping it away from others. Municipalities along the South Shore should work to understand how these processes are at work locally and consider mutually beneficial means of protecting their shore side communities from the impacts of storm damage.

Weir River Estuary Land Protection – Amongst the numerous benefits that can be attributed to protecting land in the Weir River Estuary, covering an area that includes portions of Hull, Hingham, and Cohasset, protection of coastal land and wetland areas can serve to mitigate flooding and potential storm damage. These protected areas directly serve to absorb storm water and act as flood water retention areas. Indirectly, land along the water that is protected will not be developed with homes and buildings that would later be subject to storm and flood damage.

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 Zoning and By-law changes adopted in recent years, the Wetlands Act enforced by the Conservation Commission, and the recent adoption of the Community Preservation Act, the town determined that existing regulatory measures are taking good advantage of local Home Rule land use regulatory authority to minimize natural hazard impacts of development. Priorities for the future include updating the open space plan, encouraging beach nourishment and dune development, and public education efforts toward ensuring that future development occurs in a sustainable manner.

PROCESS FOR SETTING PRIORITIES FOR MITIGATINON 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 Hazard Mitigation Planning 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 43 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

Table 43 – Mitigation Measure Prioritization				
Mitigation Action	**Geographic Coverage**	**Estimated Benefit**	**Estimated Cost**	**Priority**
Flood Mitigation				
Alphabet Streets Drainage (Bay Avenue East Project)	Bay Ave. East area	High	High	High
Relocate Aquarion Water Pipes	Alphabets, L to X St.	High	High	High
Encourage Building Elevation (Freeboard)	Town-wide	High	Low	High
Stormwater Drainage System Improvements (Beach Avenue drains, others as needed)	Town-wide	High	High	High
Install/Repair Check Valves and Back-Flow Preventers as needed	Town-wide	High	Medium	Medium
Upgrade D St. pump, consider relocation/elevation	Alphabets	High	High	High
Repair Nantasket Seawall – install revetment	Nantasket Beach - DCR	High	High	High
Repair of Town Seawalls, Dikes, and Jetties Complete Crescent Beach, Caddish Avenue, repairs as needed	Town-wide	High	High	High
Dune Repair and Protection	Nantasket Beach Phipps Street, north	High	Low	High
A Street Fire Station Flood Protection – install hurricane doors	Town-wide	Medium	Medium	Medium
Paving Reduction Program	Town-wide	Medium	Medium	Medium
Open Space Plan Update	Town-wide	Medium	Medium	Medium
GIS Floodplain Mapping – update as needed	Town-wide	High	Low	High
Pursue public ownership of beach lots to protect Nantasket Beach dune	Nantasket Beach Phipps St. north	High	High	High
Wind Mitigation				
Protect Electric Lines – continue project to Pemberton Point.	Hull Village to Pemberton Point	High	Medium	High
Brushfire Mitigation				
Arrange mutual aid with Plymouth County for brushfire truck	Brushfire areas	Medium	Low	Medium
Winter Storm Hazard Mitigation				
Evaluate public buildings for ability to withstand snow loads; retrofit to greatest degree feasible.	Public buildings	Medium	Low	Medium
Earthquake Mitigation				
Public building seismic assessments	Public Buildings	Medium	Medium	Medium
Dam Mitigation				
Maintain alarm system for Straits Pond tidegate	Atlantic Avenue	High	Low	High

Table 43 – Mitigation Measure Prioritization				
Mitigation Action	**Geographic Coverage**	**Estimated Benefit**	**Estimated Cost**	**Priority**
Extreme Temperature Mitigation				
Consider establishment of a cooling center for extreme heat days	Town-wide	Medium	Low	Medium
Drought Mitigation				
Encourage drought resistant landscaping	Town-wide	Medium	Low	Medium
Multihazard Mitigation				
Public Education	Town-wide	High	Low	High
Rehabilitate Village Fire Station	Village	High	High	High
Climate Resilience/Adaptation				
Relocate light plant garages to higher elevation	Light Plant	High	High	High
Implement battery storage project	Town-wide	High	High	High
Develop evacuation plan considering sea level rise	Town-wide	High	Low	High
Elevate electricity and HVAC at sewer plant	Town-wide	High	High	High
Encourage beach nourishment on Nantasket Beach (DCR)	Nantasket DCR	High	High	High
Consider future climate impacts in all capital planning, as well as master plans, open space plans, etc.	Town-wide	High	Low	High
Consider plan to protect DPW barn from future flooding	Town-wide	High	High	Medium
Promote bicycle/pedestrian transportation to reduce auto use	Town-wide	Medium	High	High
Pursue opportunities to extend and expand Nantasket Beach dune	Nantasket Beach	High	High	High
Continue to incorporate recommendations from the Coastal Climate Change Vulnerability Assessment and Adaptation Study	Town-wide	High	Variable	High
Evaluate options to protect sewer plant from future flooding risk	Town-wide	High	Medium	High
Develop formalized property owner flood protection and flood insurance education plan	Town-wide	High	Low	High
Install flood protection for vulnerable segments of the Memorial School/EOC	Town-wide	High	Medium	High
Research ownership and status of WBZ dike tidegate to determine repair options	Bayside	High	Low	High
Purchase a drone to facilitate documentation of pre and post storm shoreline conditions	Town-wide	High	Low	High
Investigate options to protect against flooding along Caddish Avenue	Bayside	High	Low	High

RECOMMENDED HAZARD MITIGATION MEASURES

The recommended hazard mitigation measures for this 2024 updated plan are shown in Table 44 below. The mitigation measures include each of the following:

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 28, 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 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.

> Massachusetts Emergency Management Agency (MEMA) – MEMA coordinates FEMA hazard mitigation grants. https://www.mass.gov/orgs/massachusetts-emergency-management-agency.

Table 44 Recommended Hazard Mitigation Measures

Mitigation Measure	Priority	Lead Agency	Estimated Cost	Potential Funding
FLOODING HAZARDS				
1) Adopt Floodplain Management Bylaw (Floodplain Overlay District Bylaw) and develop cloud-based Floodplain development permitting system.	High	Planning Board & Building	Low/ Staff Time	Hull General Fund, Planning and Building Dept.
2) Improve high water barrier adjacent to Moreland Ave, Bay St, and Hampton Circle, develop nature-based protection to the HCA, and construct WWTF pump station to be resilient to 2070 (or longer)	High	Public Works	High	MVP Grants; BRIC Grants; State Revolving Fund; Hull DPW;
3) Encourage Building Elevation – Freeboard Develop a Community Elevation Program – Identify Homes to benefit; engage and assist residents; do elevation work collectively for cost savings	High	Building & Conservation	Low/ Staff Time	Hull General Fund, Building Dept.
4) Stormwater drainage improvements at Phipps Street & Manomet Avenue	High	Public Works	High	Town of Hull $500K Bond
5) Install/Repair Check Valves and Back-Flow Preventers as needed	Medium	Public Works	Medium	Hull General Fund, Public Works Dept.,
~~**6)**~~ Install a Marginal Road Pump Station; could be a combined sewer and stormwater pump station.	High	Public Works	High	Hull General Fund, Public Works Dept., BRIC Grant

Mitigation Measure	Priority	Lead Agency	Estimated Cost	Potential Funding
7) A Street Fire Station Flood Protection – install hurricane doors	Medium	Fire	Medium	Hull General Fund, Fire Dept.

8) Stormwater Management Improvements:
• Bay Avenue East Project: Outlet pipes need to be redone, add flapper valves
• Beach Ave drains, catch basins, outfall
• Caddish Avenue & Q Street
• Elevate roads/Stormwater mitigation
  ○ Main Street by the dustbowl
  ○ Fitzpatrick Street
  ○ Caddish and Sunset
• Hampton Circle
• Adams Street
• P & Q Streets cobble nourishment
• Draper and Newport (Lagoon Pump on order)
	High	Public Works	High	Hull General Fund, Public Works Dept., Roadway Bond, BRIC Grants

9) Develop a formalized property owner flood protection and flood insurance education program	High	Building Dept.& Conservation	Low/ Staff Time	Hull General Fund, Building Dept. and Conservation
10) GIS Floodplain Mapping – Update for new FEMA Flood Insurance Rate Maps 2024/25	High	Conservation	Low	Hull General Fund, Conservation.
11) Roadway subdrainage for drainage to Hampton Circle from Sagamore Hill, Green Hill, Strawberry Hill, Allerton Hill	Medium	Public Works	High	Hull General Fund, Public Works Dept.

Mitigation Measure	Priority	Lead Agency	Estimated Cost	Potential Funding
COASTAL HAZARDS				
12) Reconstruct Nantasket Seawall – Extend seawall northward along Hull Shore Drive Extension. Develop alternatives for shoreline protection from DCR to bathhouse Adaptive mitigation of seawalls	High	DCR/ACOE HRA	High	DCR/ ACOE
13) Reconstruct Town Seawalls, Dikes, and Jetties – Complete Crescent Beach. Caddish Avenue A Street to XYZ and Sunset	High	Public Works	High	Hull General Fund, Public Works Dept., State Dam and Seawall grants BRIC
14) Dune Protection and Reconstruction (Beach Ave., from Phipps St to lower Beach Ave (below Malta St.) and upper Beach Ave, N – S Streets)	High	Conservation	High	Hull General Fund, CAC Dept., MVP grants; BRIC grants
15) Pursue public ownership of beach lots to protect Nantasket Beach dune	High	Town Manager	High	Hull General Fund
16) Reconstruct Point Allerton Seawall (DCR)	High	DCR	High	DCR
17) Newport Road seawall and dike (to protect FEMA Communications Bunker)	High	Public Works	High	State Dam and Seawall grants; BRIC grants
18) Harbor View Road seawall reconstruction	High	Public Works	High	BRIC Grants

Mitigation Measure	Priority	Lead Agency	Estimated Cost	Potential Funding
19) Reconstruct Pemberton seawall	High	Public Works		BRIC Grant
20) Earthen berm around wastewater treatment plant	High	Sewer	High	BRIC Grant
21) Upgrade wastewater treatment facility , pumping stations, and force mains for greater resiliency	High	Sewer	High	Hull General Fund-Sewer Dept./BRIC/DEP
22) Protect Electric Lines – complete project to Pemberton Point.	High	Hull Municipal Light Dept	High	Town of Hull, Municipal Light Dept.
EARTHQUAKE HAZARDS				
23) Update the Comprehensive Emergency Management Plan addressing earthquakes	Medium	Fire Dept.	Low	Hull General Fund, Fire Dept.
DAM MITIGATION				
24) Install new alarm system for Straits Pond tide gate (new electronics)	High	Public Works	Low	Hull General Fund, Public Works Dept.,
EXTREME TEMPERATURE HAZARDS				
25) Establishment of a cooling center for extreme heat days; consider Memorial School	Low	Emergency Management	Low	Hull General Fund, Emergency Management

Mitigation Measure	Priority	Lead Agency	Estimated Cost	Potential Funding
26) Tree Planting Program and shade structures	Medium	Conservation Public Works	Medium	Hull General Fund, Public Works Dept./ Conservation
DROUGHT HAZARDS				
27) Public Education program on water conservation and drought management	Medium	Conservation, Water Dept.	Low / Staff Time	Hull General Fund, Conservation and Water Dept.
MULTI-HAZARD HAZARDS				
28) Evaluate alternative power transmission feed to Hull	High	Hull Light Dept.	High	Town of Hull Light Dept.
29) Identify Alternate locations for new Hull Public Safety Building (Police & Fire Depts.)	High	Police Dept. Fire Dept.	High	Hull General Fund, Police Dept. & Fire Dept.
30) Rehabilitate Village Fire Station B	High	Fire	High	Hull General Fund, Fire Dept.
31) Rebuild Pemberton Pier and Seawall (commuter boat, evacuation, fuel delivery)	High	Public Works Emergency Management	High	Hull General Fund, Public Works Dept, Emergency Management
32) Reconfigure Nantasket Ave – Pedestrian / bike accommodation (including 2-way street proposal and meshing with DCR climate adaptation/resiliency effort for the Reservation)	High	DCR	High	MassWorks/ Mass DOT/DCR

Mitigation Measure	Priority	Lead Agency	Estimated Cost	Potential Funding
33) Develop a partnership agreement between the Town and DCR to coordinate on capital projects	High	Town Manager & DCR	Low / Staff Time	Hull General Fund, Town Manager
CLIMATE RESILIENCE/ADAPTATION				
34) Develop climate adaptation and resiliency strategies for resiliency of the HLP: Relocate Hull Light Plant garages to higher elevation	High	Hull Light Dept.	High	Town of Hull Light Dept.
35) Investigate battery storage and other resilience measures for the grid	Medium	Hull Light Dept.	High	Town of Hull Light Dept.
36) Develop evacuation plan considering sea level rise. Coordinate with Hingham and Cohasset	Medium	Emergency Management, Deputy Fire Chief	Medium	Hull General Fund, Emergency Management / Grant National Tsunami Center
37) Elevate electricity and HVAC at sewer plant	High	Sewer Dept.	High	Hull General Fund, Sewer Dept. / BRIC grant
38) Encourage beach nourishment on Nantasket Beach. Explore offshore borrow sites for beach nourishment materials	High	Conservation/ Town leadership	High	DCR ACOE
39) Develop climate adaptation and resiliency strategies for resiliency of the DPW facility: Elevate DPW Barn or relocate operations to protect from future flooding and sea level rise impacts	High	Public Works	High	Hull General Fund, Public Works Dept.

Mitigation Measure	Priority	Lead Agency	Estimated Cost	Potential Funding
40) Promote bicycle/pedestrian transportation to reduce auto use	High	Planning	Medium	State Ch. 90 / Hull General Fund, Dept. of Public Works
41) Incorporate recommendations from the Coastal Climate Change Vulnerability Assessment and Adaptation Study and consider climate impacts in all capital projects, master plans, open space plans	High	Multiple departments	Variable	Hull General Fund, multiple departments; MPV grants, ACR Grants
42) Develop formalized property owner flood protection and flood insurance education program	High	Building & Conservation	Low	Hull General Fund, multiple departments
43) Install flood **proofing (e.g. doors)** at the Memorial School	High	Building & Emergency Management	Medium	Hull General Fund, Public Works,
44) Evaluate tide gate functioning and install automated tide gate at WBZ dike (FEMA Communications bunker)	High	Conservation	Low	Hull General Fund, Public Works, BRIC Grants
45) Install cameras in shoreline areas to monitor storm conditions	High	Harbormaster	Medium	Grant funds
46) Conduct drone surveys to facilitate documentation of pre and post storm shoreline conditions.	High	Hull Community Television	Low	Hull General Fund, Public Works
47) Wastewater Pumping Station #3, George Washington Blvd – Reduce size or eliminate Force Main/convert to gravity sewer	High	Hull Sewer Dept.	High	Hull General Fund-Sewer Dept./DEP/BRIC
48) Develop resilient and climate adaptive roadways – new 2-way layout of Nantasket Ave adjacent to DCR and HRA properties	Medium	Multiple Departments	High	FEMA, MVP, ACR, MAPC, and CZM grants

Mitigation Measure	Priority	Lead Agency	Estimated Cost	Potential Funding
49) Village/Friends & L Street Playgrounds designed to provide some relief from flooding	Medium	Community Development & Planning	Medium	Hull CPA
50) Develop bikeway/shady park/flood mitigation/ and stormwater treatment plan for Town Rail Road way.	Medium	Community Development & Planning	Medium	Hull CPA, BRIC, MVP, ACR, and CZM grants

SECTION 9: PLAN ADOPTION AND MAINTENANCE

Plan Adoption

The Hull Hazard Mitigation Plan 2024 Update was adopted by the Board of Selectmen on [ADD DATE. See Appendix E for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE].

Plan Maintenance

The Town of Hull Hazard Mitigation Team meets annually every September to review and update the Hazard Mitigation Plan. MAPC worked with the Hull Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will continue to meet annually to function as the Hazard Mitigation Implementation Team, with the Conservation Administrator designated as the coordinator. Additional members could be added to the local implementation 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 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.

Implementation and Evaluation Schedule

The coordinator of the Hazard Mitigation Implementation Team will coordinate annual meetings of the local implementation group members and other interested local stakeholders. S/he will document progress and any additions or changes to mitigation measures. The annual updates 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, coordinated by the Conservation Administrator, 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 annual reviews 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 Implementation Team may decide to

undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The Hull Hazard Mitigation Plan Update will be forwarded to MEMA and DCR for review and to FEMA for approval.

Integration of the Plans with Other Planning Initiatives

Upon approval of the Hull Hazard Mitigation Plan 2018 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
- Light
- Planning
- Conservation
- Health
- Building
- Sewer

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

The Hazard Mitigation Plan will be integrated into other town plans and policies as they are updated and renewed, including the Hull Master Plan, Open Space Plan, Comprehensive Emergency Management Plan, and Capital Investment Program.

SECTION 10: REFERENCES

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13. MA Office of Coastal Zone Management, Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning, December 2013.
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26. US Census, 2020, American Community Survey
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APPENCIX A: HAZARD MAPPING

The MAPC GIS (Geographic Information Systems) Lab produced a series of maps for each community. Some of the data came from the Northeast States Emergency Consortium (NESEC). More information on NESEC can be found at http://www.serve.com/NESEC/. Due to the various sources for the data and varying levels of accuracy, the identification of an area as being in one of the hazard categories must be considered as a general classification that should always be supplemented with more local knowledge. The map series consists of eleven maps as described below

Map 1.	Population Density
Map 1b	Environmental Justice
Map 2.	Potential Development
Map 3.	Flood Zones
Map 3b	2010 Flood Claims
Map 4.	Earthquakes and Landslides
Map 5.	Hurricanes and Tornadoes
Map 6.	Average Snowfall
Map 7.	Composite Natural Hazards
Map 8	Hazard Areas and New Development
Map 9	Extreme Heat
Map 10	Sea Level Rise
Map 11	Wildfires

Map1: Population Density – This map uses the US Census block data for 2010 and shows population density as the number of people per acre in seven categories with 60 or more people per acre representing the highest density areas.

Map 1b: Environmental Justice – This map shows Environmental Justice (EJ) populations using 2020 data. EJ designations from the State include English isolation, income, and minority residents.

Map 2: Land Use – This map shows land use from MassGIS' 2016 Land Cover/Land Use dataset.

Map 2: Land Use – This map depicts current land use and critical infrastructure sites.

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones as depicted on the FIRMs (Federal Insurance Rate Maps) for Plymouth County as its source. This map is not intended for use in determining whether or not a specific property is located within a FEMA NFIP flood zone. The currently adopted FIRMS for Hull are kept by the Town. For more information, refer to the FEMA Map Service Center website http://www.msc.fema.gov. The definitions of the flood zones are described in detail on this site as well. The flood zone map for each community also shows critical facilities.

Map3b: Flood Claims – This map shows flood insurance and disaster claim records from March 2010. The March 29, 2010 federal disaster declaration associated with severe rainfall and flooding triggered the launch of the Federal Emergency Management Agency's (FEMA's) Individual Assistance Program through which residential property owners, businesses, and institutions without flood insurance

were eligible to apply for relief to pay for storm-related expenditures and repairs. Across the seven counties, over 27,000 individual claims were approved for nearly $59 million in disaster assistance, while reimbursements to state and local governments totaled $25 million. In the MAPC region, 18,400 claims were approved for $30 million dollars in disaster assistance.

Map 4: Earthquakes and Landslides – This information came from NESEC. For most communities, there was no data for earthquakes because only the epicenters of an earthquake are mapped. The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. For more information on how landslide susceptibility was mapped, refer to http://pubs.usgs.gov/pp/p1183/pp1183.html.

Map 5: Hurricanes and Tornadoes – This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms, if any occurred in this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In most cases, the effects of the wind and rain from these storms were felt in other communities even if the track was not within that community. This map also shows the location of tornadoes with a classification as to the level of damages. What appears on the map varies by community since not all communities experience the same wind-related events. These maps also show the 100 year wind speed.

Map 6: Average Snowfall - - This map shows the average snowfall. It also shows storm tracks for nor'easters, if any storms tracked through the community.

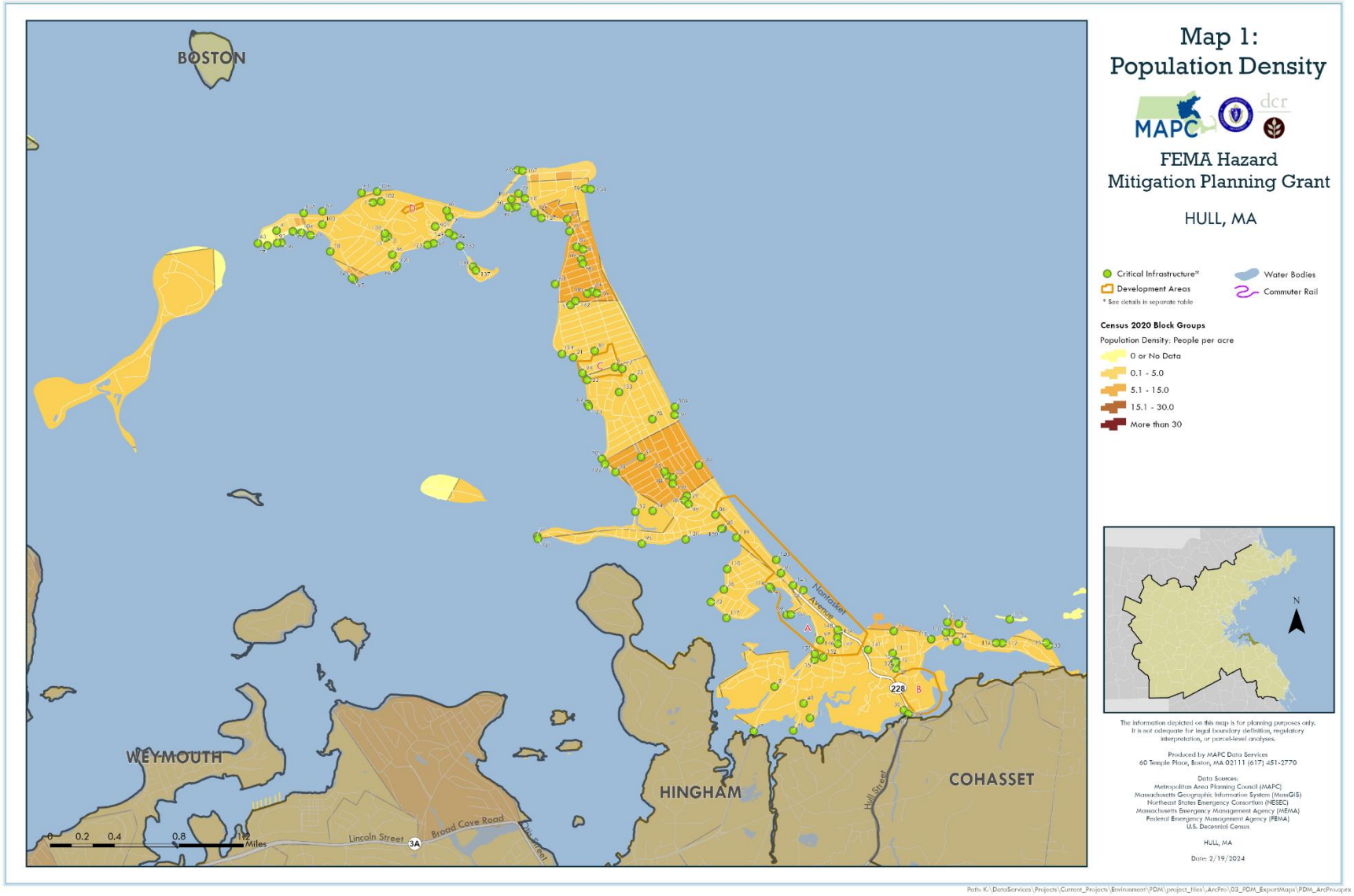
Map 7: Composite Natural Hazards - This map shows four categories of composite natural hazards for areas of existing development. The hazards included in this map are 100 year wind speeds of 110 mph or higher, low and moderate landslide risk, FEMA Q3 flood zones (100 year and 500 year) and hurricane surge inundation areas. Areas with only one hazard were considered to be low hazard areas. Moderate areas have two of the hazards present. High hazard areas have three hazards present and severe hazard areas have four hazards present.

Map 8: Hazard Areas and New Development – For each community, locally identified hazard areas are overlaid on an aerial photograph dated April, 2008. The critical infrastructure sites are also shown. The source of the aerial photograph is Mass GIS. This map also shows potential future development areas. MAPC consulted with town staff to determine areas that were likely to be developed or redeveloped in the future

Map 9: Extreme Heat – MAPC's Statewide Land Surface Temperature (LST) Index was created by combining estimates of surface temperature from days in 2018, 2019, and 2020 where the daily air temperature maximum exceeded 70 degrees Fahrenheit. The Statewide LST Index "Hot Spots" data depicts the 5% highest LST index areas in each Regional Planning Agency (RPA) region. The data was generated by identifying pixels whose LST index values are equal to or greater than 95% of LST index values in the region, and then delineating cohesive regions where pixels meet this criterion as polygons. Map 9 represents the "Hot Spots" relative to the MAPC region, mapped on top of the National Land Cover Database's 2016 30-m tree canopy data.

Map 10: Sea Level Rise

Map 11: Wildfires – This map shows wildfire risk to the community using USDA data. Wildfire risk is classified as very low, low, moderate, high, and very high.


BOSTON
WEYMOUTH
HINGHAM
COHASSET
Nantasket Avenue
Hull Street
Lincoln Street
Broad Cove Road
228
3A
0 0.2 0.4 0.8 1.2 Miles
Map 1:
Population Density
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Census 2020 Block Groups
Population Density: People per acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
N
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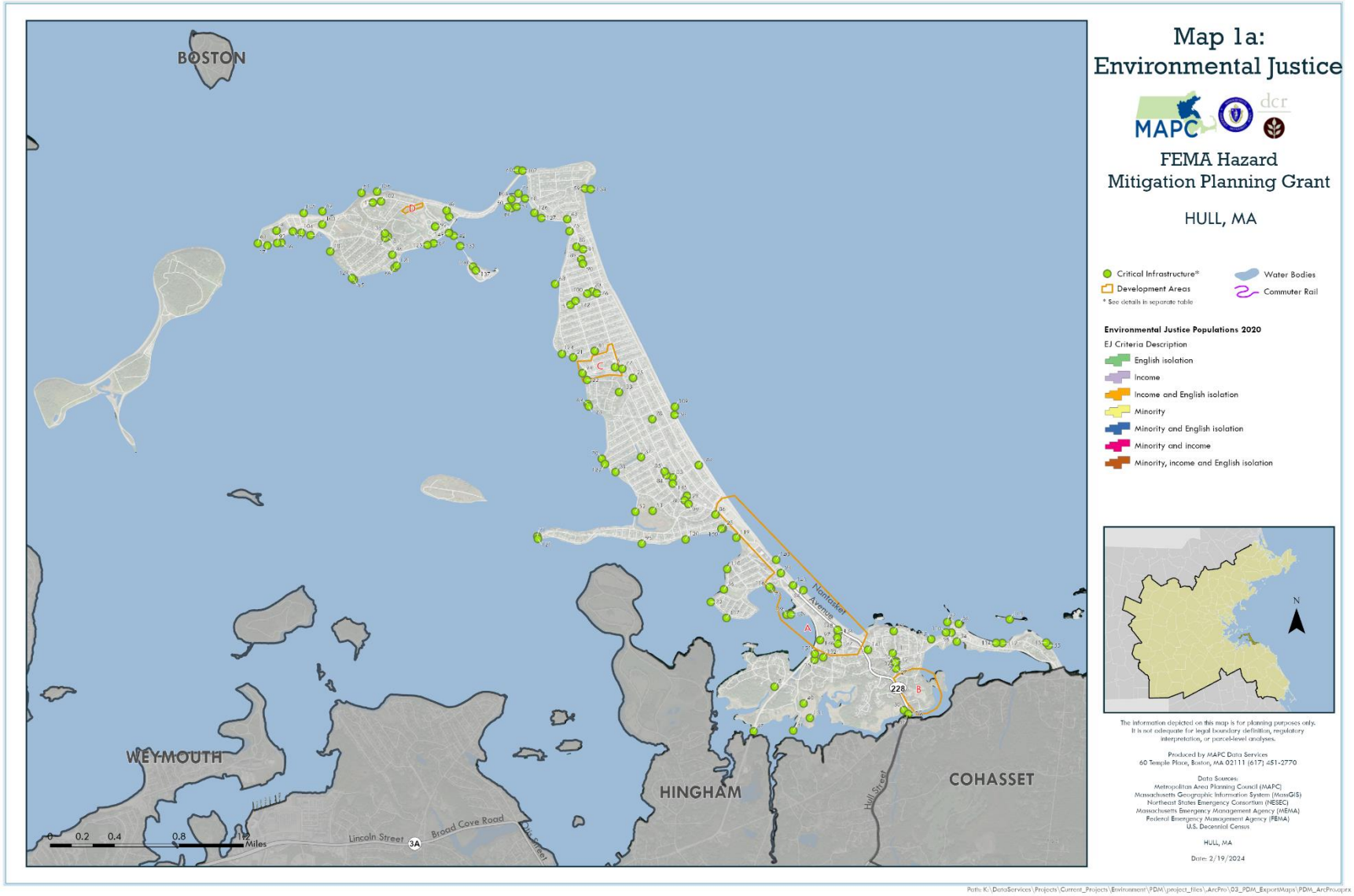
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024


Map 1a:
Environmental Justice
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Environmental Justice Populations 2020
EJ Criteria Description
English isolation
Income
Income and English isolation
Minority
Minority and English isolation
Minority and income
Minority, income and English isolation
BOSTON
WEYMOUTH
HINGHAM
COHASSET
Nantasket Avenue
Lincoln Street
Broad Cove Road
Hull Street
228
3A
0 0.2 0.4 0.8 1.2 Miles
N
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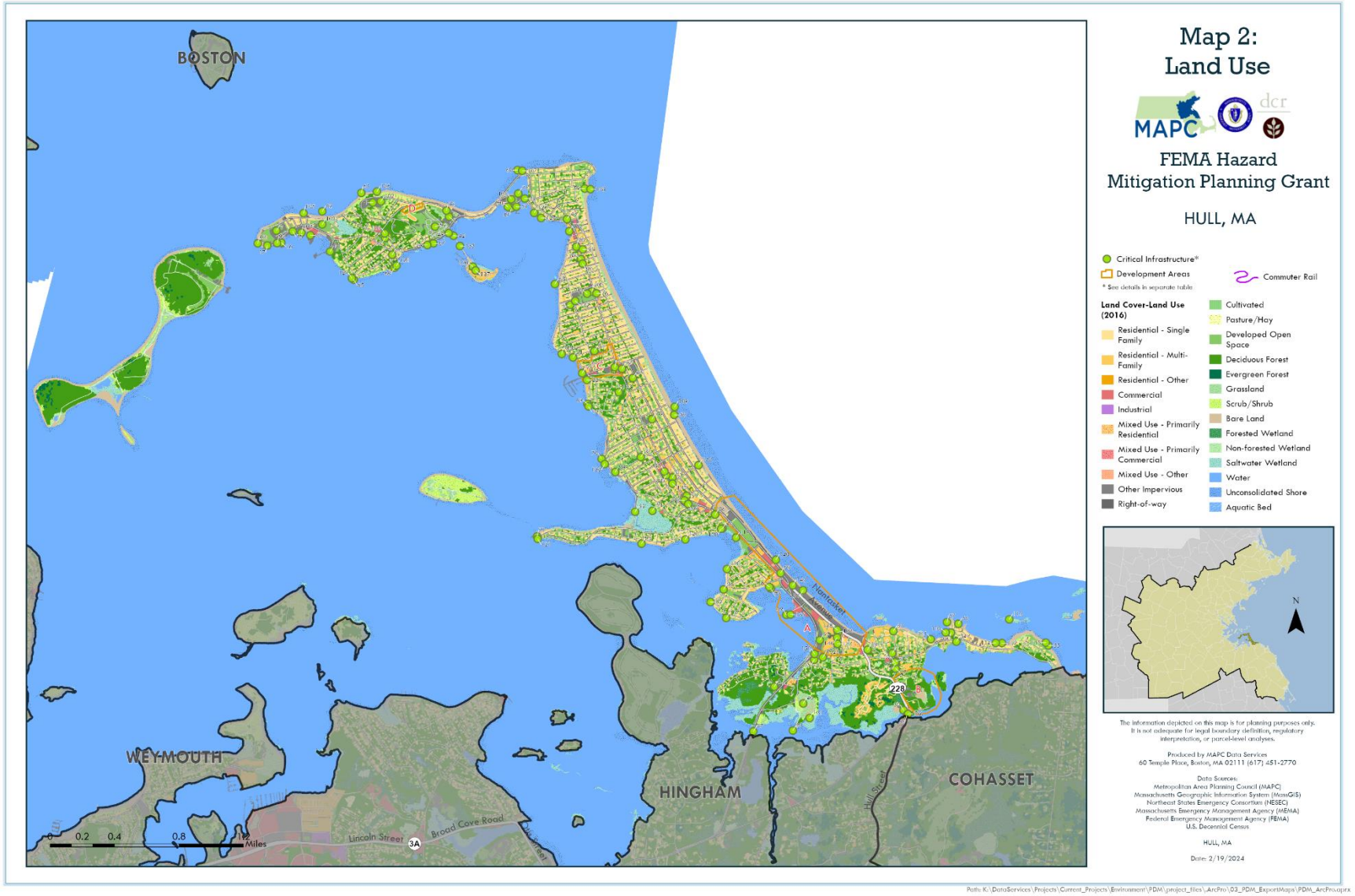
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024


BOSTON
WEYMOUTH
HINGHAM
COHASSET
Lincoln Street
Broad Cove Road
Hull Street
Nantasket Avenue
228
3A
0 0.2 0.4 0.8 1.2 Miles
Map 2:
Land Use
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Commuter Rail
Land Cover-Land Use (2016)
Residential - Single Family
Residential - Multi-Family
Residential - Other
Commercial
Industrial
Mixed Use - Primarily Residential
Mixed Use - Primarily Commercial
Mixed Use - Other
Other Impervious
Right-of-way
Cultivated
Pasture/Hay
Developed Open Space
Deciduous Forest
Evergreen Forest
Grassland
Scrub/Shrub
Bare Land
Forested Wetland
Non-forested Wetland
Saltwater Wetland
Water
Unconsolidated Shore
Aquatic Bed
N
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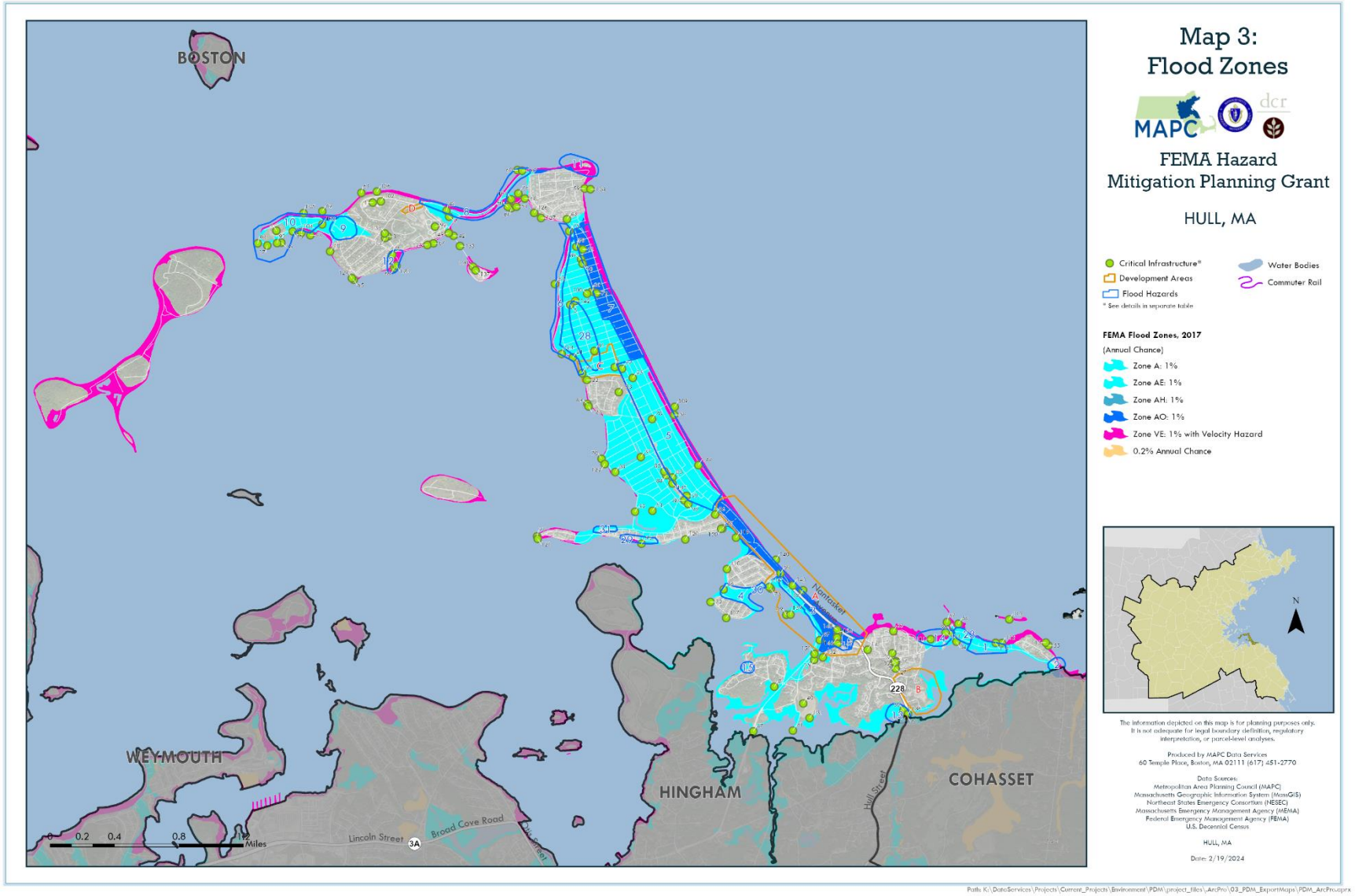
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024


BOSTON
WEYMOUTH
HINGHAM
COHASSET
Nantasket Beach
Lincoln Street
Broad Cove Road
Hull Street
0 0.2 0.4 0.8 1.2 Miles
Map 3:
Flood Zones
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
Flood Hazards
* See details in separate table
Water Bodies
Commuter Rail
FEMA Flood Zones, 2017
(Annual Chance)
Zone A: 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with Velocity Hazard
0.2% Annual Chance
N
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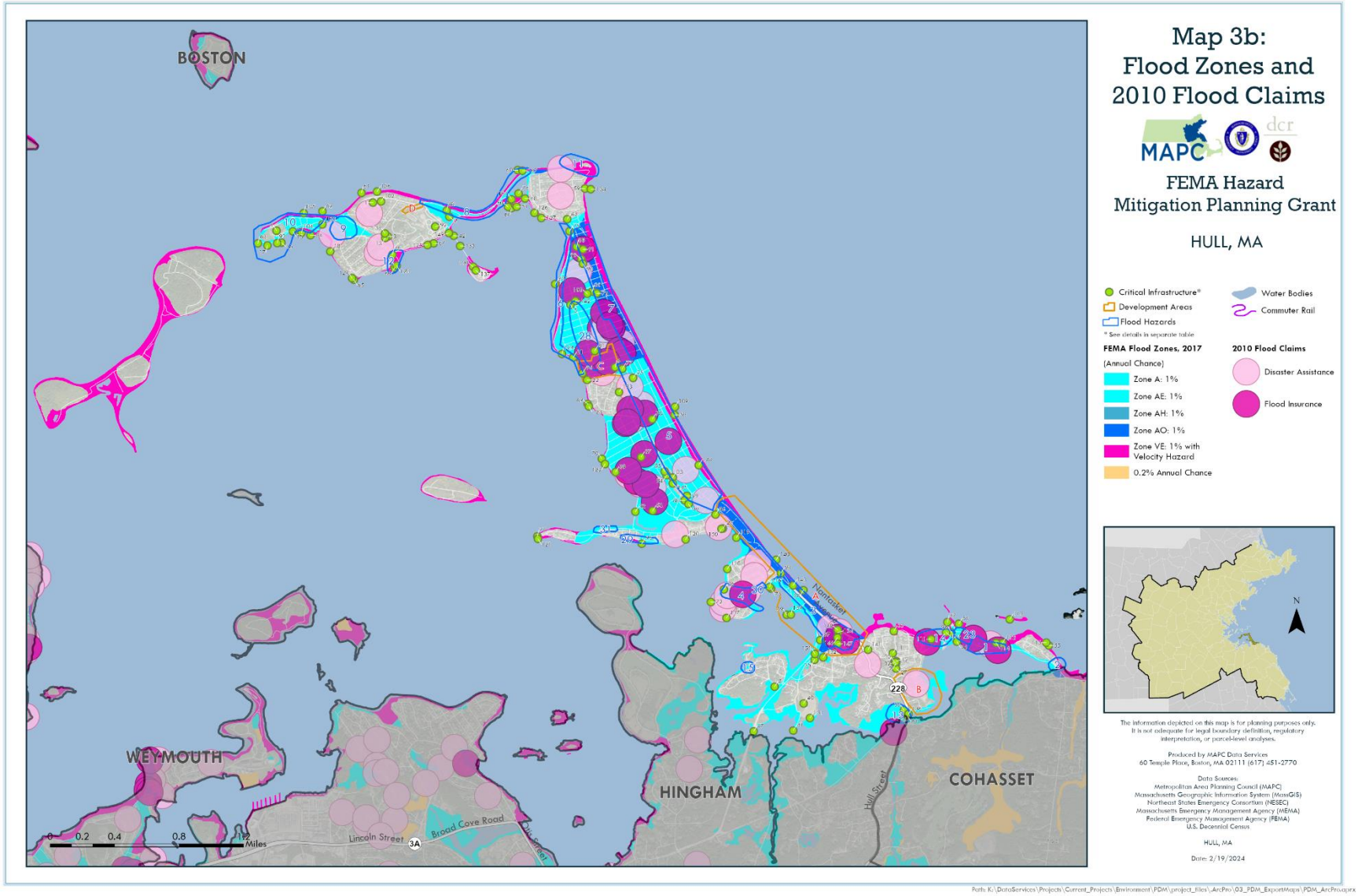
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024


Map 3b:
Flood Zones and
2010 Flood Claims
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
Flood Hazards
* See details in separate table
Water Bodies
Commuter Rail
FEMA Flood Zones, 2017
(Annual Chance)
Zone A: 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with Velocity Hazard
0.2% Annual Chance
2010 Flood Claims
Disaster Assistance
Flood Insurance
BOSTON
WEYMOUTH
HINGHAM
COHASSET
Nantasket Avenue
Lincoln Street
Broad Cove Road
Hull Street
3A
228
0 0.2 0.4 0.8 1.2 Miles
N
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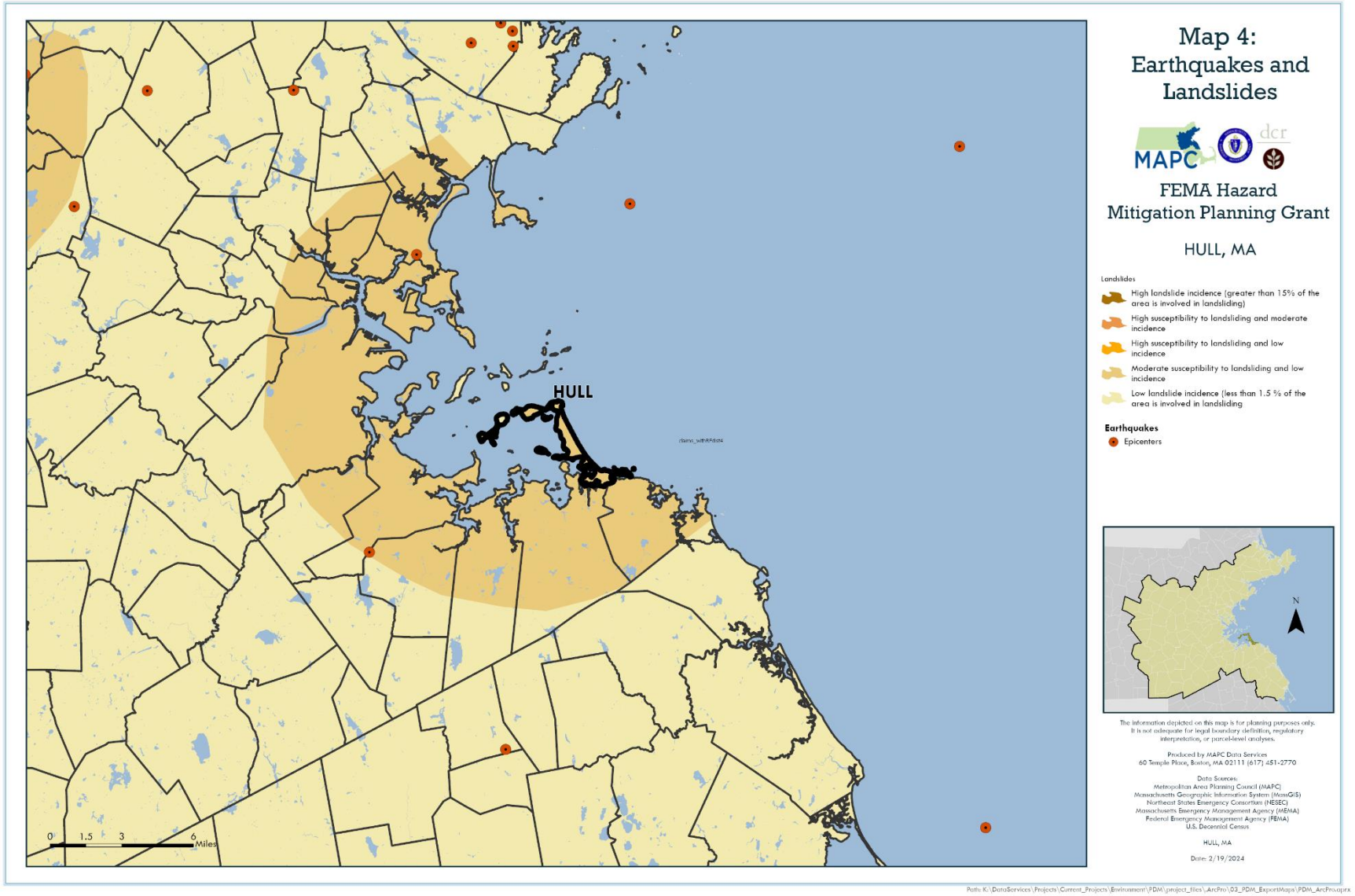
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024


HULL
0 1.5 3 6 Miles
Map 4:
Earthquakes and
Landslides
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
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
Earthquakes
Epicenters
N
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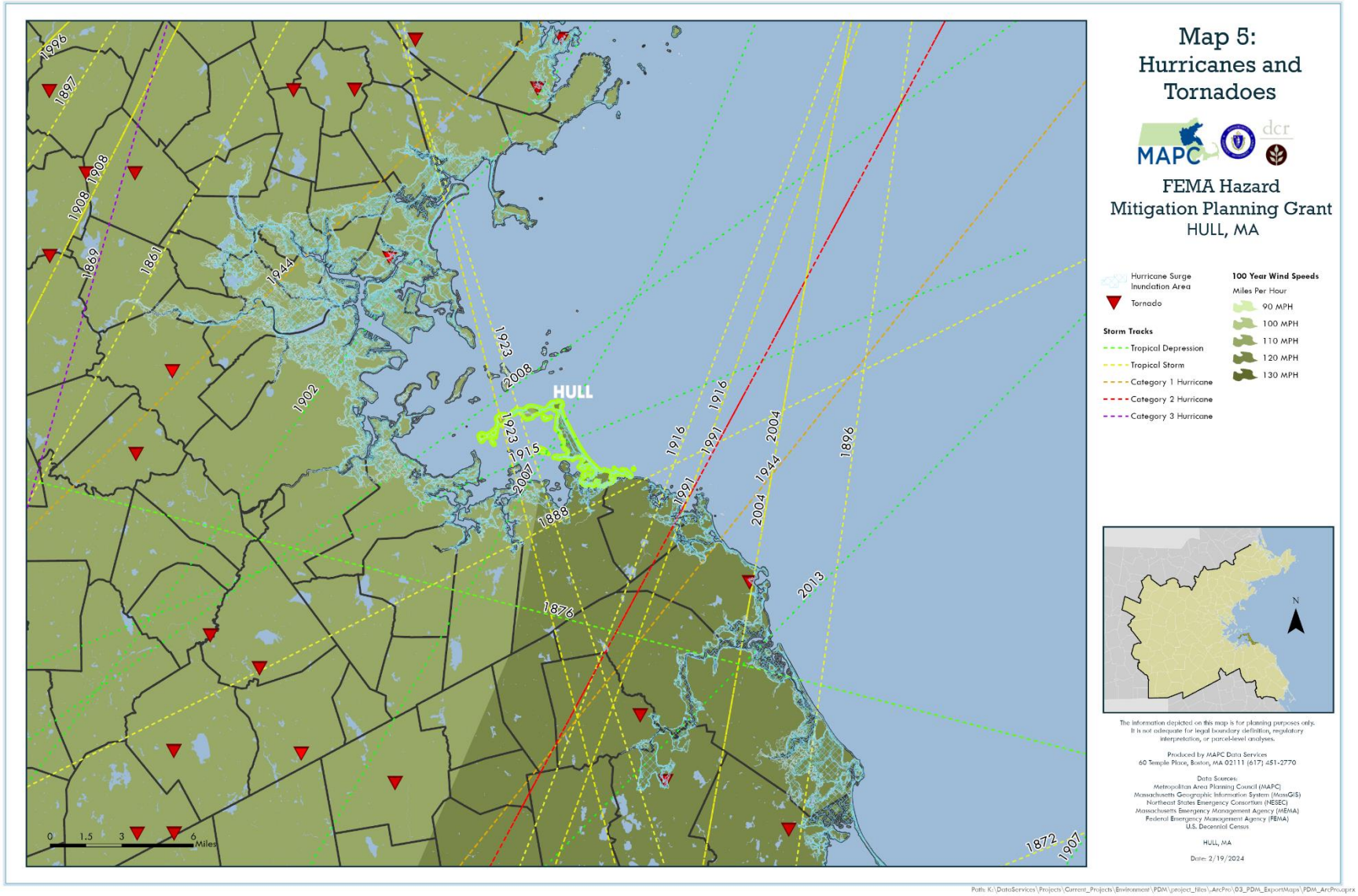
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024


Map 5:
Hurricanes and Tornadoes
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
HULL, MA
Hurricane Surge Inundation Area
Tornado
Storm Tracks
Tropical Depression
Tropical Storm
Category 1 Hurricane
Category 2 Hurricane
Category 3 Hurricane
100 Year Wind Speeds
Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
HULL
1996
1897
1908
1908
1869
1861
1944
1902
1923
2008
1923
1915
2007
1888
1876
1916
1991
1916
1991
2004
1944
2004
1896
2013
1872
1907
0 1.5 3 6 Miles
N
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Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024
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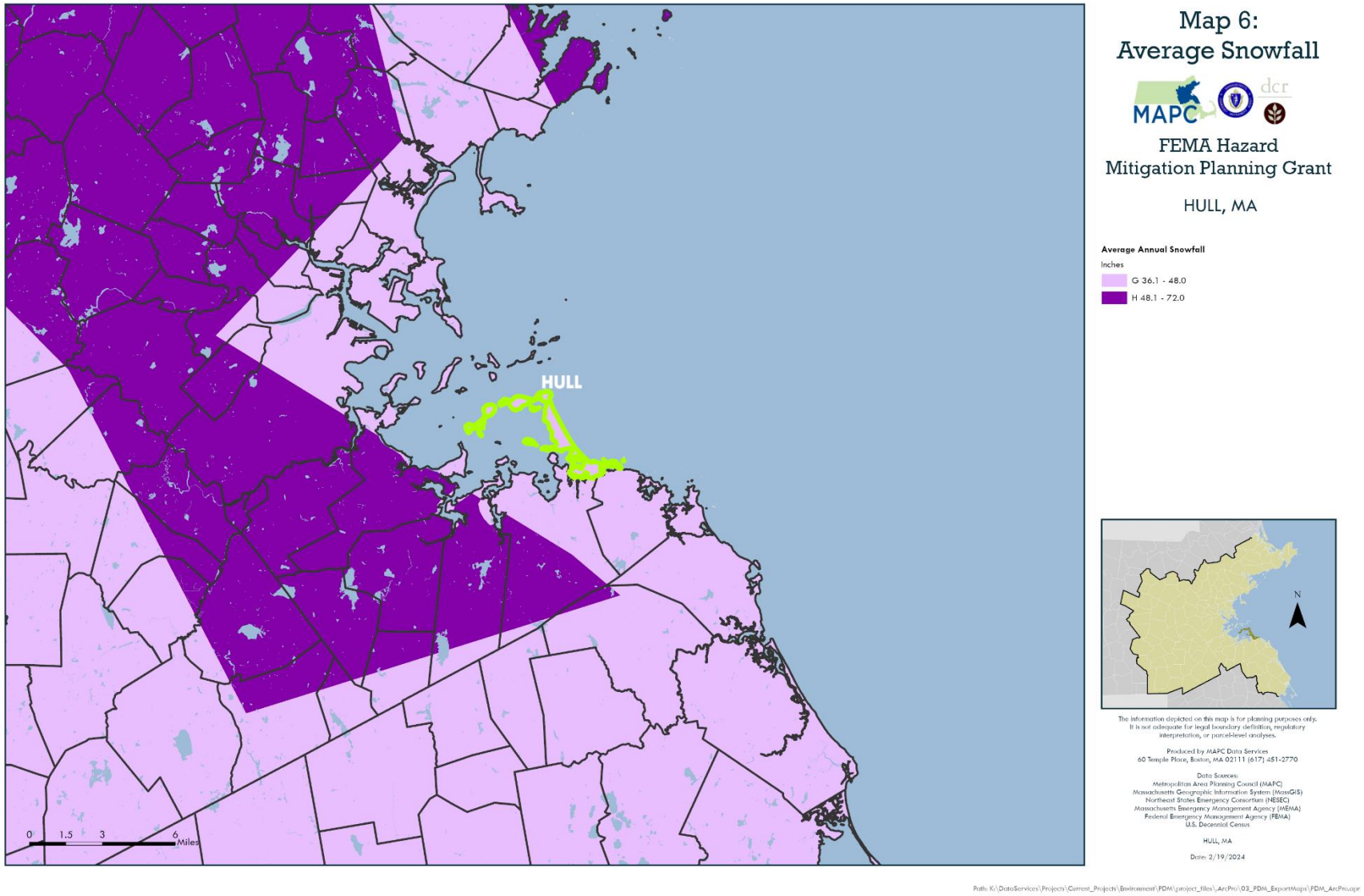
HULL
0 1.5 3 6 Miles
Map 6:
Average Snowfall
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Average Annual Snowfall
Inches
G 36.1 - 48.0
H 48.1 - 72.0
N
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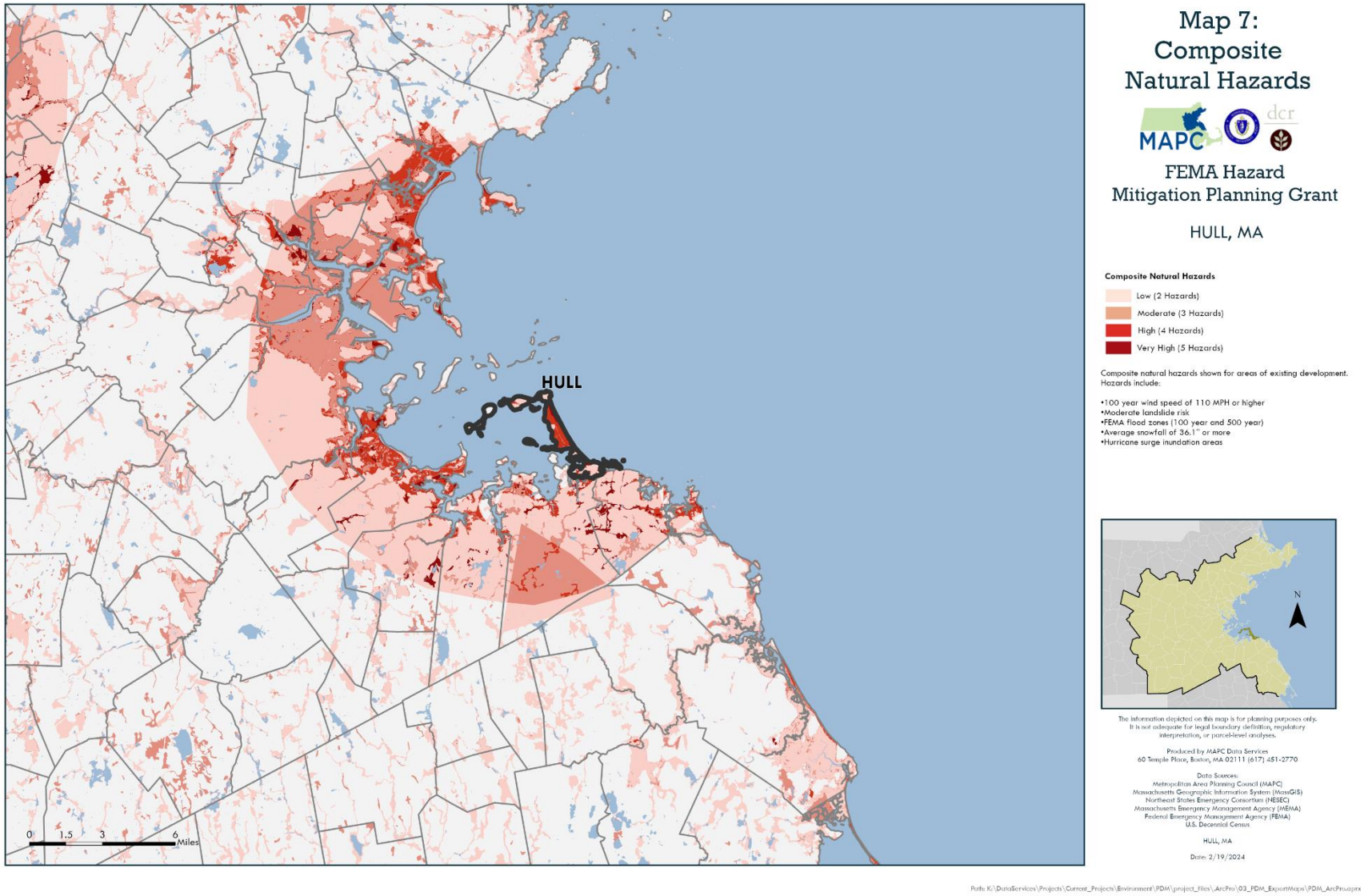
U.S. Decennial Census
HULL, MA
Date: 2/19/2024


HULL
0 1.5 3 6 Miles
Map 7:
Composite
Natural Hazards
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
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
N
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Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024
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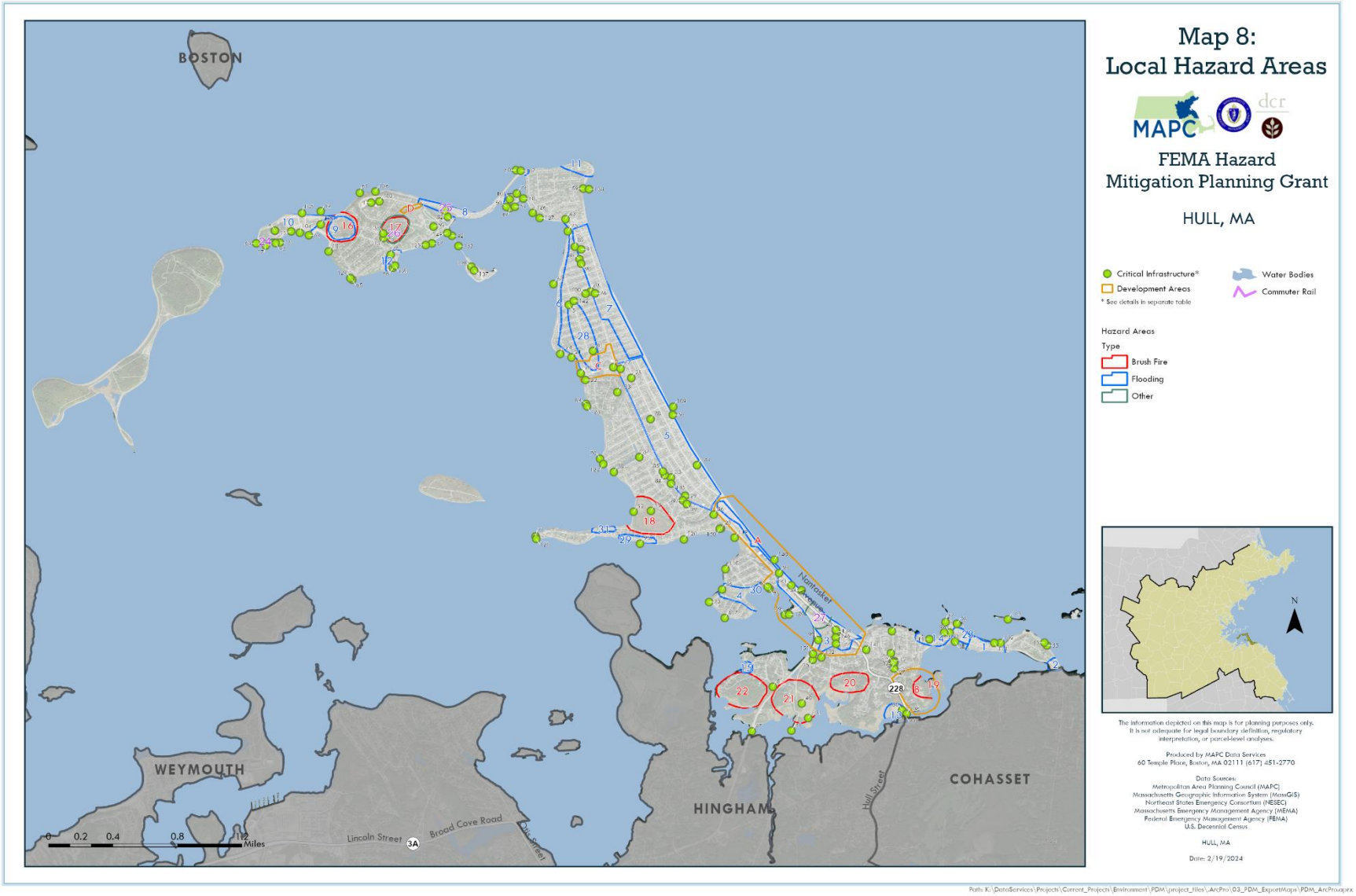
Map 8:
Local Hazard Areas
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Hazard Areas
Type
Brush Fire
Flooding
Other
BOSTON
WEYMOUTH
HINGHAM
COHASSET
Lincoln Street
Broad Cove Road
Hull Street
Nantasket Avenue
0 0.2 0.4 0.8 1.2 Miles
N
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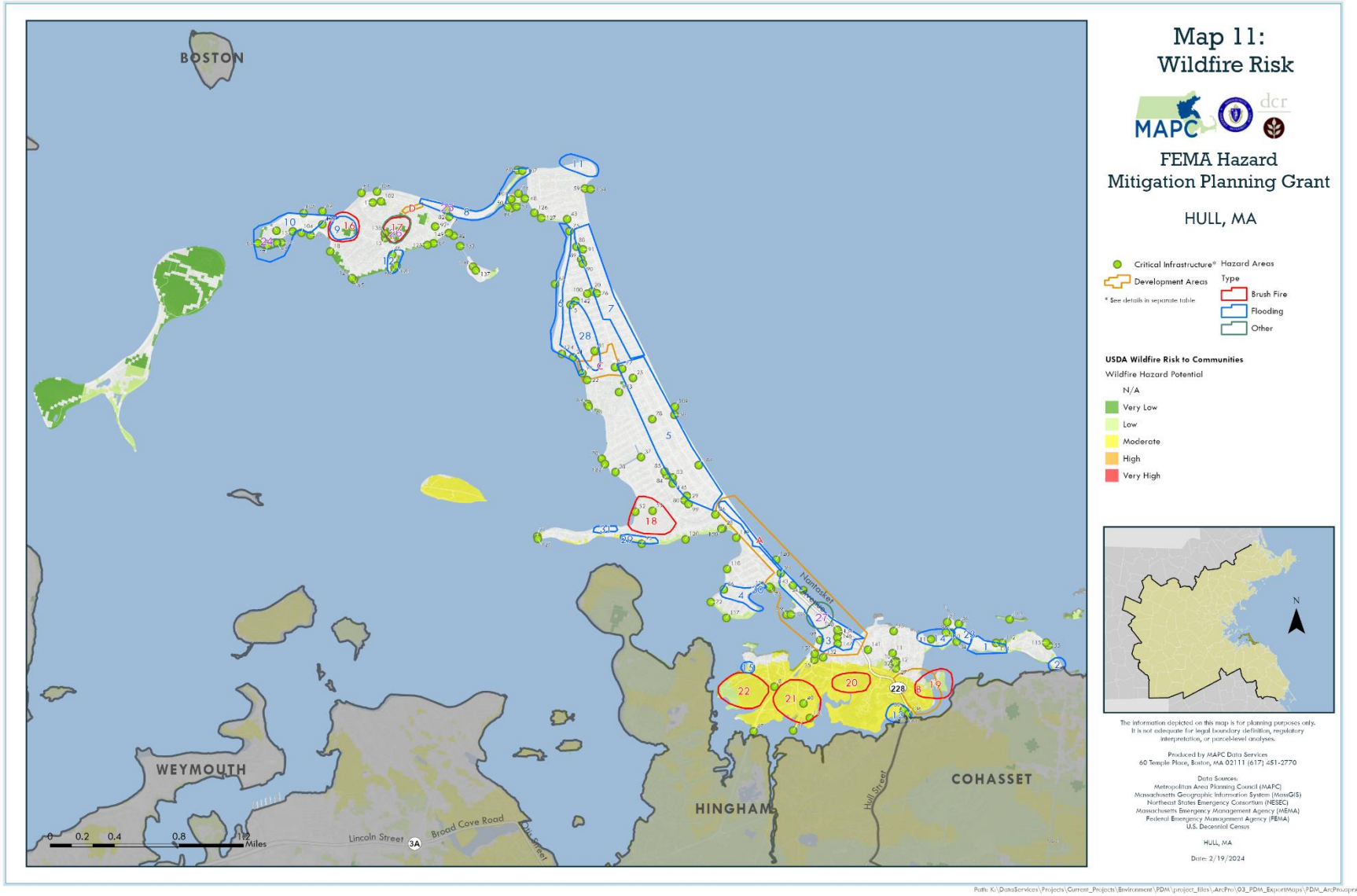
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024


Map 11:
Wildfire Risk
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Hazard Areas
Type
Brush Fire
Flooding
Other
USDA Wildfire Risk to Communities
Wildfire Hazard Potential
N/A
Very Low
Low
Moderate
High
Very High
BOSTON
WEYMOUTH
HINGHAM
COHASSET
Lincoln Street
Broad Cove Road
Hull Street
Nantasket
0 0.2 0.4 0.8 1.2 Miles
N
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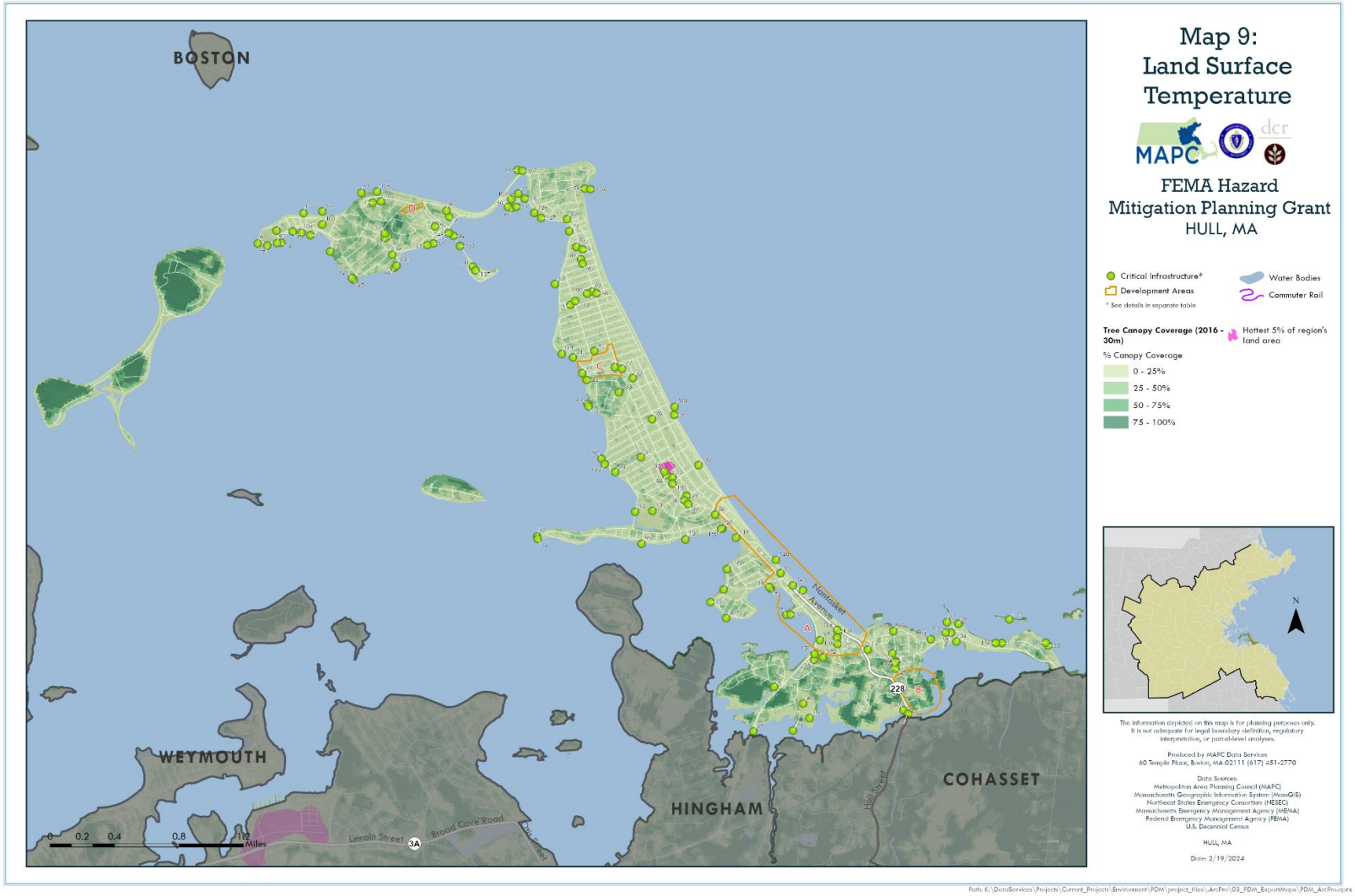
BOSTON
WEYMOUTH
HINGHAM
COHASSET
Nantasket Avenue
Lincoln Street
Broad Cove Road
Hull Street
228
3A
0 0.2 0.4 0.8 1.2 Miles
Map 9:
Land Surface Temperature
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Tree Canopy Coverage (2016 - 30m)
Hottest 5% of region's land area
% Canopy Coverage
0 - 25%
25 - 50%
50 - 75%
75 - 100%
N
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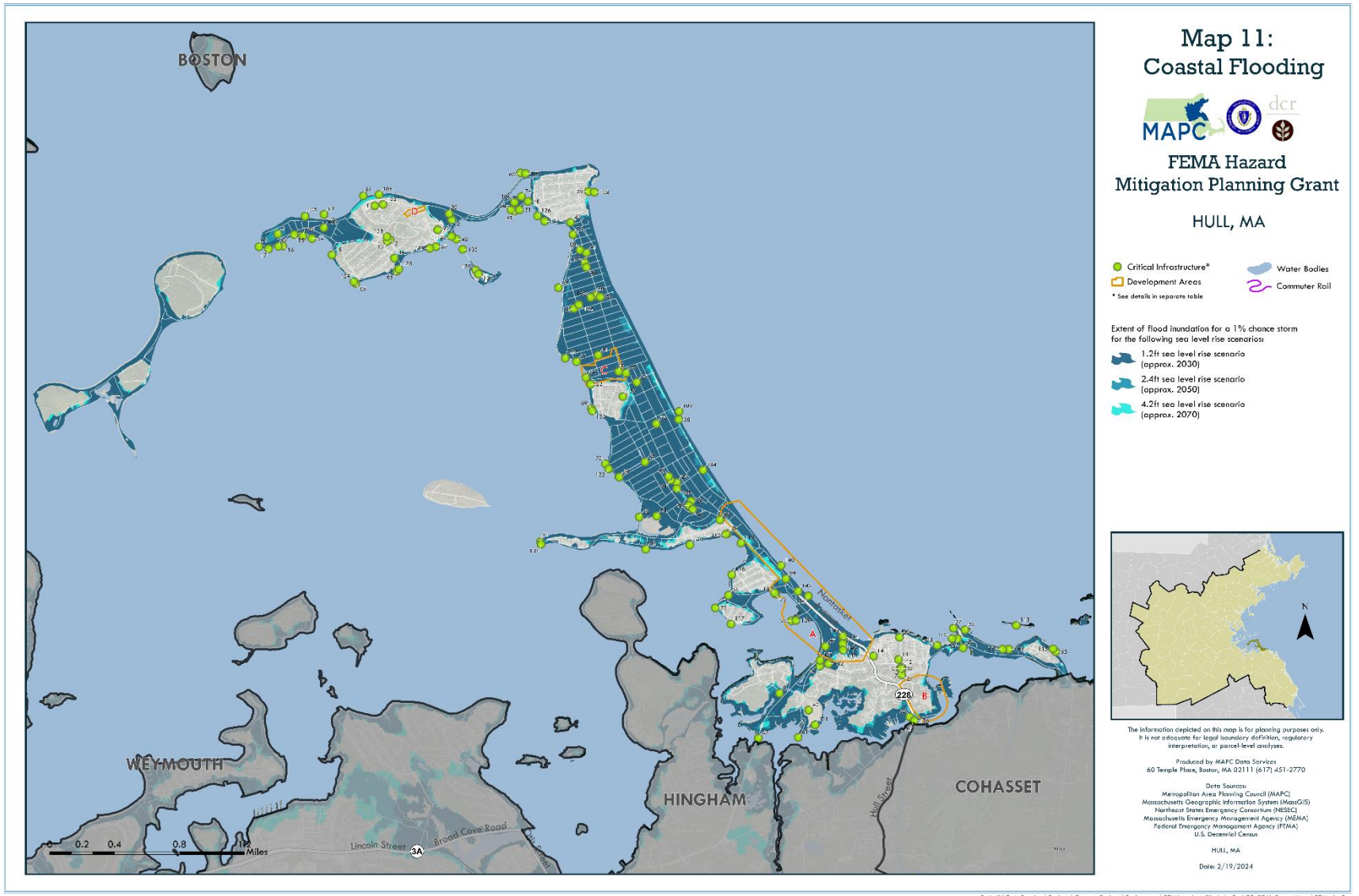
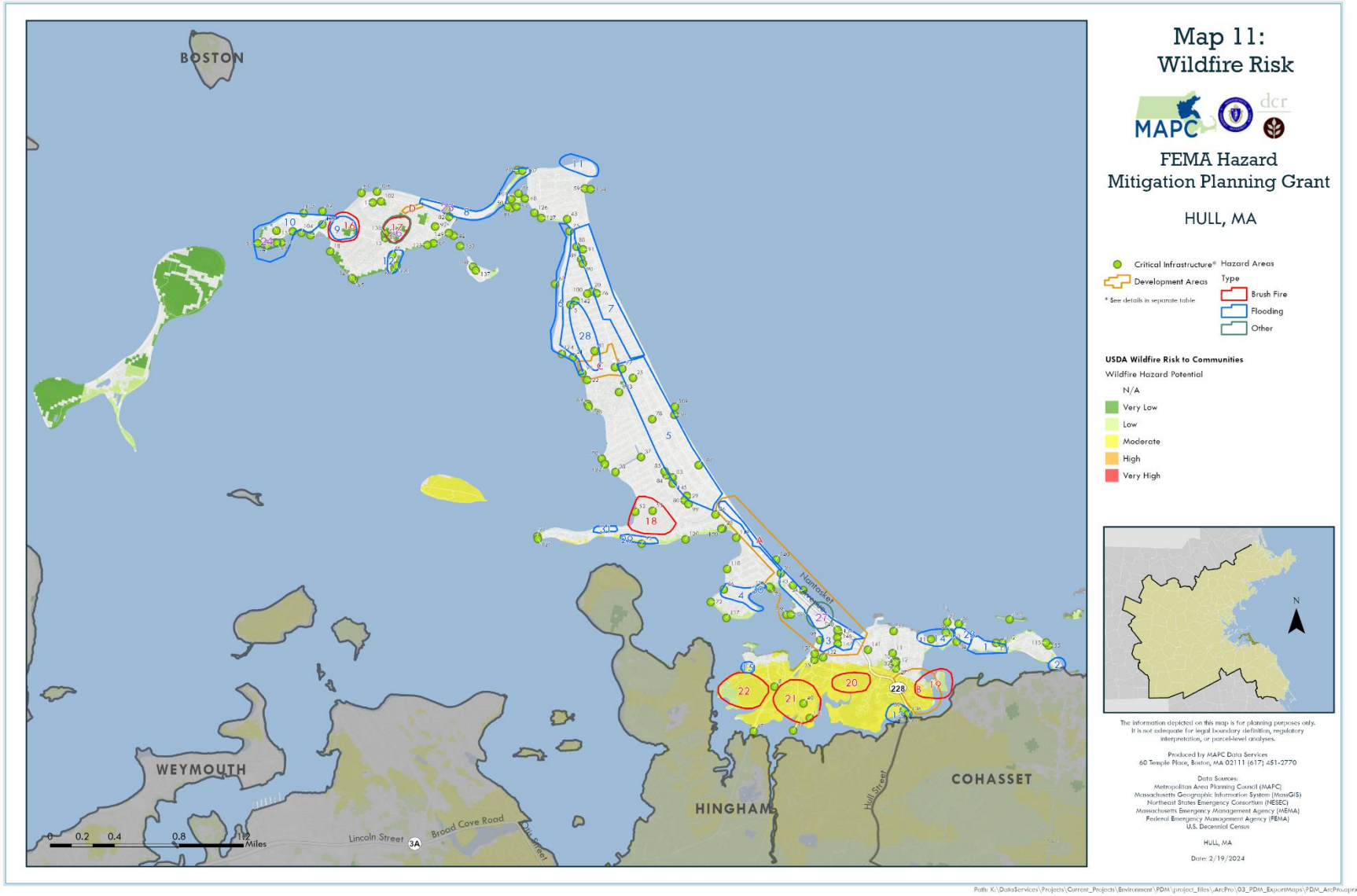
HULL, MA
Date: 2/19/2024


Map 11:
Coastal Flooding
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Extent of flood inundation for a 1% chance storm
for the following sea level rise scenarios:
1.2ft sea level rise scenario
(approx. 2030)
2.4ft sea level rise scenario
(approx. 2050)
4.2ft sea level rise scenario
(approx. 2070)
BOSTON
WEYMOUTH
HINGHAM
COHASSET
Nantasket Avenue
Lincoln Street
Broad Cove Road
Hull Street
3A
228
0 0.2 0.4 0.8 1.2 Miles
N
The information depicted on this map is for planning purposes only.
It is not adequate for legal boundary definition, regulatory
interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024
Path: K:\DataServices\Projects\Current_Projects\Environment\PDM\project_files\ArcPro\03_PDM_ExportMaps\PDM_ArcPro.aprx


Map 11:
Wildfire Risk
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HULL, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Hazard Areas
Type
Brush Fire
Flooding
Other
USDA Wildfire Risk to Communities
Wildfire Hazard Potential
N/A
Very Low
Low
Moderate
High
Very High
BOSTON
WEYMOUTH
HINGHAM
COHASSET
Lincoln Street
Broad Cove Road
Hull Street
Nantasket
0 0.2 0.4 0.8 1.2 Miles
N
The information depicted on this map is for planning purposes only.
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Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HULL, MA
Date: 2/19/2024

APPENDIX B: LOCAL HAZARD MITIGATION TEAM

Hull Hazard Mitigation Plan Update
Kickoff Meeting

Wednesday, May 24, 2023
10:00 AM

AGENDA

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1. Welcome and Introductions

2. Overview of the HMP Project

- Overview of the FEMA Hazard Mitigation Plans
- Project tasks and schedule (see attached)

3. Convening the Hull Local Hazard Mitigation Team

Role of the Local Team:

- Bring local knowledge and perspective of multiple departments
- We need to reach out to include other stakeholders: business community, residents, and relevant boards/commissions
- Participate in four quarterly meetings (see below)

At the first team meeting we will update key local data from the previous plan:

- Local Hazard Areas of Concern
- Critical Facilities
- New Developments (completed since 2018 & currently pending)

MAPC's GIS Planner will map new or revised sites using Google MyMaps

Hull Hazard Mitigation Plan Update

Summary of the Planning Process

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1) Hull Hazard Mitigation Kickoff: Project Overview — May 2023
   Hull Team Meeting #1: Overview / Data & Map Update J — June 2023

- Review project tasks and timeline
- Update: **Critical Facilities**: Inventory and Map
- Update: **Local Hazard Areas** and Map
- Update: **Development Sites** and Map
- Public Meetings, outreach to stakeholders

2) Hull Team Meeting #2: Update of Existing Mitigation — Sept. 2023

- Update: **Hazard Mitigation Goals** for the Plan
- Update: **Existing Mitigation Measures**
- Prepare for **Public Meeting #1**

3) Public Meeting #1: Plan Overview/Public Input — Oct. 2023

4) Hull Team Meeting #3: Develop Mitigation Strategy — Dec. 2023

- Review status of **Recommended Mitigation Strategies** from the Previous Plan
- Discuss possible changes to mitigation strategies and need for new strategies

5) Hull Team Meeting #4: Develop Mitigation Strategy — Mar, 2024

- Develop Recommended Mitigation Measures and Prioritize
- Designate Implementing agencies, Timeframes, Estimated Costs, Funding Sources
- Prepare for 2nd Public Meeting and outreach to stakeholders

6) Public Meeting #2: Presentation of Draft Plan — April 2023

7) Draft HMP: submitted to MEMA & FEMA — May 2024

Hull Hazard Mitigation Plan Update
Team Meeting #1

Wednesday, June 21, 2023
10:00 AM

AGENDA

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1. Welcome and Introductions

2. Review of HMP Project and Schedule (see attached timeline)

3. Getting Started: Local Data Updates from the 2016 Plan

- *We will update the following 3 types of local data from the 2016 plan (see attached worksheets):*

  1. **Local Hazard Areas (Flooding & Wildfire)**
  2. **Critical Facilities**
  3. **New Development sites**

- *MAPC's GIS Planner Rachel Bowers will join via Zoom to map new or revised sites using the online platform Google MyMaps*

4. Next steps: Prepare for Public Meetings and Outreach

- <u>We will hold 2 Public Meetings:</u>

  1st public meeting during the planning process (October 2023)
  2nd public meeting at the end to present the draft plan (April 2024)

- Local team to identify local stakeholders to invite

Hull Hazard Mitigation Plan Update
Team Meeting #2

Wednesday, September 20, 2023
10:00 AM
Hull Town Hall

AGENDA

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1. Welcome and Project Update

2. Review and Update Hull's Mitigation Goals for the Plan
See Mitigation Goals from the 2018 plan attached

3. Update Status of Existing Mitigation Measures
See table of Existing Mitigation from the 2018 Plan attached

- Note any **Changes for 2023**
- Update any **Improvements Needed**
- Add any N**ew Measures** adopted since 2018

4. Prepare for the First Public Meeting

- Set Date and hosting board
- *Meeting Invitation and outreach:*
  - Team to Identify local stakeholders to invite (refer to MVP invitees?)
  - Public outreach on Town website, email lists, social media?

Hull Hazard Mitigation Plan Update
Team Meeting #3

Wednesday, November 15, 2023
10:00 AM
Hull Town Hall

AGENDA

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5. Welcome and Project Update

6. Review Status of Mitigation Strategies from the 2018 Plan
See Worksheet for Mitigation Strategies attached

7. Next Steps

2. First Public Meeting
- **Tuesday, November 28, 7 PM** at Hull High School
- MAPC to present an overview of the plan; questions from the public
- *Meeting Invitation and outreach:*
  - Please help Identify local stakeholders to invite
  - Businesses, community groups, service providers, etc.
  - Flyer available to send by email or print out (attached)

3. Final Team Meeting
- **Wednesday, December 13, 10:00 AM**
- Finalize mitigation recommendations for the plan

4. Second Public Meeting (last step)
- Plan submittal to MEMA after Public Meeting

Hull Hazard Mitigation Plan Update

Team Meeting #4

Wednesday, December 14, 2023
10:00 AM
Hull Town Hall

AGENDA

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1. Welcome and Project Update

2. Review Draft Recommended Mitigation Strategy for the 2024 Plan

   See Worksheet for Mitigation Strategies attached

APPENDIX C: DOCUMENTAION OF PUBLIC MEETINGS

Hull Hazard Mitigation Plan
Public Meeting

When: **Tuesday, November 28, 2023,7:00 PM**

Where: **Hull High School, Exhibition Room**
180 Main St, Hull, MA

Hull experiences natural hazards that can impact residents and businesses, including flooding, severe winter storms, and coastal storms.

The Town is updating its Hazard Mitigation Plan to assess vulnerability to natural hazards and strategies to increase the Town's resilience.

We want to hear from you! Join us at the meeting and tell us about your concerns for natural hazards and resilience actions the Town can take.

Please join us on November 28!

If you have questions or comments, send an email to ResilientHull@mapcorg

Floods? Blizzards? Nor'easters?

The Town of Hull is updating its Hazard Mitigation Plan

We want to hear from you!

Please Join us for a Public Presentation

Questions, comments, suggestions?

Email **ResilientHull@mapc.org**

Tuesday, Nov. 28, 7:00 PM
Hull High School
Exhibition Room
180 Main St, Hull MA

Hazard Mitigation Planning 2023-2024 Update

First Public Meeting: November 28, 2023

Meeting Notes

Low attendance anticipated (5-10 residents). High attendance received (50+ residents).

Some concerns mentioned by residents early-on:

- Sea level rise: How much has the ocean/harbor already risen (about 1 foot over the last century)? How much is anticipated, and how are we preparing for that?
- Beach migration: How much loss of beach has there been over the years? What did Nantasket used to look like? No beach left at high tides (DCR area).
- Power outages, not a hazard themselves but resulting from wind and ice storms, high concern for residents is keeping the power on.
- Cold snaps: Referenced 2022 that there was a stretch of very cold temperatures that knocked out many people's heating systems and led to bursting water pipes. How is the Town preparing for dramatic temperature days like that, and how can residents protect their equipment?
- Flooding: Referenced the on-going Hampton Circle Area neighborhood climate adaptation project and whether the concerns are about the homes located in the floodplain or just about the playground; residents want to feel like the town is taking forward action on addressing flooding at homes and inundated roads.

Further discussion touched on ideas and requests:

- Hull is a barrier beach that protects many municipalities along inner Boston Harbor. Can we do a feasibility study to add a breakwater or something in the ocean? Will Boston or the state pay for this to happen and recognize the value of Hull as a critical asset in their own hazard mitigation planning?
- Bolstering the reef off of Crescent Beach; it was created to protect the area. Up until 1957, there was no seawall so a breakwater was added to augment the natural reef. Boulders are falling out because of the waves and now there are gaps. The Army Corps of Engineers built it. Curiosity about the history and sharing this with residents.
- `Point Allerton Ave severe erosion, a house fell off a few years ago. Can no longer walk there, chain link fence installed to protect people from this dangerous area. Would natural jetties/breaking waves with rocks be a solution? Because of previous mitigation on the bank, water rolls up the seawall and shoots over and down the back.

Understanding and improving the hazard mitigation planning process:

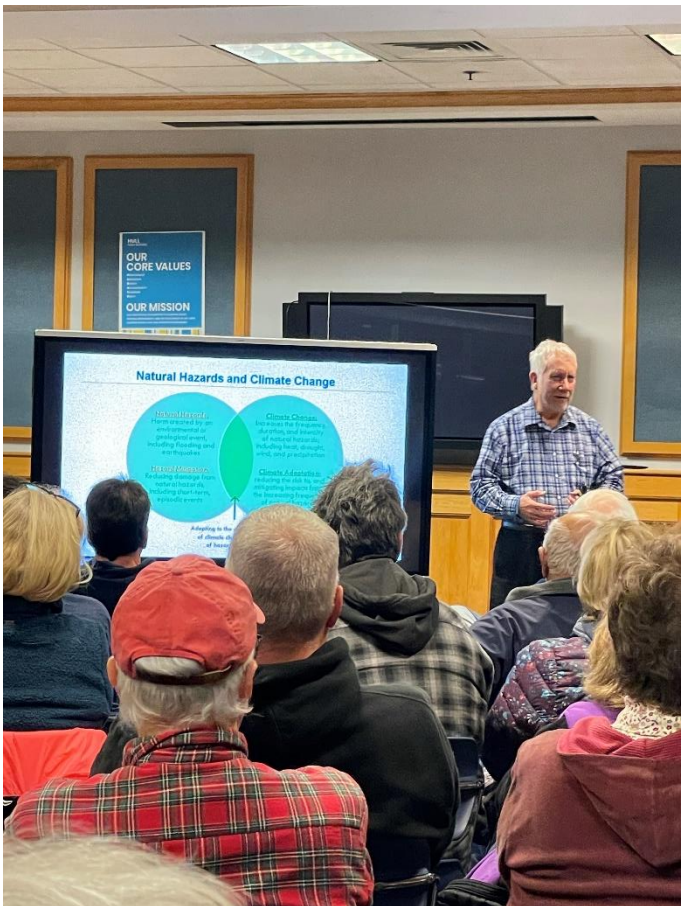
- What is the process for monitoring conditions as they change each year? Can the Town establish a formal process for evolving its plans and goals and thus address changing conditions? The Town does monitor and report on implementation progress on an annual basis and completes a formal HMP update every 5 years, which this meeting is part of.

- Relationship with Boston and neighboring municipalities; explore/engage in regional opportunities. The Commonwealth has an updated state hazard mitigation plan (published 5-year update 1 month ago) by MEMA, known as the "2023 ResilientMass Plan (2023 ResilientMass Plan | Mass.gov)
- How does Hull's plan align with the state's plan? Commonwealth HMP says 2.5 ft sea level rise by 2050. New DCR Commissioner is collaborating with Hull.
- What is the subregional context: Plymouth County, Suffolk, Essex, Norfolk
- What grant opportunities that open up because of the plan?
- Two risks to failing compliance in HMP: no federal FEMA flooding eligibility, all homeowners lose flood insurance, National Flood Insurance Program participants can see their premiums could go up or down 5% depending on Hull's change in class status because we participate in FEMA's Community Rating System.

Residents moved into a discussion about strategic planning and information accessibility:

- Having one big strategic plan for the town is critical. There are many different plans that feel like they have competing needs. How do the plans tie in together? How do we make sure all departments and plans are working towards a unified goal and purpose?
- Calls for the Town to improve its public engagement and information access online. The plans are all so deep in the website; it is very difficult to access; most residents may give up before finding what they are looking for or end up digging for a long time
- The search function on the town website is not useful.
    - No single location for plans: *Creating a prominent page on the website "Hull's Mission" or reforming the front page with a unified statement; provide some historical timeline/process flow, and provide information on how to navigate the website/possibly align plans based on the mission. Allow a form for the public to submit input on what Hull means to them, and display some positive feedback as testimonials.*
- For meetings like this, get a screen that lifts up off the ground so everyone can see and a sound system so everyone can hear.

Hull Public Meeting on the Hazard Mitigation Plan, Hull High School, November 28, 2023



APPENDIX D: SUMMARY OF REPEITIVE LOSS AREA ANALYSIS

SUMMARY

Town of Hull Repetitive Loss Area Analysis

The National Flood Insurance Program (NFIP) is continually faced with the task of paying claims while trying to keep the price of flood insurance at an affordable level. The NFIP has a particular problem with flood loss properties, which are estimated to cost $3.5 million per year in flood insurance claim payments throughout the United States. Repetitive loss properties represent only 1.4% of all flood insurance policies, yet historically the have accounted for nearly one-fourth of the claim payments. From 2006 through 2015, more than $19 billion in flood claims has submitted to the NFIP. Mitigating these repeatedly flooded properties will reduce the overall cost to the NFIP, the communities in which they are located, and the individual homeowners. The Town of Hull conducted an area analysis based on repetitive loss property data supplied by FEMA for the period of 1978 – 2015 in accordance to the NFIP's Community Rating System. This Repetitive Loss Area Analysis (RLAA) follows FEMA guidelines to determine why an area has repeated flood losses and what alternative flood protection measures would help break the cycle of repetitive flooding.

The study area for this RLAA is located in the main peninsula of the Town of Hull and includes Spinnaker Island. Much of the results contained in the RLAA includes information about private property and is protected by the Privacy Act of 1974 and thus not available for general public review. Individual home owners of RLPs are encouraged to contact the Town's CRS coordinator to review information provided by FEMA about their property and to add to the knowledge base about local flooding causes in order to develop more effective flood protection measures for their home.

Tables 1 and 2 summarize the FEMA data provided for this RLAA which lists the total number of Repetitive Loss Properties (RLPs) and their respective number of NFIP claims during the RLAA study period for unmitigated and mitigated RLPs, respectively.

Table 1. Unmitigated repetitive loss properties, number of NFIP claims, and the amount paid out, Town of Hull, 1978-2015

	Single Family Residential	Multi Family Residential	Commercial	Total
Number of Properties	204	20	5	229
Number of Losses	660	71	18	749
Total Claims	**$6,448,017**	**$627,105**	**$543,324**	**$7,618,446**

Note: Multi-Family Residential includes 9 2-Family, 1 3-Family, 6 Apt buildings,1 condo, and 3 boarding houses; Commercial includes the Post Office, and 2 "charitable" properties (Wellspring and Lifesaving Museum)

Table 2. Mitigated repetitive loss properties, number of NFIP claims, and the amount paid out, Town of Hull, 1978-2017.

	Single Family Residential	Multi Family Residential	Commercial	Total
Number of Properties	17	0	1	18
Number of Losses	77	0	2	79
Total Claims	**$1,605,182**		**$9,006**	**$1,614,188**

Note: One commercial building in the HRA lot has been removed and that parcel is no longer recognized on the Assessor's Maps.

Flooding in Hull is caused by high tides, heavy rain, and storm surge from coastal storms. Flooding is exacerbated by five general conditions:

- Slightly more than 60% of the town is low lying and considered by FEMA as land subjected to coastal storm flowage and surrounded by the waters of Boston Harbor and Massachusetts Bay (Fig. 1)
- Low-lying areas in the Town's relatively flat floodplain are developed and accumulate either stormwater runoff from streets draining neighboring hills and overwash from coastal storm surge. These areas drain more slowly during periods of high tide as infiltration into the relatively porous sanding soils is restricted by the effects high tide on the ground water table.
- Street drainage systems are often impacted by drifting sand and lie close to tide water and ground water elevations. Therefore water can pond more significantly in the lowest lying areas of the town and tend to drain slowly to the harbor and bay. This effect is more pronounced in the low-lying areas of the Town's flood plain.
- Natural dunes systems that protect mainly the ocean side (Massachusetts Bay) of the peninsula are in need of nourishment to offset the loss of sand due to coastal storms. Many of the storm protection structures like seawalls and revetments are antiquated and in need of repair. Some of these structures have been repaired or are being elevated to improve storm surge flooding protection in light of sea level rise (SLR) and the increased frequency and intensity of coastal storms.
- Adjacent Boston Harbor has experienced approximately 1 foot of sea level rise (SLR) in the past 100 years. The Town of Hull's Coastal Climate Change Vulnerability Assessment and Adaption Study (2016) predicts an additional SLR of 0.7 ft by 2030 and nearly 3 ½ feet by 2070. The frequency and power of coastal storms are also expected to increase.

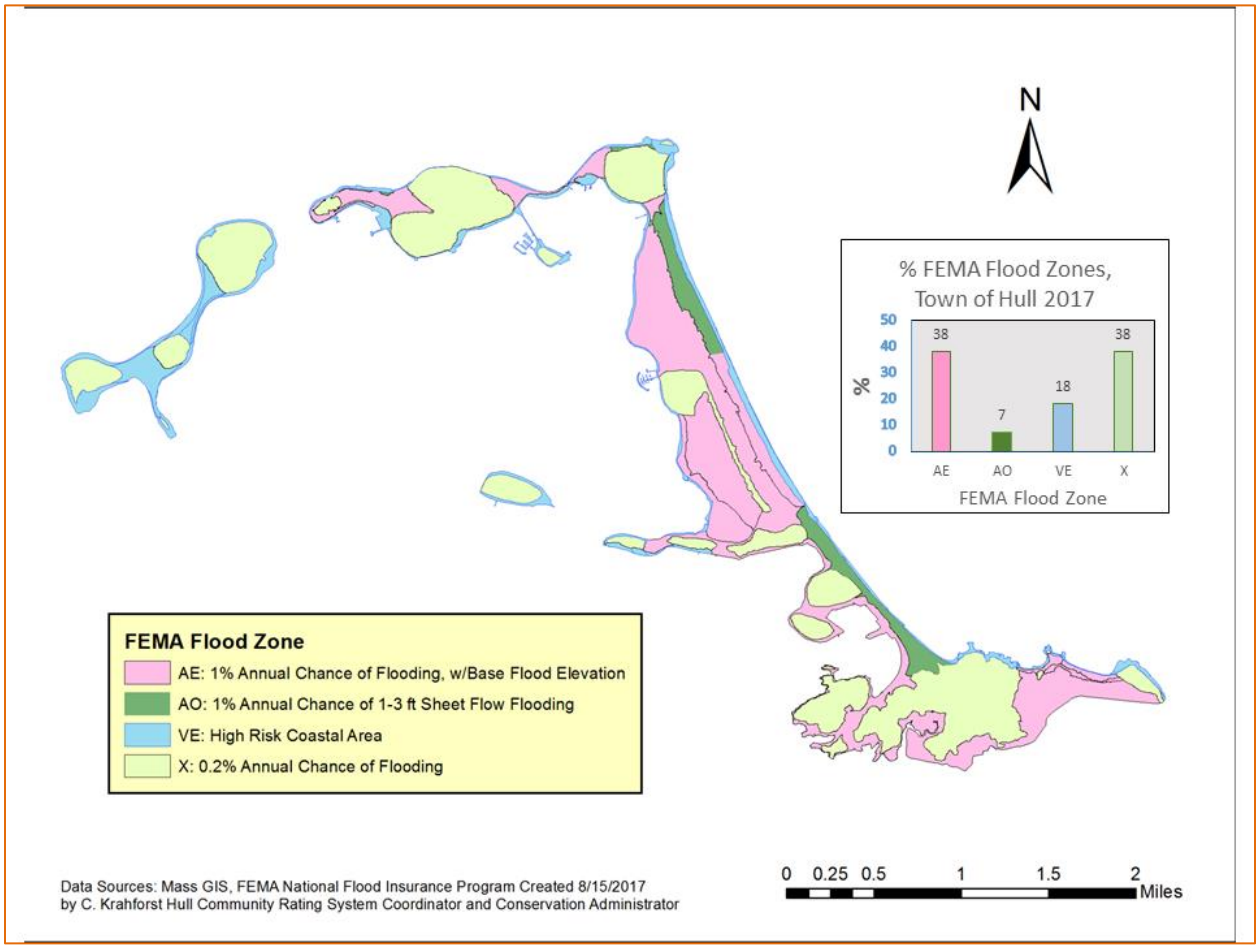


Figure 1. Geospatial distribution of FEMA Flood Zones, Town of Hull.

There have been some drainage improvements, dune grass planting, and structural repairs to storm surge protection structures but flood damage has not been eliminated.

Recommendations:

- Encourage RLP owners to pursue mitigation measures.
- Continue to maintain and improve town wide storm drainage systems.
- Clean and remove accumulated material in flood control channels and canals
- Continue to seek out and secure funding for seawall repair, maintenance, and improvements
- Seek out and secure funding for sand nourishment for Nantasket Beach, possibly through the beneficial reuse of dredge material with the US Army Corps of Engineers
- Incorporate the findings and recommendations of the 2016 Climate Change and Vulnerability Study for projects designed to improve and repair the Town's infrastructure and facilities.
- Improve the Town's CRS classification

For Residents of the Town of Hull:

- Contact the Town of Hull's Conservation and Building Departments for more information for flood mitigation and possible funding opportunities
- Obtain Elevation Certificates for homes located in FEMA designated A and V Flood zones
- Review alternative mitigation measures discussed in this analysis and implement those that are most appropriate.

The Town has identified 10 areas were the majority of repetitive loss properties exist. These concentrated repetitive loss areas (CRLAs) are shown in Fig. 2.

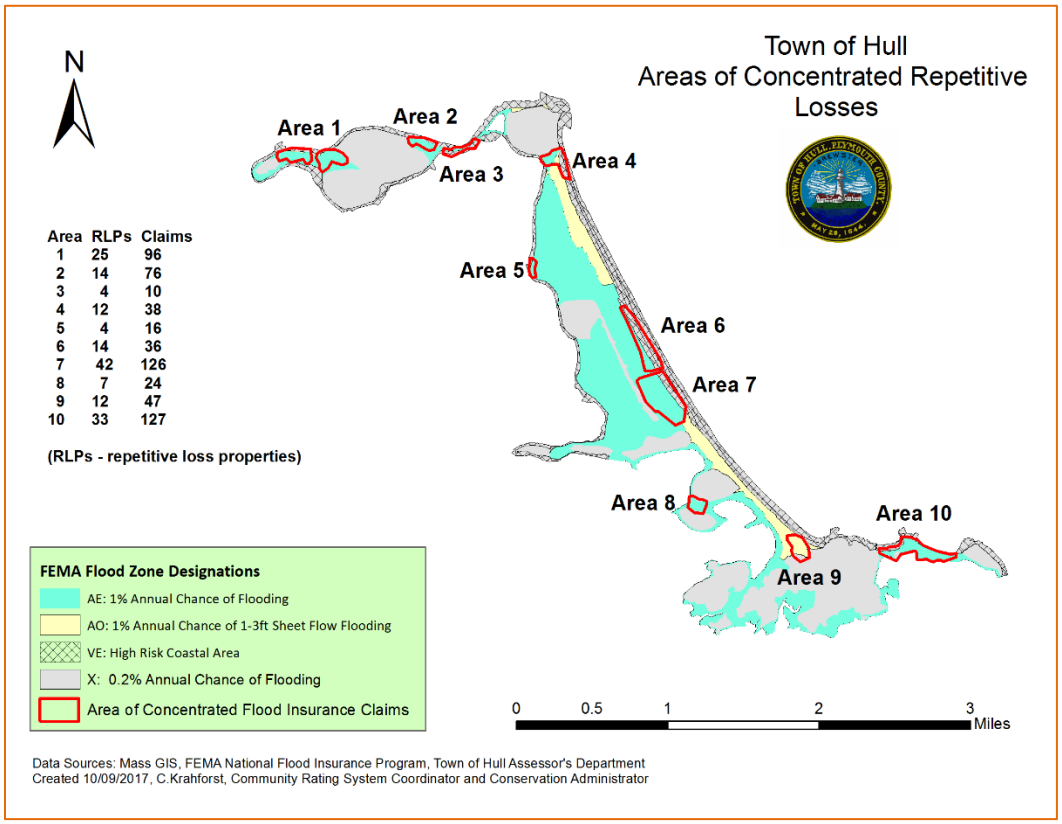


Figure 2. Areas of Concentrated Repetitive Loss Properties and National Flood Insurance Program Claims, 1978 - 2015.

A review of the major storms that have occurred during the period of study (from 1978 – 2015) shows that 8 coastal storms account for nearly 80% (77.7%) of all claims (Fig.3). The characteristics of these storms have been detailed in the RLAA as well as which storm events contributed to the most claims in each CRLAs. All of the RLPs, including those outside of any CRLA, were evaluated for recommended mitigation measures to reduce flood insurance claims, the bulk of which, based on remediation cost and

feasibility, recommend wet proofing measures (e.g., filling in of basements, adding flood vents). For homes located in FEMA VE Zones, the preferred RLAA recommendation is to elevate the home and their utility systems to a minimum of two feet above the base flood elevation.

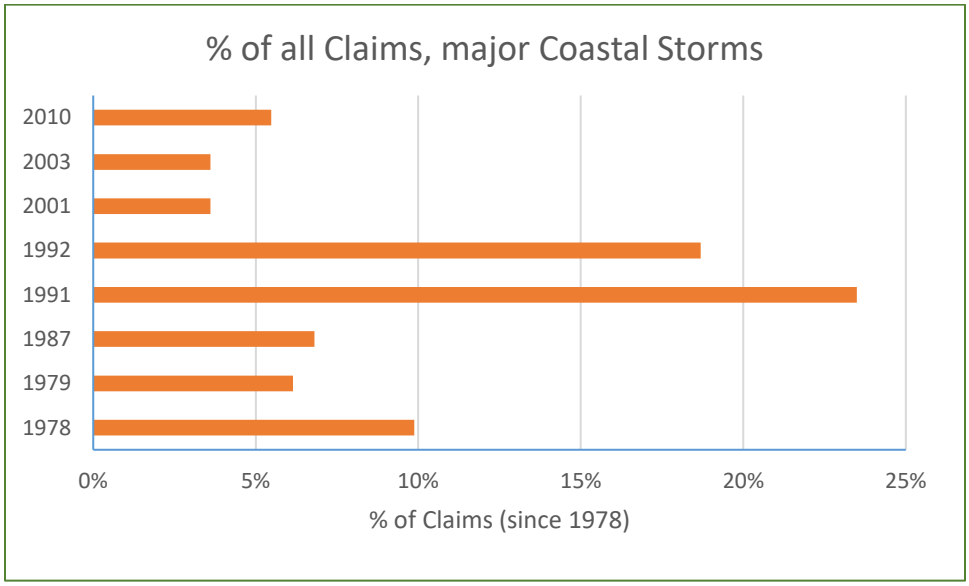


Figure 3 Storm events that have contributed to more than 4% of the number of NFIP flood insurance claims, Town of Hull, 1978 – 2015.

APPENDIX E: DOCUMENTATION OF PLAN ADOPTION

TO BE ADDED WHEN FEMA ISSUES APPROVAL PENDING ADOPTION